

Code of Practice For Rack Safety Inspections



AUSTRALIAN STEEL INSTITUTE

Australian Steel Storage Industry Group
(ASSIG)

Foreword

This Code of Practice on how to manage rack safety inspections is produced by the Australian Steel Storage Industry Group (ASSIG).

The main objective of this Code of Practice is to set out the framework:

- 1) For the inspection of steel storage pallet racking solutions across the racking industry throughout Australia and New Zealand.
- 2) To recommend the process and quality of conducting inspections and competency of the inspectors.
- 3) To ensure that all inspections shall be carried out in accordance with the Work Health & Safety (WHS) Act and legislation.

By adopting best practices that the industry offers, it will help minimise the potential risk of injury to personnel, damage to goods & interruption of business.

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Terminology

Pallet racking: *Pallet racking* is a material handling storage aid system, designed specifically to store materials on pallets (or “skids”) and accessed by mechanical handling equipment.

Competent person: A person who has acquired through training, qualification or experience, or a combination of both the knowledge and skills required to safely carry out a task.

Purpose of Inspections

It is recommended that a system of regular inspections for pallet racking installations shall be carried out on a regular basis and at least once every 12 months, as a minimum in accordance with AS 4084-2012 (Ref. AS 4084-2012, Section 8.1 General, and Section 8.2-Inspections, pages 99-100.)

For inspections carried out **after** a seismic or cyclonic event, it is recommended that the inspector issue a copy of the inspection report to the manufacturer for their technical review and comment. A qualified structural engineer may be required to inspect the site subject to the initial report and findings.

In accordance with AS 4084-2012 inspections shall be carried out to:

- (a) Ensure the correct application and use of equipment.
- (b) Ensure that the working load limits are adhered to.
- (c) Ensure that the racking installation has not been altered. A copy of the load application and configuration drawings shall be retained for this purpose.
- (d) Examine the extent of damage due to impact on the racking installation.
- (e) Examine the out of plumb of the racking.
- (f) Examine for any dislocation and deformation of sections and connections for uprights and beams.
- (g) Examine connectors for deformation or signs of cracking at the welds.
- (h) Examine base plate for anchors.

Additionally, it is recommended that a formal reporting and recording process for all damage and repairs is carried out.

Rack Inspector Competencies and Qualifications

ASSIG have set minimum qualifications for rack inspectors. The following minimum requirements of EXPERIENCE, EDUCATION and KNOWLEDGE are recommended as a pre-requisite prior to understanding further 'ON THE JOB TRAINING'.

Each company that provides rack inspection services shall demonstrate an evidence-based structured training programme.

1. EXPERIENCE (proof of evidence must be provided)

Inspectors shall have minimum of 5 years full time experience working in the industry in the role of either DESIGNER, ENGINEER, INSTALLER, or with similar experience using pallet racking systems, and minimum 'on the job' training of 100 hours, or 50 hours when deemed competent by a Senior Rack Inspector

OR

Inspectors with competency in using simple measuring equipment in a logical, systematic way (such as qualified tradesmen) and ability to record results of the survey clearly. Further 'on the job' training is recommended for a minimum period of 200 hours in the presence of a *qualified rack inspector*.

2. EDUCATION (proof of successful completion required)

Inspectors shall have a minimum level of education qualification as stated below:

- a) Construction Industry Safety Card
- b) Company Safety Induction course
- c) Site specific Safety Induction where applicable
- d) Certificate in rack safety inspections Cert III or Cert IV in WHS

3. KNOWLEDGE

Inspectors shall have read and understood the following publications (proof of knowledge during 'on the job' training should form part of demonstrated evidence):

- a) Duty of Care provisions for each state authority
- b) AS 4084-2012, Sections 1.6, 1.7, 6.4, 6.5, 6.6 and 8
- c) BCA access/egress requirements
- d) ASSIG Code of Practice for Rack Safety Inspections
- e) Company Operator/User manuals
- f) Company Rack Inspection manuals

Approval may be granted to complete educational qualifications during 'On the Job' training.

'ON THE JOB' TRAINING

'On the Job' training should be undertaken under the guidance of a senior experienced rack inspector nominated by the company and should cover the following areas of competency:

- a. Damage Identification
- b. Damage Assessment and Classification
- c. Causes of Damage
- d. Damage Reporting and Repairs
- e. Customer Service

For inspectors with rack design/installation industry experience a minimum period of 100 hours 'on the job' training is required before competency can be achieved and recognised, or 50 hours when deemed competent by a Senior Rack Inspector.

For inspectors from outside the rack design/installation industry, a minimum of 200 hours 'on the job' training is required prior to competency assessment and final approved.

Further 'on the job' training may be required (at the discretion of the trainer) for successful completion of the training and final certification.

Inspections

All inspections must be carried out by a competent person, fully experienced in the identification and categorisation of racking damage. It is recommended that persons responsible for warehouse racking, set up their own damage reporting and maintenance process, along with training responsible staff, to carry out regular rack damage inspections, additional to any third party inspections taking place.

Safety of the Rack Inspector

Safety of the rack inspector is paramount to a successful inspection:

- Where a customer does not have suitable procedures for personnel interaction and material handling equipment (MHE), a risk assessment must be written, prior to starting the inspection.
- Where practicable the aisles are to be barricaded or bunted off to prevent MHE from entering, or as a minimum signage, or safety cones must be positioned at the ends of the working aisle.
- If barricades and bunting are unacceptable to the customer, it is mandatory for the inspector to request that ALL operators within the facility are advised of the presence of inspectors within the warehouse, especially as there may not be designated walkways, separating pedestrians from MHE.
- Inspectors must be trained in warehouse safety and must be alert at all times to the potential dangers within the warehouse, especially advancing with caution when entering or leaving an aisle.
- PPE must be worn at all times, safety shoes and high visibility vests having reflective tape front and back, both horizontally and vertically should also be mandatory. In circumstances where lighting is poor, a strobe light is recommended as additional PPE.
- Freezer rooms pose a different hazard to a standard warehouse, therefore prior to starting, the inspector must always negotiate the safest and most acceptable method possible, to carry out the inspection and advise a third party that they are working (alone) in a freezer environment.

