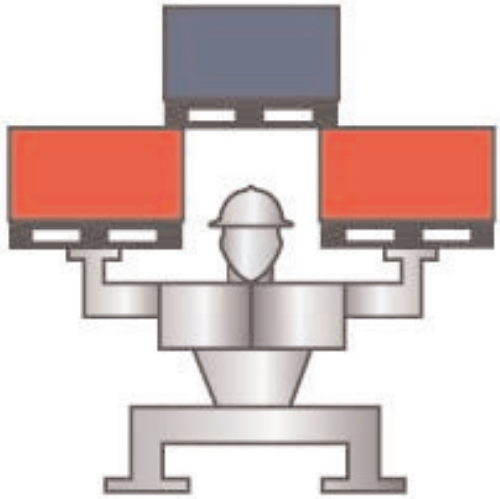
# Structural Steel Storage Systems

## GUIDELINES FOR INSTALLATION



**Selective Pallet Rack** **Drive-In Rack** **Pallet Flow Rack**

**Push-Back Rack**

**This guide is designed to assist in the assembly and installation of Frazier Structural Steel Storage Rack Systems.**

**Please read the following directions thoroughly, and review all architectural, layout and installation drawings carefully prior to assembly.**

***Failure to follow these guidelines can result in product damage and serious injury***

Version 1-11/07

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# GENERAL INSTRUCTIONS

**This guide is designed to assist in the assembly and installation of Frazier Structural Steel Storage Rack Systems. Please read the following directions thoroughly, and review all architectural, layout and installation drawings carefully prior to assembly.**

Prior to beginning installation, thoroughly check the shipment against the bill of lading to make sure all components are included.

Only trained personnel shall supervise or complete the installation, using the proper tools for assembly of structural, bolted storage rack.

Installation personnel must be thoroughly familiar with the following instructions and trained in all necessary safety procedures prior to beginning the installation.

Racks must be installed using the components and hardware specified in the installation drawings.

## Drawings

All drawings are consistently dimensioned. Down aisle dimension lines are shown as the centers of the uprights or columns. Cross aisle dimensions are face to face of objects. There may be exceptions to this format, so carefully review drawings before beginning the installation. When there are variances to the above standard format, the drawings are noted with the following symbols:

| | | | |
|---|---|---|---|
| **1.** | **c-c** | **=** | **Center to Center** |
| **2.** | **c-f** | **=** | **Center to Face** |
| **3.** | **f-w** | **=** | **Face to Inside of Wall** |
| **4.** | **f-f** | **=** | **Face to Face** |

Other designations may also be used, but do not assume their meaning. If it is not clear, contact a Frazier representative for clarification

## Bolts

All Frazier joints, unless noted specifically on the drawings, are bearing type connections and not slip critical joints. This means that all bolts should be tightened snug tight until the parts are in firm contact with each other.

**Note:**
Snug tight means as tight as you can get it with an ordinary spud wrench or socket wrench, whereby all parts of the connection are drawn together. There is no torque requirement for the bolts.

## Anchor Bolts

Anchor bolts will include installation instructions from the anchor manufacturer. These instructions may include drilling requirements, clean-out requirements, setting procedures, and/or tightening specifications. Instructions must be followed exactly. Refer to load application and rack configuration drawings for the anchor bolt requirements.

Wedge type anchors have two special considerations:

1) Substitute a chemical anchor for a wedge anchor if reinforcing steel in the floor slab is encountered during the hole drilling.

2) Many of the wedge type anchors have a specific torque requirement that the anchor must be tightened to in order to "set" the anchor collar. If an inspection of the setting is required, it must be done immediately following the anchor installation, as the torque of a properly installed anchor will significantly relax as soon as the next day.

**Notes:**
1) All base plates should be anchored by at least one anchor bolt. 2 holes are provided per base plate in case an obstruction is encountered when drilling the first hole location.

2) Frazier engineering approval is required if customer desires to use alternate anchor bolts.

## Layout

Begin all rack installations by establishing baselines in both the down aisle and cross aisle directions. It is important to use a steel tape measurement for all layout work. A cloth or plastic tape will stretch and will not provide accurate measurements.

## Guidelines for Establishing Baselines

1) Down aisle baselines should be established for the full length of the row. One continuous base line is required for each row of uprights in the system.

2) Cross aisle baselines should be established at the front end of the system for the entire width of the system to ensure that all rows of racking are in line, and at every upright position for the entire length of the row.

3) All down aisle and cross aisle baselines should be 90 degrees from each other.

4) There are various methods for establishing these baselines:

   a. **Using a transit**

   b. **Using a laser**

   c. **Using a dry line** to establish a down aisle baseline, and then using the bisecting arc method to establish a cross aisle baseline 90 degrees to the down aisle baseline.

> **Note:**
> If the dry line method is used, be sure that the length of the bisecting arc is at least equal to 1/3 of the total length of the row. See Sketch "A" on page 6.

5) The starting and ending points for the down aisle baselines should be the first and last upright positions of the row in relation to the wall or column, as shown on the layout drawings.

