

Key Requirement

**Managing
risk**

Stacking, Racking and Storage of Materials

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Purpose

The purpose of this Key Requirement is to set out Watercare's minimum controls to reduce the risks from stacking, racking and storing materials and to provide tools to enable managers and contractors to reduce these risks.

All Watercare's managers must ensure that work is planned according to these controls, as well as ensuring that the tools and resources are used and made available to workers. All Watercare's workers must ensure that they follow the processes and controls for stacking, racking and storing materials, including using all equipment as required.

Background

This Key Requirement applies to all Watercare's functions, operational workplaces and project sites and includes all workers (employees, contractors, subcontractors and agency labour hire personnel).

There is an enormous variety of storage systems and stacking methods in use today. Handling equipment is also diverse, ranging from hand trolleys through various types of forklift trucks to sophisticated warehouse robots.

There are six main reasons for a racking system failure, either acting singly or in combination:

1. design fault i.e. rack is inherently unsafe
2. installation fault
3. materials handling equipment failure
4. materials handling equipment operator error
5. supervision and control fault
6. store or warehouse structural fault

Incidents associated directly with pallets occur for five main reasons:

1. poor pallet design
2. poor pallet construction
3. use of an unsuitable pallet for the load or storage method
4. continued use of damaged pallet
5. handling errors

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Responsibilities

All workers	<ul style="list-style-type: none">• Attend training courses as required by Watercare or its contractors• Comply with the specified controls for stacking, racking and storing materials, as communicated in standard operating procedures, job safety analyses, and Tool box meetings• Use equipment according to manufacturer's directions and other risk controls imposed by Watercare
Supervisors	<ul style="list-style-type: none">• Monitor workers to ensure they understand and comply with the risk controls for stacking, racking and storing materials, as communicated in standard operating procedures, job safety analyses, and Tool box meetings
Tier 4 Managers	<ul style="list-style-type: none">• Ensure that workers are provided with appropriate equipment, that safe methods of work are planned, communicated and implemented and that workers have been trained and understand the use of this equipment• Monitor sites and projects to ensure that work is appropriately planned, that workers have adequate equipment and training and that work is being carried out in compliance with this Key Requirement
Tier 2 and Tier 3 Managers	<ul style="list-style-type: none">• Monitor sites and projects to ensure that this Key Requirement is understood by Tier 4 managers, supervisors and workers
Health and Safety Advisors	<ul style="list-style-type: none">• Assist Tier 4 managers to understand the controls in this Key Requirement• Monitor sites and projects to ensure that work is appropriately planned, that workers have adequate equipment and training and that work is being carried out in compliance with this Key Requirement
Health and Safety Manager	<ul style="list-style-type: none">• Monitor the implementation and effectiveness of this Key Requirement and report to the senior management health and safety committee• Recommend any further actions or changes to ensure adequate management of working at height
Chief Executive Officer	<ul style="list-style-type: none">• Review reports of the implementation and effectiveness of this Key Requirement and report to the Board

Planning

It is important to consider what storage is needed when planning the installation of racking. The design for racking will depend on a number of factors including:

- the types of material(s) being stored
- potential traffic flows and movements
- possible pedestrian impacts
- other health and safety impacts, such as lighting or other electrical clearances
- the shape of the materials concerned
- the shape of pallets or other storage platforms being used
- volume of material movements
- weight of materials to be stored
- any hazardous materials, which might have special storage needs
- the movement apparatus being used
- access
- the shape of the area concerned

The safe load for every floor should be known, and strict supervision should be exercised to prevent this limit being exceeded. As a general rule, a level floor is essential. However, where large stacks are regularly built, it is an advantage if the floor on the site for each stack is given a fall to the centre from all sides.

Timber, concrete or other surfacing may be required to support stored materials off the ground. Floors or surfaces required to support stacks, shelving, racks or other means of storage should be capable of sustaining the intended load together with shock loads.

If there is a possibility of the stored material becoming waterlogged, then allowance should be made for this extra weight. The supporting surface should also be strong enough to withstand the effects of any damage or deterioration of stored materials.

The design and installation should use all accepted or standard practices and or criteria. This includes racking materials, heights, clearances, vehicle movement areas and so on.

All pallet racking must be designed by a competent racking design engineer and will require building consent.