Wearing a freezer suit or appropriate warm clothing is mandatory. Time in should be limited to 30 minutes, with a mandatory time out of 10 minutes or as determined by site rules. Time out should be spent in a warm room, if available.

Additional equipment required for specific sites may also include:

- personal vertical/horizontal alarm or
- 2-way radio with motion sensor.

Racking Inspector Tool List (minimum recommended requirements):

- Copies of AS 4084-1993 and AS 4084-2012
- 1 metre long spirit level
- Laser measure
- Tape measure
- Digital camera
- PDA/tablet (if appropriate)
- Printer (if appropriate)
- Torch
- Clipboard
- Working pen and pencil (special pen/pencil required for freezers)
- Appropriate paperwork required for the inspection
- Laser/dumpy/theodolite (if required)
- Copy of design manual or rack layout drawings (where possible) of racks being inspected
- Colour coded stickers

Damage Control Procedures

All inspections should follow the AS 4084-2012 protocol for damage classification, using the Red, Amber and Green categories.

An inspection report of rack damage (red classification) should initiate a management procedure for isolating and making safe, sections of seriously damaged racking.

The inspection report should contain observations and proposals for any action necessary, with recommendations to reduce or eliminate the problem of damage reoccurring.

Methods of Measurement (Fig 1)

Where practicable place a 1000mm straight edge on the face of the damaged member, keeping the damaged area as close as possible to the centre of the straight edge, then measure the indentation.

Note: Where practicable always test over a 1000mm span. Where a 1000mm span is unavailable it is recommended to calculate maximum tolerances over the shorter distance available by pro-rata adjustment (i.e. 3mm max deflection over 1000mm = 2mm over 600mm).

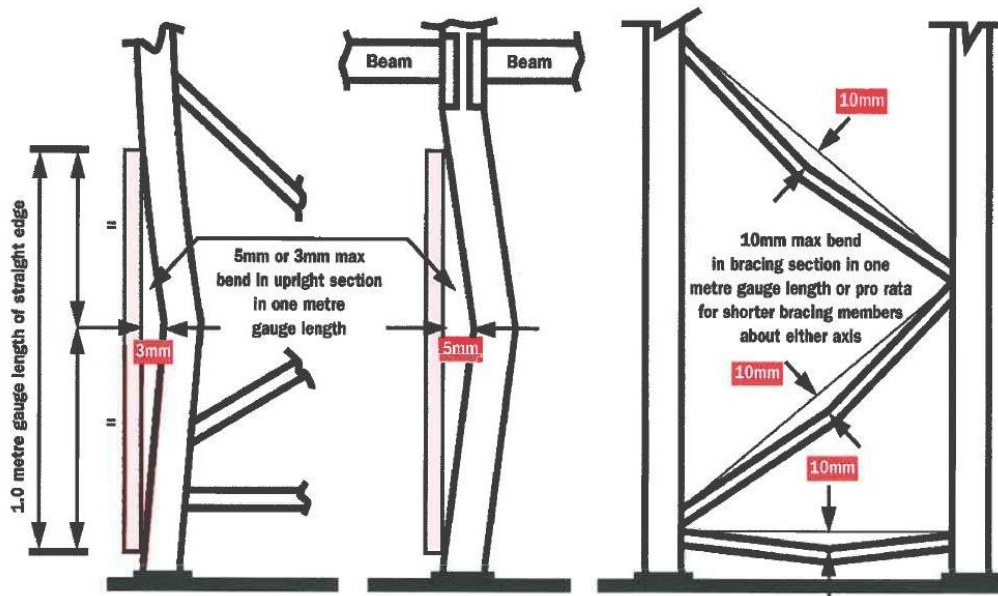


Figure 1

For an upright bent in the direction of the frame bracing, the maximum gap between the upright and the straight edge should not exceed **3mm**.

For an upright bent in the direction of the rack beam spans, the maximum gap between the upright and the straight edge should not exceed **5mm**.

For an upright that is damaged such that there is damage in both longitudinal and lateral directions, the left-to-right and front-to-back deformation shall be measured and treated separately and the appropriate 5mm and 3mm limits observed.

For bracing members bent in either plane, the gap between the straight edge and the bracing member should not exceed **10mm**.