6) The cross aisle base line is established from one point on the down aisle baseline. Once this point has been established, it is customary to offset this point by ½ the width of the upright post toward the front of the row. The cross aisle baseline will now be located on the front edge of the upright post. This establishes a better visual reference for positioning the uprights before anchoring.

7) Place all subsequent uprights to the same side of the cross aisle lines for the balance of the row.

8) After the main baselines are established in both directions, use a 100-foot tape to set up baselines for each upright within the row, in the cross aisle direction, and establish down aisle baselines for each row. It is best to mark the subsequent down aisle baselines for each row. Always use a 100-foot tape, do not use a 25-foot tape this will insure that the layout remains accurate as you proceed away from the original baselines. If the system is wider than 100 feet (50 feet from either side of the baseline), establish additional down aisle baselines using one of the three methods mentioned above. These methods guarantee that all rows are square to each other and all uprights line up in the cross aisle direction.

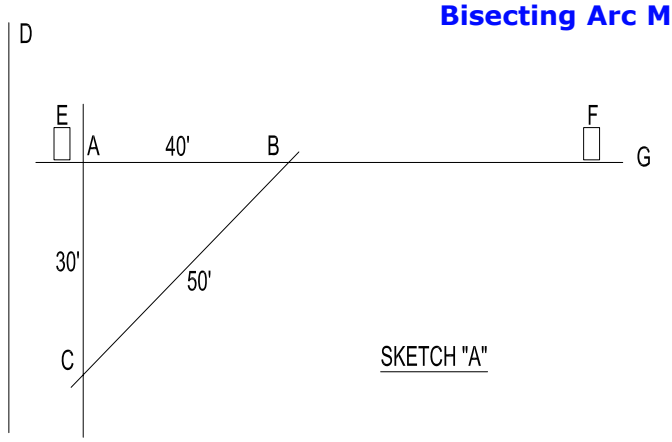
9) After all rows and bays have been marked, proceed by chalking lines in both directions, creating a checkerboard on the floor. When chalking lines, it is best to pull through at least three points. If an error in marking the floor is made, it will immediately show up because all three layout points will not line up. Never chalk a line from only one point to another.

10) At this point, apply clear paint to the intersection points of the down aisle and cross aisle lines. This ensures that the layout process will not have to be repeated once the uprights are anchored.

11) Only one down aisle baseline is required for each row of rack, if the row is a back-to-back row with row spacers. It is acceptable to have only one down aisle baseline as long as the row spacers are installed prior to anchoring the second row. However, the cross aisle base line must be continuous for the full width of the back-to-back row to ensure that the uprights line up in the cross aisle direction. If the back-to-back rows do not have row spacers, a down aisle baseline must be established for each row. This usually only occurs with drive-in, glide-in, or pallet flow systems.

**Note:**
Do not use intermediate measurements off the wall or building columns to establish baselines since they are rarely straight.

**Bisecting Arc Method**




1) Points E and F represent building columns 150 feet apart.

2) Line D represents an outside wall.

3) Line AG is a known aisle baseline parallel to columns E and F.

4) Line AG is found by measuring the appropriate distance off the centers of E and F and using a dry line, transit, or laser to connect these two points in a straight line.

5) To establish a 90 degree line to AG, find point A on line AG by measuring off of line D or the center of column E.