Stable construction of the stack is entirely dependent on the following factors:

- safe relation of height to dimension of base
- sound interlocking
- contents of the sacks or cartons
- compact construction and avoidance of transfer stress in any dunnage used for artificial bonding

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- the shape of articles
- the aggregate weight that articles in the lowest tier will need to support
- good placement of every component forming part of the stack, with special care taken to avoid overhang on any side or end of a stack intended to be vertical
- the quality of the bonding, stepping, tying or other method that forms the stack. The ratio of height to base dimensions should be proportioned correctly so that failure of part or whole of the stack does not occur

Experience has shown that the height to base ratio of an unsupported stack should not exceed 3:1. As most stacks are erected by visual alignment, a slight error in calculation near the base can easily result in a barely noticeable overhang, with a resultant loss of stability. However, where effective bonding can be achieved, and where there is a good frictional grip between the contacting surfaces, the ratio of height to base can safely be increased to 4:1.

Risk controls

The following risk controls must be used:

Prevention

Engineering controls

Racks, shelving, bins, hoppers and other structures must be designed adequately to support and contain the materials they are storing. Allowance should be made for the possibility of stored materials becoming waterlogged and for shock loads from placing materials or from accidental contact by handling equipment.

When partitions are used to increase storage capacity, or to separate stored materials, they must be designed adequately and be of sufficient strength to contain the stored material safely. Fire-protective partitions should be used between stored items of differing vulnerability to fire.

The corners or ends of shelving and racks should be protected by steel posts, angle irons or other means. Storage racks and shelves should be non-combustible and not prone to retain water.

Pallets should be of sound construction and be of adequate strength for the loads they are supporting. Where pallet loads are stacked tier on tier, the lower pallets should be of suitable strength and in good condition, and the unit loads must be able to support the weight above.

The stability of stacked pallets or unit loads should be maintained by suitable bonding, avoiding excessive stack heights, to ensure that the contents of any pallet or unit load cannot collapse. The stability and structural strength of each pallet or unit load should be assured by bonding, taping, shrink wrapping or other means.

When pallet or unit loads of cartons or sacks are stacked, care should be taken that they are not damaged by equipment.

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Stacks should not be built within 450 millimetres of a wall. Most building and party walls are not retaining walls and may not withstand the pressure set up by stacks laid against them. A 450-millimetre gap between the stack and the wall also enables the stacks to be checked.

Extra care should be taken if the storage area is subject to vibration from traffic outside or inside the premises.

Care should also be taken in stacking material in the vicinity of machinery or operations that cause vibrations. Some objects are liable to creep and lose stability under the influence of vibration. Stacks or bales made of synthetic materials are particularly susceptible, especially when first used.

Stacks, shelving and other fixtures for holding or storing materials should be laid out and designed so that there is sufficient access for safe loading and unloading by either manual or mechanical means.

Administrative controls

Installation is to be carried out by people who are suitably qualified, and a producer statement is to be provided by the installer to both the council and to Watercare's representative.

Storage areas should be designated specifically, be marked clearly and be in the charge of a responsible employee. Aisles should be marked clearly, be of ample width for the type of storage and be kept free from obstacles and waste materials.

Stacks should not block gangways, aisles, walkways, thoroughfares, firefighting equipment, and particularly, doors and exits.

Stacks should have clear spaces of at least 1 metre on all sides, apart from walls where a 450 millimetre space should be allowed. Goods must not be stacked within 1 metre of the ceiling, roof or sprinkler heads. Base areas and heights of stacks should be kept as small as circumstances permit. Goods should be kept well clear of light fittings, heating pipes and appliances, firefighting and alarm equipment and doors.

No stack, shelving, fixture or other means of storage should be placed in a position, or extended in height, so that a person climbing onto it or removing stored goods, either manually or mechanically, can come into contact with live electrical wiring or unfenced machinery.

No material should be loaded or unloaded from stacks, shelving or fixtures if there is a risk of workers directly or indirectly contacting unfenced machinery, or touching live electrical wiring, until that machinery or wiring is isolated or made safe.

Pallets or other supports used for forming unit loads should regularly be inspected for damage and wear. Items that could cause damage should be taken out of use and repaired or destroyed.

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Where un-palletised material, which is otherwise secure, is handled by a crane or forklift, it should be placed on battens or other devices to aid the use of slings or forks.

Suitable means should be used to protect workers from injury due to sharp corners, projections or edges. Corners of stored material should be marked clearly.

Safe access, by means of ladders, platforms or walkways, must be provided for workers required to climb or remove goods from stacks, shelves and fixtures. On occasion, it may be necessary to erect scaffolding. Safety belts should be used when dealing with high stacks and awkward shapes.

Racking

To ensure that personnel are not harmed and equipment is not damaged, the following rules must be adhered to when using racking:

- the maximum limits indicated on the racking must not be exceeded
- the load weight must be established before storing onto racking
- the beam connector locks on adjustable racking must be fixed securely at each end of the beam
- pallets and crates must be in good condition and be of an appropriate size to allow safe and stable storage in the racking
- unstable loads must be secured with strapping, plastic wrap or some other method if appropriate
- racking must not be modified or have components removed unless done with the consultation of a suitably qualified worker

Formal monthly inspections of racking are to be carried out by a designated worker and should include the removal of equipment from random bays to allow a more in-depth inspection. Yearly or half-yearly checks of racking are to be carried out by a technically competent worker.