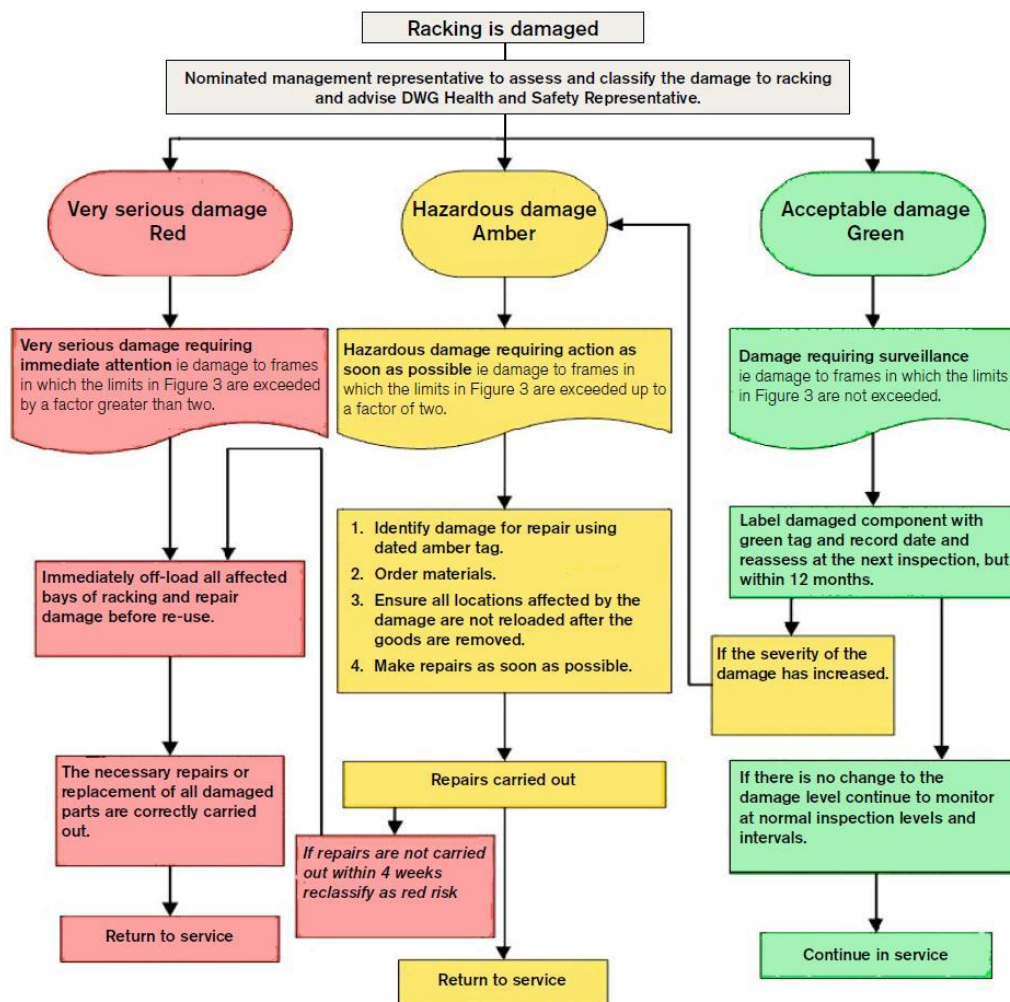
Racking components subjected to tears and splits should be unloaded and replaced immediately.

Please note: Local deformation of the shape or section at the base of the upright may be difficult to measure. Where this occurs, the inspector should use his/her best judgement and make recommendations to replace components where, in his/her opinion, the damage is close to exceeding tolerances, or is of a nature that they consider will affect the overall stability or integrity of the rack structure.

Damage Evaluation

The seriousness of structural damage to pallet racking components, should be evaluated, classified and recorded systematically.

Damage Action Flow Chart



Damage Action Flow

Green Risk

Acceptable damage

When the level of damage does not exceed the permissible limits specified in **Fig.1** the racking shall be considered serviceable and does not require either unit load reduction or immediate unloading.

Damaged components shall be recorded as suitable for further service until the next inspection and shall be clearly identified (e.g. stick on labels) for specific re-examination and assessment at future assessments.

NOTE: Exceeding the green level shall be considered hazardous or very serious damage to the racking system.

Amber Risk

Hazardous damage

When the level of damage exceeds the permissible limits specified in **Fig.1**, the damaged section shall be clearly marked and isolated until remedial work has been carried out before the racking can be reloaded. The client should be informed of all areas rated AMBER and advised of the correct action to take, and the consequences should correct action not be taken. If remedial work cannot be carried out within 4 weeks, the level of damage shall be re-designated as 'very serious damage' (red risk).

Red Risk

Very serious damage

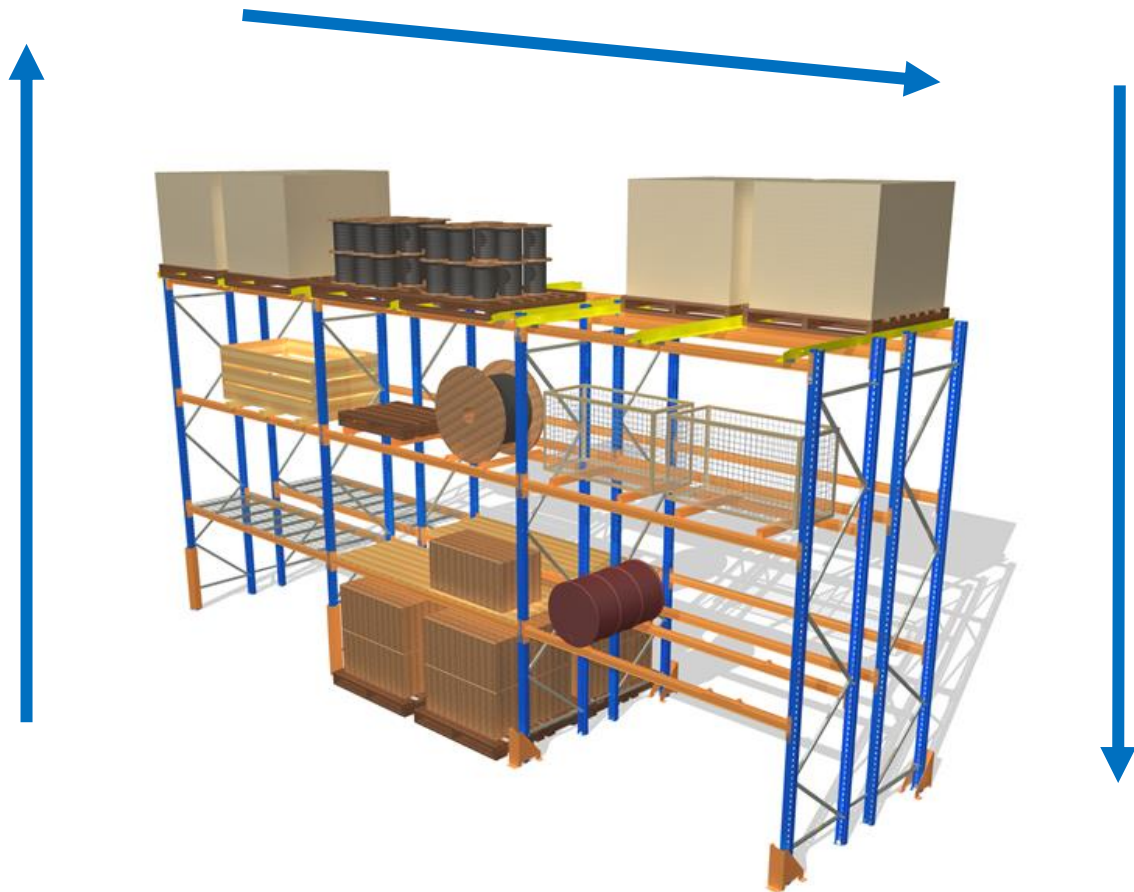
When the level of damage is in excess of the permissible limits specified in **Fig. 1** by more than a factor of 2, the damaged section and appropriate adjacent section(s) shall be immediately unloaded and isolated from further use until remedial work has been carried out and certified as safe. The client should be informed of all areas rated RED and advised of the correct action to take, and the consequences should correct action not be taken.