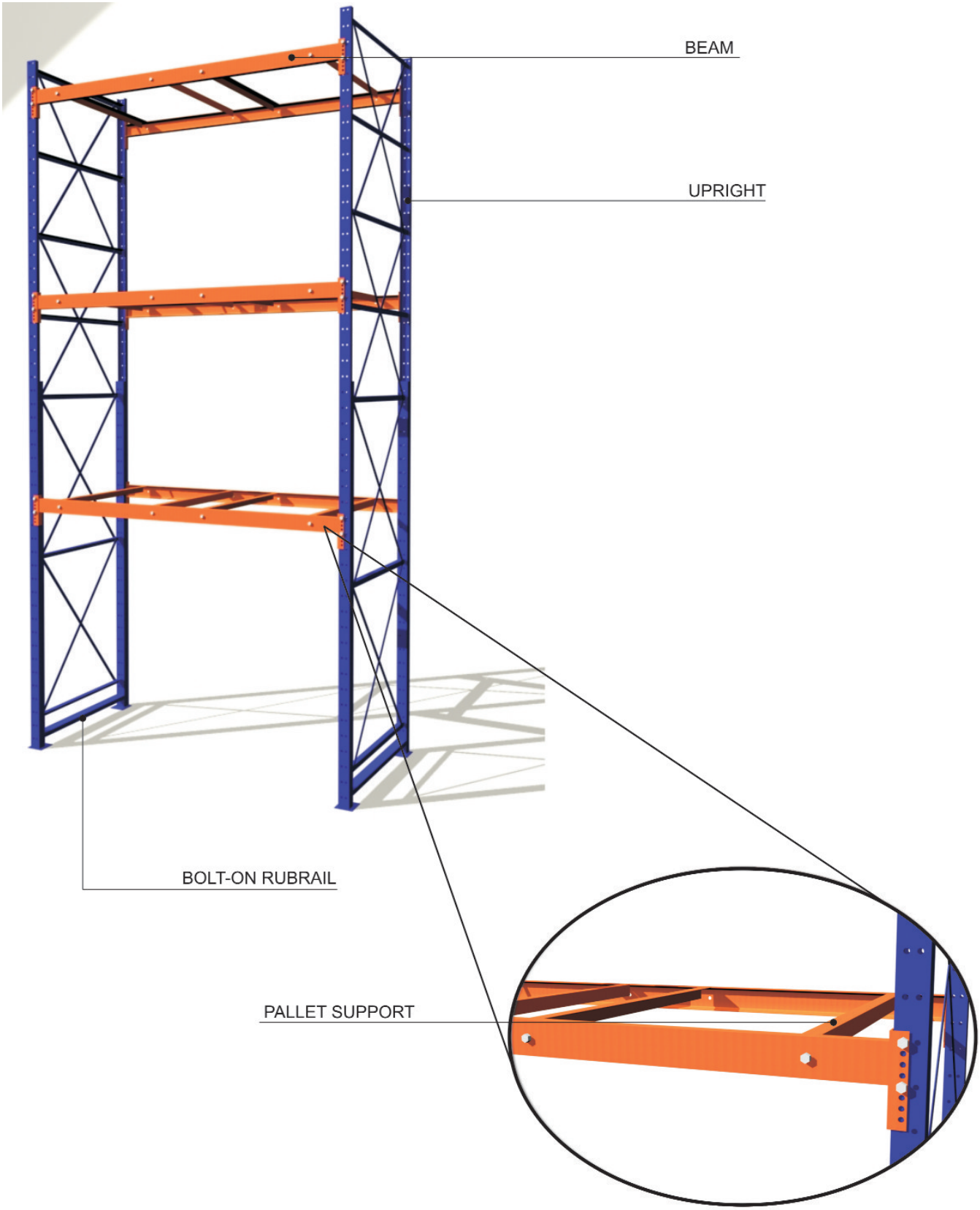
6) Once point A has been established measure 40 feet and mark point B on line AG.

7) From point B, using a 100' tape swing an arc 50 feet from B near where you think line AC should be.

8) From point A, using a 100' tape swing an opposing arc 30 feet from A to intersect with the first arc from points B to C.

9) After an intersection point of the two arcs is established, chalk a line from point A to C. The resulting line will be 90 degrees to line AG. Check by using numbers smaller or larger than 30', 40' 50' to prove a right triangle exists at points ABC. (24', 32', 40')

## Selective Pallet Rack



## SELECTIVE PALLET RACK INSTALLATION

1) Layout the floor as described on page 5.

2) Stand the first two uprights in a row and install all beams. Rough plumb the first bay so that the row does not lean too much as the install proceeds. Typically, if only the first level of beams is tightened, it will hold the starter bay plumb. Be sure to loosen these beams when the row is complete and ready to plumb in the down aisle direction.

3) Anchor these uprights at the appropriate points on the grid, but only set the anchors halfway into the holes and do not tighten.

4) Proceed with the erection of the balance of the row. Install the beams, but leave the connections loose.

5) It is recommended that the uprights be anchored as the erection proceeds, but only by setting the anchors halfway into the holes. This ensures that when the rack is cross aisle plumbed, there is enough length left in the anchor bolts to add shims if necessary.

6) Once the row is completed, make sure it is anchored, but only set the anchor s half way down.

7) Make sure the uprights are positioned accurately to the layout grid.

8) Shim the rack cross aisle. Place a plumb bob on each upright and shim either the front or rear base plate to straighten the frame. **See shimming guidelines & diagram page 9.**

9) Once the row is anchored and shimmed cross aisle, proceed with tightening the anchor bolts.

10) Proceed with the installation of pallet supports and back ties. This can be done at the same time as installing individual bays, but leave the bolts loose.

11) With the row anchored, detailed, and plumbed cross aisle, begin plumbing the row in the down aisle direction.

12) Attach a cable to the top beam elevation of the first upright on the front or aisle side post, in the row of sufficient length to reach 5 to 6 uprights back at the base.

13) Hang a plumb bob, use a transit or a bazooka bob, to determine in which direction the row needs to be pulled.

14) Check both the front and rear posts of the upright. It is possible that the front post of the upright may need to go in one direction and the rear post in the other down aisle direction. If this occurs, add additional cables to the rear post as well, to pull the row square.

15) Attach a come-a-long to the end of the cable to aid in pulling the row.

16) Check the first and last frame in the row and if it is within tolerance, tighten all bolts in the beams, pallet supports and back-to-back ties with the cables in place. If the last upright in the row is out of tolerance, attach a second cable at the rear 5 bays and pull the row in the opposite direction, to eliminate any growth that may have occurred due to the slop in the beam and upright holes and then tighten all bolts in the row.

17) If the row of rack is particularly long, this process should take place in 25 bay sections.

18) The row is complete once all bolted connections are tight.