Forklift Operations

Forklifts must be operated by qualified and authorised workers.

Forklifts must be fitted with horns, lights and reverse warnings. Forklifts must be in safe working condition. They must be serviced as per the manufacturer's recommendations. Daily visual checks and weekly formal checks are to be carried out by a competent worker. Operators must report all damage as it occurs or when it is noticed.

The pallet weights lifted must not exceed the maximum weight that the forklift is designed to lift.

Other workers must stand at a safe distance (minimum 2 metres with no load or load height distance with load) from the forklift.

Bagged goods

The first tier should be so arranged that the bags can be spread flat, and the same should be done in succeeding tiers. Interlocking should be used if possible. Where possible, the mouths of the bags should be on the inside of the stack.

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Bagged material of differing sizes and shapes should not be stacked on top of each other unless proper precautions are taken to prevent movement by settling or vibration.

Pallets with spacers or some form of horizontal bonding should be used if there is a risk of movement or if they are to be stacked high.

Special precautions should be taken with synthetic bags or sacks, which have a tendency to slip.

Cartons

Careful consideration should be given to the weight of stacks of cartons. Dampness will reduce the strength of cartons, and a damp flow may well lead to damage of the lowest tier and ultimate collapse of the stack. Interlocking (e.g. the bricklaying method) can be used in stacking cartons.

Cases and boxes

As most boxes are reinforced with external battens, workers need to ensure the battens bear the weight, not the box.

Drums, casks and cylinders

Drums, casks and cylinders may be stacked on their sides or ends, unless specifically required to stand upright by their manufacturer or supplier, e.g. acetylene cylinders. If items are stacked on their sides, wedges should be fixed at the ends of each row to prevent movement.

Sheet materials

Sheet materials, including glass, may be stacked flat or on its edge. Sharp edges should be protected to prevent injury to workers and passers-by. The supports used in edge-on stacking must be of adequate strength to bear the side thrust of the vertical sheets.

Extra care should be taken when stacking and handling glass. Owing to the weight of metal and glass sheet in bulk, care should be taken not to overload racks and the floor.

Steel tubes, bars and joist sections

Suitable racks should be provided for steel tubes, bars, joist sections and similar materials. Large-diameter tubes or pipes can be stacked on their sides, as for drums.

Wedges, chocks, stakes or other means should be used to prevent the bottom tier from rolling or moving.

Where successive tiers rest on battens, planks or other flat surfaces, they should be restrained from moving by wedges secured to the battens or planks.

Material should always be removed from the top of the stack or from the top tier first.

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De-stacking

Most incidents involving the collapse of stacked materials occur during de-stacking. The prime cause of this is haphazard removal. Basic rules for breaking down stacks are:

- one worker only should be responsible for the way the stack is reduced
- if the worker in charge of de-stacking had no part in erecting the stack, he or she should find out how it was constructed before work begins
- the stack should be taken down tier by tier, so that no part is in danger, as would happen if the stack were bitten into locally
- when a large stack has been given a natural fence by building the periphery higher than the centre, this fence should be maintained during de-stacking. The work should be done from the centre, reducing the periphery last so that there is a barricade to prevent people falling off
- if tubular or other fencing has been built in or around the stack, it should be dismantled and adjusted as the height is decreased

As there is a high tripping hazard in the working area of a stack, tidiness and systematic work methods are essential. People working on stacks must be clear of overhead travelling cranes. Proper signalling arrangements should be made and a lookout should be posted.

All stacking and de-stacking should be carried out under competent supervision.

Racking must have the "maximum load" clearly labelled on each aisle-facing beam.



Appropriate safety signage must be displayed clearly.

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Storage inspections

All materials held in storage should be inspected to determine whether they are susceptible to damage, heating, deterioration, swelling, shrinking, corrosion or attack by insects or rodents. The frequency of inspection will depend on the type and method of storage. Where these conditions are evident and could cause loss of stability, collapse, fire or any other harmful effect, action should be taken to eliminate the hazard.

Incoming goods should carefully be inspected for damage before being placed in store.

Racks, shelving, fixtures and other equipment used for storing, loading and unloading materials should regularly be inspected for damage and other defects which might cause loss of strength or might result in damage or injury.

Any damaged or defective equipment should be taken out of service until repaired. It may be necessary to fence off or isolate such equipment. Electrical equipment and fittings should also be inspected and tested regularly.