Any repair works shall be in consultation with the racking supplier or a qualified structural engineer. **Note: if any modifications to the original rack structure are identified by the inspector, the client or user should be notified and checks undertaken that changes were approved by the rack manufacturer or designer. The client should be advised that any unauthorised modifications may void any OEM warranty and may not comply with the standards.**

NOTE: Only like for like materials **must** be used when repairing a damaged rack.

Damaged components must be replaced with new or good quality undamaged second hand product, but not reworked or copy products.

Examples of a Suggested Inspection Process



Always inspect racks in a systematic order. For example,

Up

Across

Down

OR

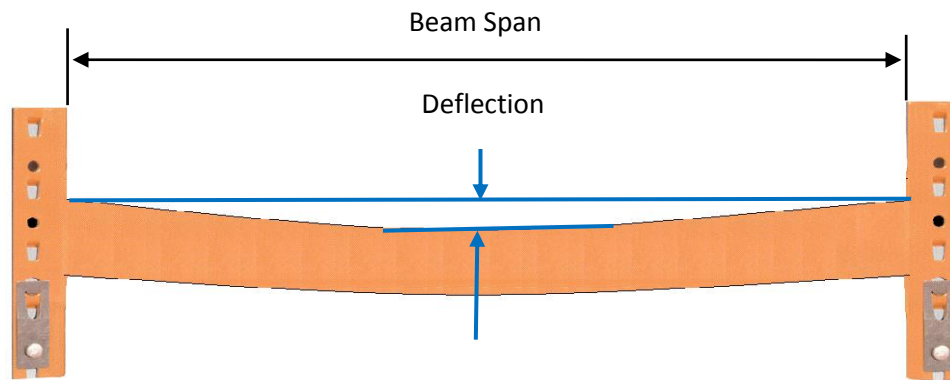
Up

Across

Repeat

Look down aisle along the rack for horizontal beam damage / out of plumb frames, etc.

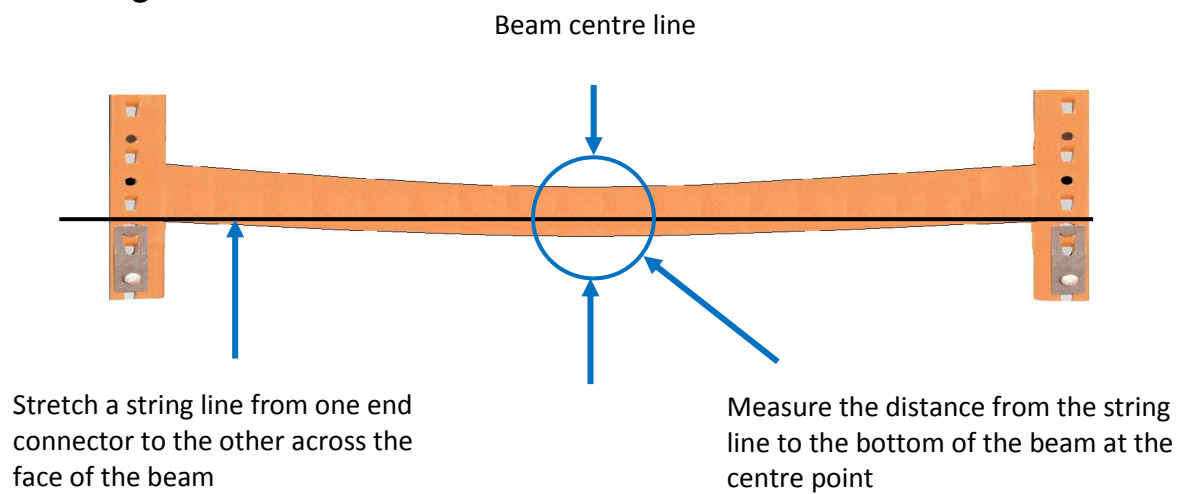
Assessment of Beams- Vertical Deflection



Maximum deflection = span/180 (fully loaded beam)

Maximum deflection for an unloaded beam = span/900

Measuring Deflection



Calculate allowable deflection

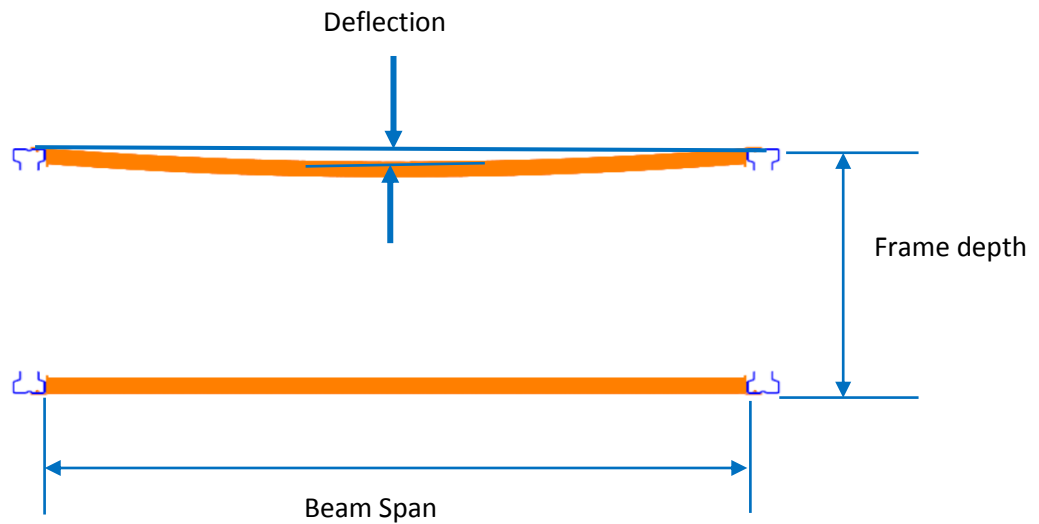
Loaded deflection

$$\frac{\text{Length of beam}}{180}$$

Unloaded deflection

$$\frac{\text{Length of beam}}{900}$$

Horizontal Beam Deflection



$$\text{MAXIMUM DEFLECTION} = \text{Span} / 360$$

For an unloaded beam

Out-of-plumb Racking

Out-of-plumb racking poses a risk that could eventually lead to rack failure.