19) Each row of rack should be plumbed in this fashion. If you choose to plumb a back-to-back row down aisle with the back ties installed, you must be sure that all four upright posts are in the line with each other in the cross aisle direction. Both rows must be aligned with each other.

20) Do not use a 4-foot level to plumb any rack over 10 feet tall. This method is very inaccurate and should not be used.

# SHIMMING GUIDELINES

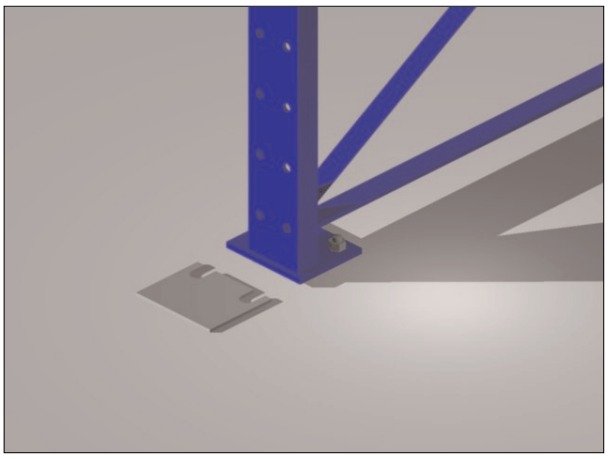
## Rack Manufacturer's Institute (RMI)Specification for Storage Rack - Section 7.2.4 - Shims:

Shims may be used under the base plate to maintain the plumbness of the storage rack. The shims shall be made of a material that meets or exceeds the design bearing strength (LRFD) or allowable bearing strength (ASD) of the floor. The shim size and location under the base plate shall be equal to or greater than the required base plate size and location.

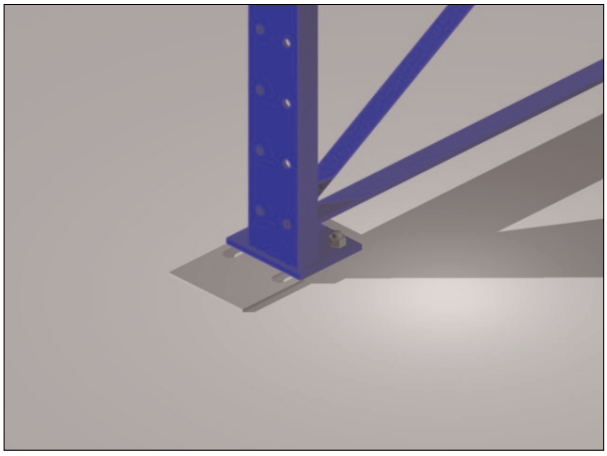
In no case shall the total thickness of any set of shims under a base plate exceed six times the diameter of the largest anchor bolt used in the plate.

Shims that are a total thickness of less than or equal to six times the anchor bolt diameter under bases with less than two anchor bolts shall be interlocked or welded together in a fashion that is capable of transferring all the shear forces at the base.

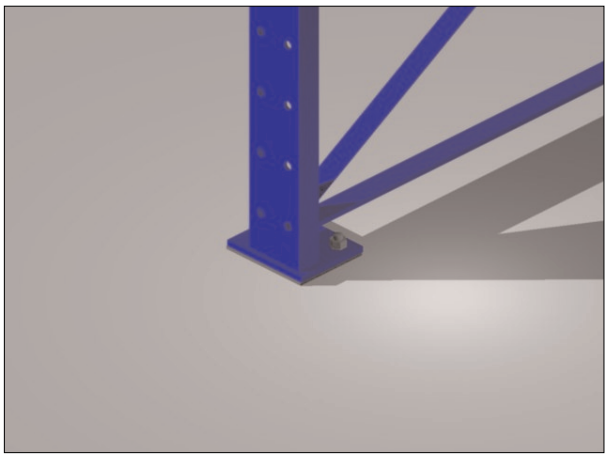
Shims that are a total thickness of less than or equal to two times the anchor bold diameter need not be interlocked or welded together.