Any visible signs of out-of-plumb or signs of the rack leaning must be investigated immediately.

The causes of out-of-plumb racking can be:

- Damage from impact
- Incorrect installation
- Component failure
- Excessive loads
- Concrete floor sinking
- Built on bitumen

Vertical Out-of-plumb (Measurement)

Empty Rack = height/500

Fully loaded Rack = height/200

Finished Tolerances

To comply with AS 4084-2012 pallet racking is to be installed to meet finished tolerances as specified in Section 7 when unloaded.

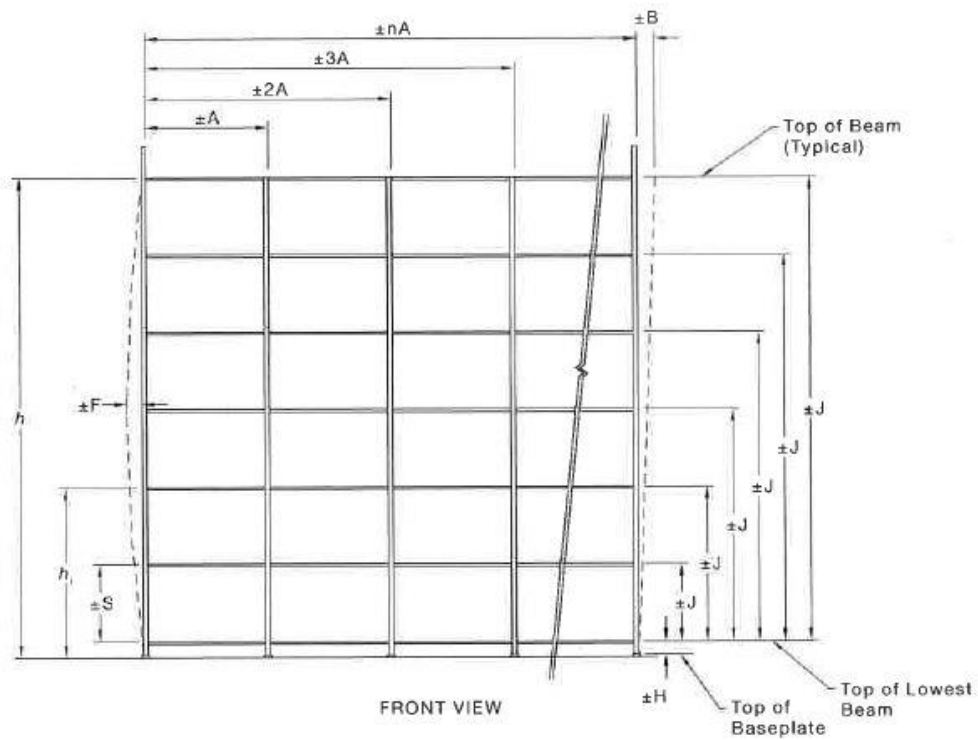
TABLE 1.7.1(a)
FINISHED TOLERANCES

| Type of tolerance (see Figure 1.7.1) | Description | Tolerance, mm | | |
|---|---|------------------------|------------------------|--------------------------------------|
| | | Tolerance, grade | | |
| | | I | II | III |
| A | Maximum variation in individual bays | ±3 | ±3 | ±3 |
| nA | Total cumulative deviation in racking length (nA = total deviation, where n is the number of bays) | ±30 | ±20 | ±10 |
| B | Maximum installation out-of-plumb of upright perpendicular to the plane of the upright frames (down-aisle) | $h/500$ | $h/750$ | $h/1000$ |
| C | Racking depth (single or multiple frames) | ±5 | ±5 | ±5 |
| D | String depth | ±5 | ±5 | ±5 |
| E _b | Rail positioning with regard to the pallet racking measured as the difference between the values at the bottom of the upright frames or clear aisle for Graders I and II | ±5 | ±5 | See FEM 9.831 and FEM 9.832 |
| E _t | Rail positioning with regard to the pallet racking measured as the difference between the values at the top of the upright frames or clear aisle for Graders I and II | ±5 | ±5 | See FEM 9.831 and FEM 9.832 |
| F | Maximum imperfection of upright with regard to the theoretical longitudinal upright x or y axis | $h/1000$ | $h/1000$ | $h/1000$ |
| G | Maximum installation out-of-plumb of upright in the plane of the upright frame (cross-aisle) | $h/500$ | $h/750$ | $h/1000$ |
| H | Distance between top of base plate and top of lowest beam level | ±10 | ±7 | ±5 |
| J | Maximum deviation of beam level or portal level with regard to the lowest beam level | $\pm h_i/500$ or ±5 | $\pm h_i/750$ or ±4 | $\pm h_i/1000$ |
| S | Maximum deviation of adjacent vertical beam spacing | ±5 | ±3 | ±2 |

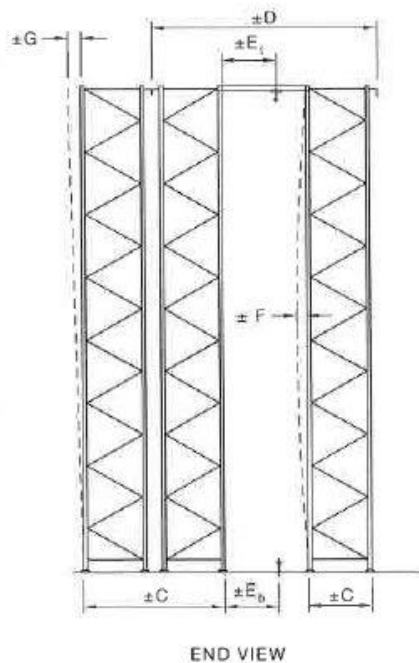
NOTE: In Table 1.7.1(a), h is the distance to the topmost beam level and h_i is the distance to beam level i , see Fig. 1.7.1.