**1) Before - Refer to RMI Specification above for shimming guidelines**

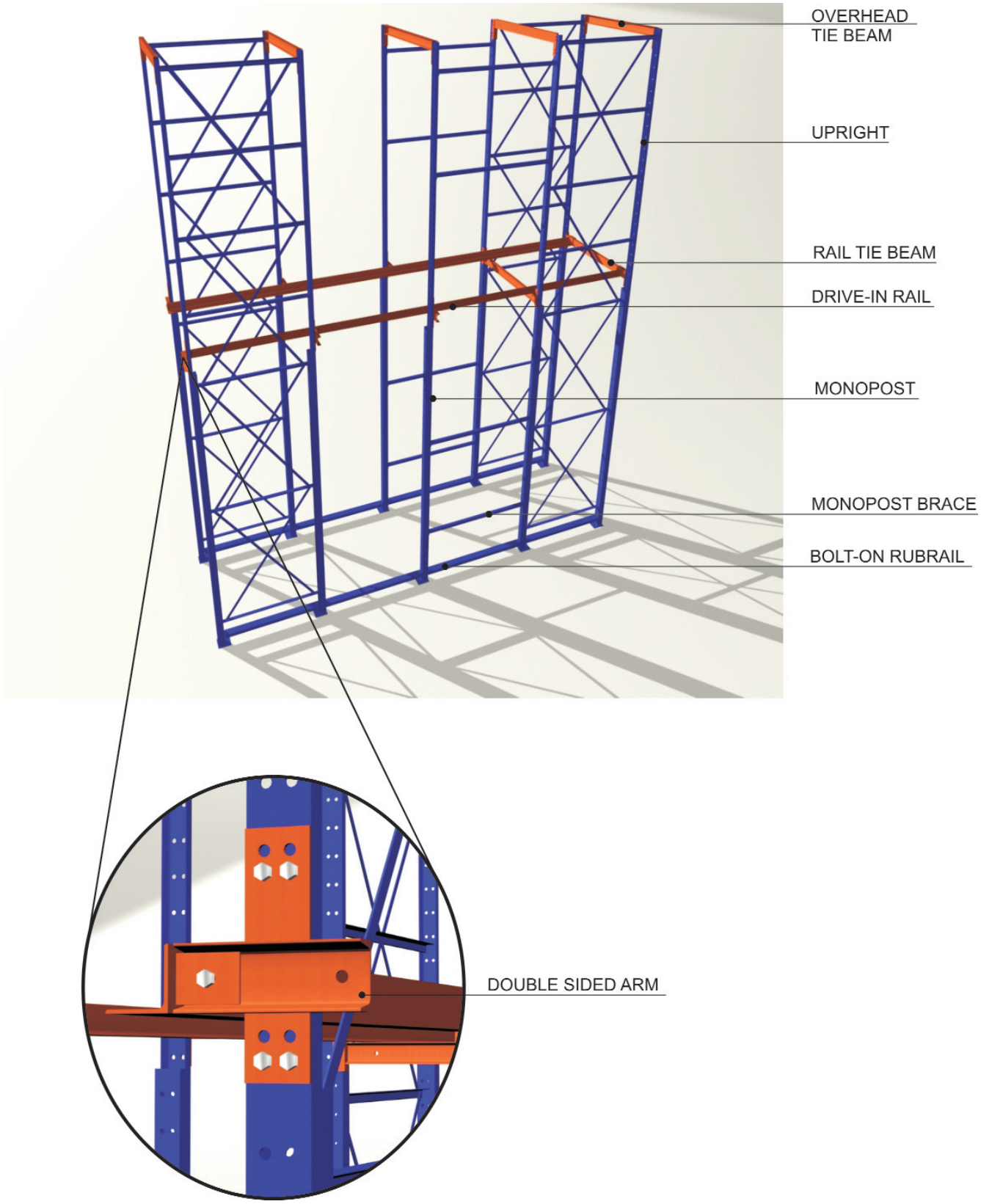


**2) During - Keep anchor bolts loose until required number of shims are added**



**3) After - Tighten anchor bolts**

# Drive- In Pallet Rack



## DRIVE-IN/DRIVE-THRU INSTALLATION

1) In terms of installation, drive-in rack is basically selective rack without beams, although multiple frames deep.

2) Follow the layout procedures on page 5.

3) Follow the basic installation procedures for selective rack. When installing individual uprights, plumb and tighten at least 3 bays before continuing to stand the balance of the row. This will stabilize the row since drive-in rack only uses top ties and rail ties. Once the row is fully installed and it is ready to plumb down aisle, be sure to loosen these connections so that the row will plumb correctly in the down aisle direction. If all the rails and arms are tightened prior to plumbing down aisle, it will help square the frame line and then all that remains is to tighten the top ties and rail ties.

4) If you stand drive-in rack as individual uprights and add the drive-in arms and rails later, leave all connections for the drive-in arms loose. This will make installing the rails easier. If the drive-in arms are tightened prior to installing the rails, they will not fit. Once the rails and arms are installed and bolted up, tighten all the rail connections.

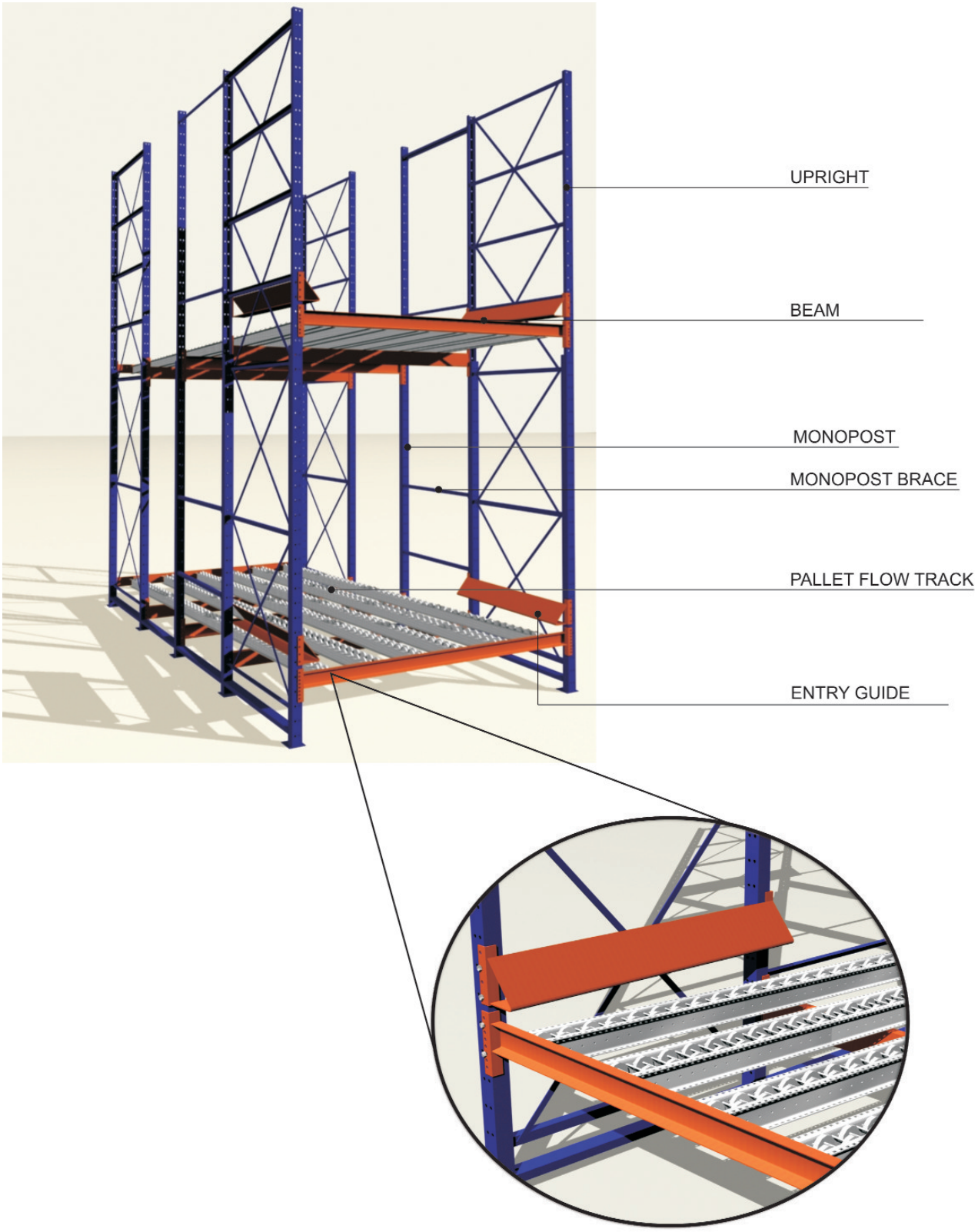
5) Some installers may choose to build a complete section on the ground and stand each frame line as a complete unit. In this case, tighten all bolts in the arms and rails on the ground prior to standing. This will square the complete frame line.

6) Cross aisle plumbing a completed unit is more difficult. Usually the completed unit will seek its own level, and spaces will be left under base plates where the low points in the floor are located. These should be filled in with shims after the unit is checked and plumbed cross aisle.

7) Drive-in rack uses top ties and rear beam ties. When plumbing the rack in the down aisle direction, start at the rear upright post, using the same procedure as detailed in the Selective Rack Section. After the rear section is plumb, work toward the aisles insuring that all columns are plumb.

8) There are slotted holes in the mounting clips of the drive-in rails. These do not require flat washers.

# Pallet Flow Rack



## PALLET FLOW RACK INSTALLATION

1) Layout for this system is critical. Follow the procedures on page 5.

2) After completing the layout and prior to erecting the rack, the floor must be measured to determine the high point of the floor and the amount of shimming needed at each grid point. All elevation shots should be recorded for each grid point so that it can be cross-checked after the installation is complete.

3) The completed system should be shimmed to the high point of the floor for individual rows, to ensure that the pitch of the rollers is maintained so that the pallets flow correctly.

4) All upright anchor bolt holes should be drilled prior to shimming and raising the system to the high point of the floor.

5) All anchors should be placed upside down in the floor to hold the system to the grid. If the system requires more than 3/8 of an inch of shim at any grid point, fixed hole shims should be used to prevent them from coming loose over time. the shim pack thickness is to be limited to no more than six times the largest anchor bolt diameter in that baseplate. If shimming is required that is thicker than six times the anchor bolt diameter, consult with the Frazier Engineering department. If fixed hole shims are not used then the shim stack should be welded together to hold them in place. All welding is to be done in a manner acceptable to Frazier Engineering.

6) After the shims are in place and elevations are verified, set the anchors correctly, but not all the way into the holes.

7) Since the system is shimmed to the high point of the floor, the cross aisle plumbing required should be minimal and only require one shim to be added to a baseplate. This shim can be slotted so it can be installed after the anchors are in place. Once the system is plumb cross aisle, verify the base plate elevations again relative to the high point of the floor. Once confirmed to be correct, tighten the anchor bolts.

8) The maximum tolerance at any grid point in relation to the high point of the floor is +/- 1/16 inch.