TABLE 1.7.1(b)
TOLERANCE GRADES

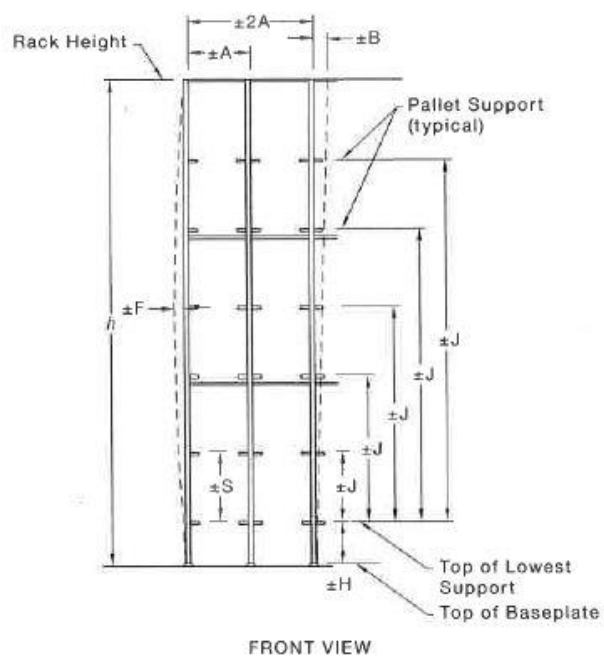
| Tolerance Grade | Type of unit load handling equipment |
|-----------------|---|
| I | Manually operated equipment guided by operator (e.g. wide and narrow aisle racking) |
| II | Manually operated equipment guided by electrical or mechanical devices (e.g. very narrow aisle racking) |
| III | Fully automatically operated equipment guided by electrical or mechanical devices (e.g. ASRS racking) |



(a) Down-aisle tolerances (closed face racking)



(b) Cross-aisle tolerances



(c) Down-aisle tolerances (open face racking)

FIGURE 1.7.1 TYPES OF TOLERANCES

Inspection Considerations

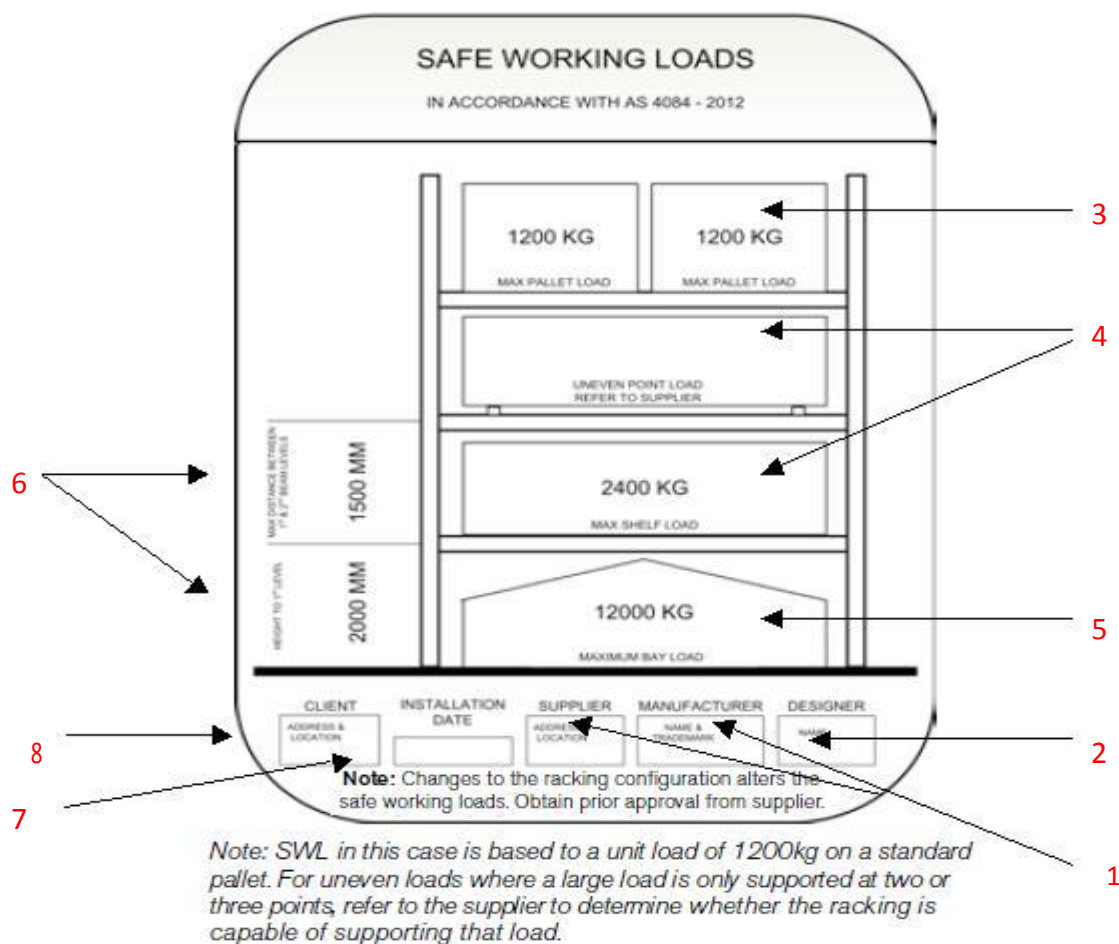
Load signs

AS 4084-2012 states that the racking installation shall have, in one or more conspicuous locations, a permanent, corrosive resistant plaque, not less than 125mm long and 250mm high, mechanically secured to the racking structure at 2m above the floor level.