9) Follow the installation procedures for selective rack on page7, and be sure that all rows are plumbed in the same down aisle direction. This is necessary to prevent bows occurring in the pallet flow track when it is installed.

10) Do not install any pallet flow track until all racking is plumb and tight.

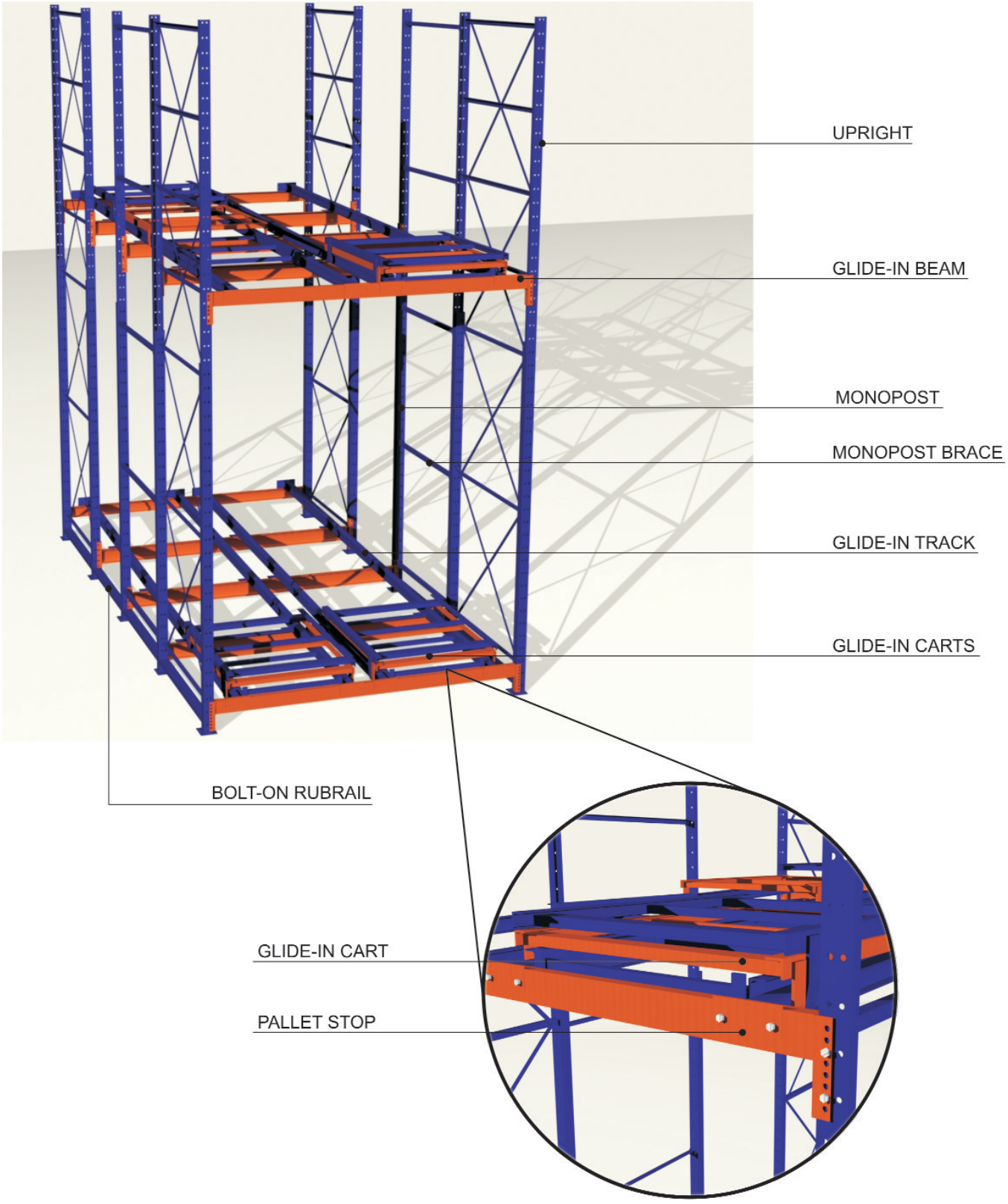
11) Once the rack system is tight and shimmed correctly, install the pallet flow rails. No additional shimming or adjusting is required.

12) If the pallet flow rails are equipped with brakes, be sure to install the brakes in the proper direction. Each brake assembly is marked with the direction of flow.

13) Some longer pallet flow systems have bolted splices. Install these prior to attaching the tracks to the mounting angles on the beams.

14) All pallet flow systems are supplied with shop drawings that fully detail the location of each track. Do not proceed to install tracks prior to reviewing these drawings. If you do not have these drawings, contact your Frazier representative.

# Glide-In, Push-Back Rack



## GLIDE-IN, PUSH-BACK INSTALLATION

1) Follow the layout procedures on page 5.

2) Follow the installation procedures for selective rack on page 7.

3) This type of rack also requires the floor to be shimmed to the high point of the floor for 4 and 5-deep systems only. It is not required for 2 and 3-deep systems.