A typical load sign should contain but not be limited to:

1. Racking manufacturer's name, supplier's name and trademark
2. Designer's name
3. Working unit load limit
4. Total working unit load limit for each pallet beam level
5. Total working unit load limit for each bay
6. Maximum distance from the base plate to the first beam level and maximum distance between first and second beam levels
7. Installation date
8. Client's name

Typical racking SWL sign

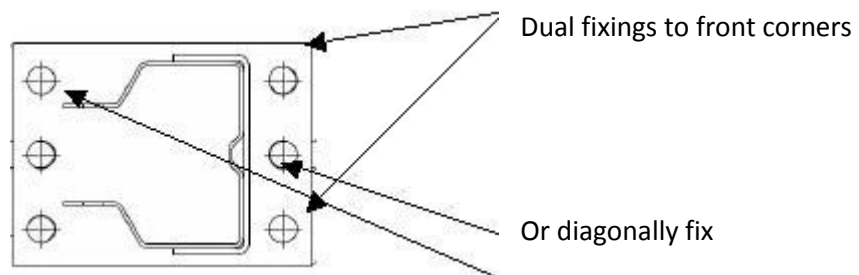


Beams

- All beams are fitted with safety clips.
- All connectors are correctly installed in the uprights (no dislodgement).
- No visible deformity of the beam (if this not evident in loaded situation – the beams should be unloaded and checked).
- Rotation of the beam caused by impact or overloading.
- Sign of cracks in the welds.
- Sign of bowing or bending on beam end connector.
- Sign of corrosion.
- Impact damage to beams.
- Sign of separation of the welded sections.
- Check if the levels correspond to the SWL signage.

Base plates

- Visible damage to the base plate.
- Damaged floor fixings.
- Base plate is secured to frame correctly.
- For selective pallet racking to conform to AS 4084-2012, there must be 2 anchors securing the base plate to the concrete slab. Installations prior to the 2012 Standard may only have 1 fixing.



Levelling plates

- Do not exceed manufacturer's minimum stack height.
- Twisted and out of vertical stack.
- Missing.
- Steel.

Loose, missing or dislodged racking components

Loose, missing or dislodged racking components can cause major immediate risks with the structural integrity of the racking.

Frames

- All uprights are fixed to floor using the correct type floor anchors, for the application (2 floor anchors /base plate required if installed after 28/2/2012 ref AS 4084 2012).
- Signs of visible damage to the upright sections e.g. twisting of the upright; any sign of any tears or significant dents in the uprights – the frame should be unloaded and not put back into use until repairs have been completed.
- Signs of visible damage to the bracing sections.
- Rack protection is installed and is in a good state of repair.

Splices

- Fitted as per manufacturer's recommendations.
- Large gap (max. 2mm) between spliced sections of upright.
- Not spliced below the bottom beam level. (Preferable for lower upright height to be not less than 60% of overall height.)
- Number of splices in upright.
- The bottom part of the spliced upright must not be a lighter gauge than the top section.

Corrosion

Severely corroded components can fail without warning. At the first sign of corrosion an investigation should be carried out to determine the cause of the corrosion. Thin walled boxed beams could develop corrosion from the inside, and it may take considerable time before showing signs of any corrosive damage. A collapse could occur before showing signs of corrosion, therefore special care and consideration should be taken when assessing the risk. As a guide, blistering on the surface will indicate excessive corrosion is taking place internally.

Pallets

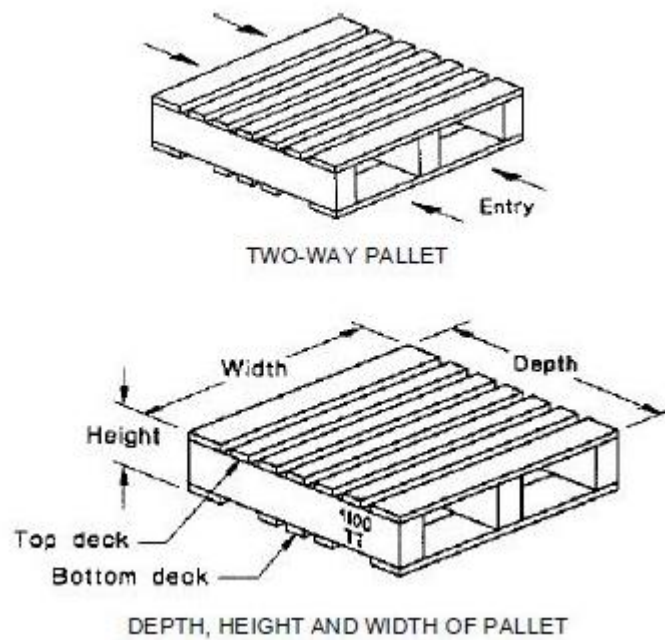
Pallets often get overlooked in the rack inspection process; however pallets can cause damage to the structure or mobile plant and cause serious injury to persons working in the vicinity.

- Pallet should be designed for the racking and lock into position (Australian Standard Pallet – CHEP type).
- All pallets should have front to rear bearers capable of supporting the loaded pallet – other styles of pallets require additional support (refer customer to manufacturer).
- Broken pallets should be removed from the racking – possibility of collapse.
- Oversized pallets should not be stored in a rack unless the rack has been designed for the pallet.
- Oversized pallets should not be stored in a standard double entry rack – possibility of interaction of pallets at the rear of the rack.
- Undersized pallets should not be stored in pallet racking – possibility that they can fall through the rack.
- Products should not protrude beyond the pallet unless the rack has been designed for this situation.
- Loose product stored on upper pallet levels should be secured to the pallet (strapped or wrapped as required) to prevent items falling from height.
- Safety mesh should be attached at full height to the rear of the rack structure where

single deep rack backs on to pedestrian walkways.