4) Pay particular attention to the Frazier installation drawings that have frames or monoposts with only one leg boxed. Do not assume the boxing is on the front column. In many instances the boxing is required on the interior columns due to higher post loads. This will be identified on the side elevations of the Frazier installation drawings.

5) Install the tracks after the system is plumb cross aisle and leave them loose.

6) Proceed with plumbing the system in the down aisle direction, making sure all frames are leaning in the same direction.

7) Tighten all tracks, beams and anchors.

8) It is best to complete one section as early as possible to determine the appropriate number of washers for each wheel on the cart. This tends to vary greatly and there is no set rule for what is required. As a rule of thumb, the first cart will require 1 washer per wheel, 2 washers per wheel for the second, and 3 for the third. In a 5-deep system with a 4th cart, start with 3 washers per wheel.

9) When the cart is installed in a completed bay with all beams and tracks tight, push the cart to one side, the resulting gap on the opposite side should be about ¼" from the outside of the wheel to the inside web of the channel or S beam. It is possible to vary the number of washers per wheel to get the correct spacing. This may result in having 2 washers on one side of the cart and only one on the other side. The number of washers can also be varied on the front wheel versus the rear. The carts will seek their own center in the rail, regardless of the washer combinations. The washers are placed between the wheel and the frame of the cart so they act as spacers. There are no lock washers required for the nuts on the wheels.

10) Tighten all cart wheel nuts using an electric impact gun.

11) Frazier's standard-duty cart design uses a bent leg cart which puts the wheel at a 9 degree angle. When washering these carts, the edge of the wheel should be ¼" from the lower heel of the channel or the S beam.

12) Make sure to check the clearance between carts on this design. There will be only ¼ to 3/8 of an inch clearance between carts so washering the carts requires more attention. The height of the carts can be adjusted by adding or subtracting washers. This must be done in unison with maintaining the required clearance to the inside web of the channel or S beam.

13) Once the correct washering pattern is determined for each type of cart in the system, all carts can be washered in the same fashion. Bear in mind that there may be individual bays that require some adjustment once the cart is tested in a specific bay, but this should be minimal. Under no circumstances should any part of the wheel protrude beyond the lower flange of the channel or S beam.

14) When installing the track, be sure that the web of the I-beam track is 90 degrees to the beam. This will prevent the carts from creeping to one side on a 3 or more deep glide-in system. The front connection on the track is slotted horizontally. Be sure to move the tracks to the maximum width on the front beam prior to tightening the rails.

15) Glide-in stop plates should be installed on the face of the aisle side beam. For a 2 pallet per bay system there are 4 stop plates. Install the stop plates at the same time as bolting up the tracks.

16) All carts must flow empty. It is the responsibility of the installer to ensure that they do. Following the above procedures will help to ensure that this can be done with a minimum of effort.

17) Use all ½ X 2" bolts to bolt the track to the front beam.

18) Use ½ X 1 1/4" bolts on all other track connections. Flat washers should not be used other than for the cart adjustments. Although there are slotted holes on the track connections, a flat washer is not required.

19) Install 2 rubber bumpers per cart. On a 2-deep system, 2 rubber bumpers are required on the inside bolts at the front of the tracks. On 3, 4, and 5-deep systems, 4 rubber bumpers are required, one on each track bolt at the front beam connection. The rubber bumpers are installed by forcing them over the ends of the 2" bolt. On a system that is 4 or 5-deep, the upper carts will stop themselves against each other.

20) There are right and left tracks. Only one track will have notches in them to install the carts. When standing in the aisle facing a typical bay, the notched tracks will always be on the right side of the pallet or bay not the left. If the notched track is installed on the wrong side of the pallet or bay, the carts will not drop into the slots.

21) Once the tracks are tight, the carts are dropped in and installed.

22) Make sure the carts are installed in the proper direction. The lower or first cart has stops welded on one end; This is the front. Subsequent carts use the support angle for the wheels as their stops. If the system uses level carts the longer legs on the carts should always be in the front to compensate for the pitch of the tracks. If the carts have been installed properly, the front edges of each cart should line up with each other when in the home position.

23) All carts should be installed from the top down. Since the carts nest within each other if you start with the lower carts first you will not be able to install the upper carts. Put in the top cart and roll it back. Install the next cart and push 2 back until all the carts are installed.

## TOLERANCES

| | | | |
|---|---|---|---|
| **1.** | **Down aisle plumb** | **1/4 inch in 10 feet** | **3/8 inch maximum** |
| **2.** | **Cross aisle plumb** | **1/4 inch in 10 feet** | **3/8 inch maximum** |
| **3.** | **Relation of Post to Grid** | **1/8 inch maximum both directions non-accumulative** | |
| **4.** | **Elevation of shim points** | **Plus 0 minus 1/16th to high point of floor** | |

**Note: Capacity Plaques**

Installation of capacity plaques is required. Plaques with the unique system details are available from Frazier Industrial. It is the responsibility of the owner/operator of the storage system to assure that the correct plaques are installed and maintained. Capacity plaques indicate permissible load weights of the rack system and should be place in several conspicuous locations throughout the warehouse