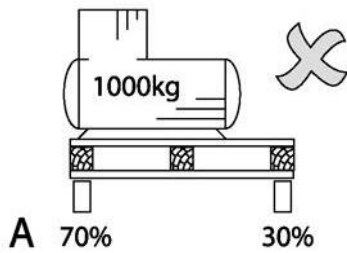
- Plastic pallets should not be used unless there is a locking mechanism to prevent the pallets sliding on the beams.

REF AS 4068-1993

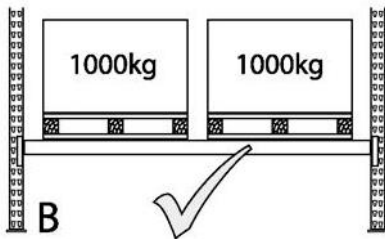


Pallets should conform with requirements of AS 4068-1993

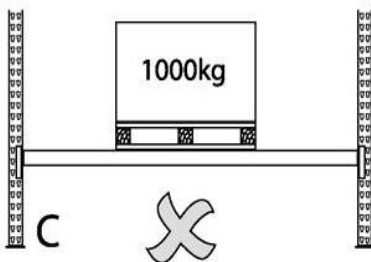
Correct placement of loads



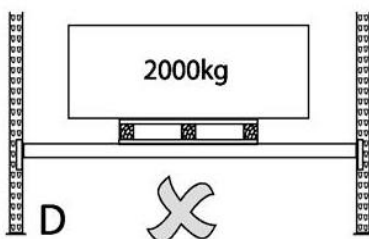
The load on the pallet must be evenly distributed across the whole area of the pallet to avoid any potential uneven loading of the rack between the front and rear beams.



The correct positioning of two 1000kg loads within a 2000kg compartment. This is an example of good loading practice where minimum clearances are being adhered to.



This is an example of a badly positioned pallet. Although this may not be an overload condition it does prevent the storage of a second pallet and is not good working practice.



This is an overload condition if the capacity per level is rated at 2000kg UDL. The illustration shows the central positioning of a single 2000kg pallet that will overload a pair of beams designed for two 1000kg pallets.

Unit load operating clearances

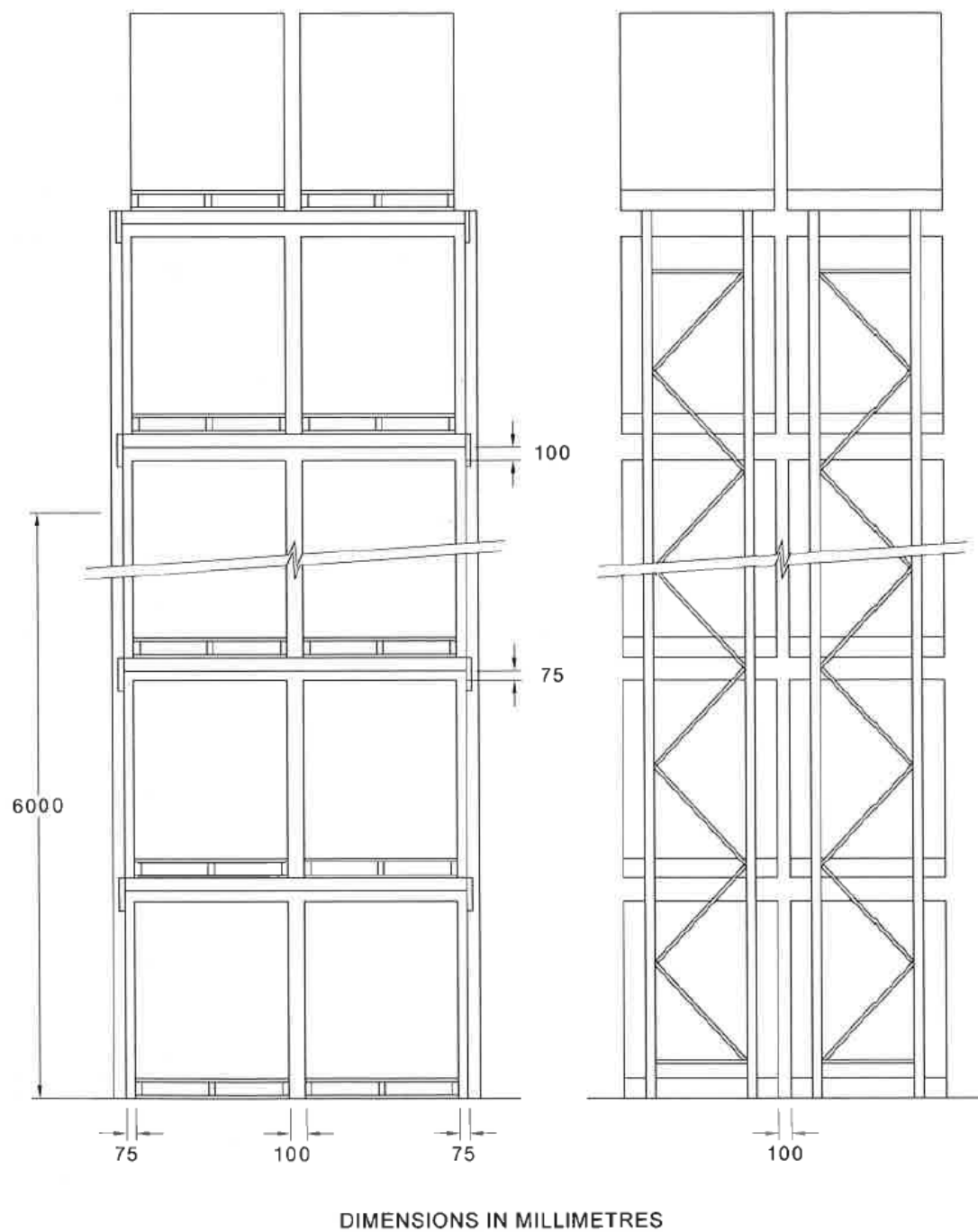


FIGURE 1.7.2 UNIT LOAD OPERATING CLEARANCES