All fire protection equipment, including fire doors and partitions, should be inspected, tested regularly and be maintained in good working order. Fire doors should be kept closed at all times unless required to be opened for the movement of goods.

Any repair, maintenance or alteration work carried out in storage areas should be supervised closely, to ensure the safety of workers and other people on the premises.

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Materials-handling equipment

Equipment such as trolleys, hand trucks, pallet trucks, chain blocks and slings used for moving and handling materials should be kept in safe and serviceable condition. They should be free of cracks or other defects, which could cause failure of the equipment or injury to employees. Such equipment should be used only for the purpose for which it was designed.

Mechanical equipment such as cranes, hoists, scoops, stackers, forklifts and ladders used in stacking, moving or loading materials should be kept in a safe and serviceable condition and should regularly be inspected and maintained. Materials-handling equipment should be used only for the purposes for which it was designed and should not be operated on steep or rough surfaces, which could result in an accident.

No worker should ride on equipment used for the moving, handling or storage of material unless it has been designed for the purpose.

All equipment should be operated in a safe and efficient manner and should not be loaded beyond the capacity for which it was designed.

Materials-handling equipment is susceptible to fire from friction generated by accumulations of grease and dirt. Fires involving forklifts can be caused by equipment failure due to lack of maintenance. All such equipment should be inspected regularly and be maintained in good working order. A system of regularly scheduled maintenance based on engine-hour or motor-hour use is recommended.

Safe movement

Goods must be stacked to prevent movement during transportation and be secured so that they will not fall off when corners or inclines are being negotiated.

Precautions must be taken to protect workers in the storage area from moving vehicles. If necessary, a worker should be designated to direct traffic in the storage yard or area.

Special care must be taken in handling and transporting flammable liquids. These should not be stored at an unsafe height.

Housekeeping

Waste should not be allowed to accumulate. A regular and frequent waste removal and cleaning process should be adopted. Storage areas should be kept clean and should be free from all refuse and incorrectly stored materials.

Fire exits must never be blocked.

Lighting

Sufficient and suitable lighting, whether natural or artificial, must be provided wherever workers will operate or pass by. This includes outside yards and storage areas. Lighting should ensure that dark shadows or glare is avoided on the working area of stacks and storage fixtures. Lighting can be supplemented by painting appropriate surfaces white or off-white.

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Appendix A: Definitions

Workers involved in the storage, stacking, loading and unloading of materials must be trained to carry out their tasks safely and efficiently. They should be made aware of the nature of the goods stored, the hazards involved, the precautions to be taken, the protective clothing and equipment to be worn, and action to be taken in emergencies.

Terminology	Description
Block stacking The correct method of dealing with breakages or spillages and neutralising hazardous chemicals and substances should also be explained.	Equipment used for special training for the particular types of equipment used (a flat floor) and stacked on top of one another in blocks
Dunnage Fire safety, including the use of firefighting equipment, should be part of all training.	Loose wood, matting or similar material used to keep a load in position during racking
Dynamic load	An external review of all Watercare's racking systems should be undertaken every 10 years. The weight that is placed on an object and then put in motion (For example, a pallet rated for a 'dynamic load' of 1,000 kilograms means you can put up to 1,000 kilograms of an evenly distributed product on the pallet. Then the pallet could be placed on a conveyor system or be moved around a warehouse by a forklift.)
Racking load Administrative controls	The strength load rating for when a pallet is placed in a racked system – however, racking load should always be taken as an estimation as warehouse racking systems can vary
Fire Safety Static load	A non-varying load; when weight is placed on an object that is kept at rest (An example of a static load would be a set of pallets that is stacked three pallets high. If each pallet has 500 kilograms on it, then the bottom pallet would have a grand total of 1,500 kilograms. A static load rating refers to a pallet's load rating while the pallet is at rest. This case the bottom pallet should be large enough to completely cover the goods the pallets on top are not being subjected to lower stress, such as a forklift the bottom part of the goods, the sewn edges of the sacks, bags may become scorched. Fires have occurred when the sacks are placed in the store while smouldering.

There should be no plant or production processes, such as carton assembly, in storage rooms unless the area is designed for the purpose and the necessary precautions taken. Vehicles should not be garaged or refuelled close to stored material.

An inventory of all goods held in store should be kept and maintained daily, especially for hazardous chemicals and substances and flammable goods. The local fire brigade should be advised of the quantity and type of goods stored that could present an immediate danger to health. Large movements of such goods, inwards or outwards, should be notified to the local fire brigade immediately.

Bulk storage of combustibles should be sited to minimise the risk of fire occurring within the stack or spreading from adjacent areas. In general, stacks should be at least 2 metres clear of perimeter boundaries and be divided by cleared gangways of at least 1 metre. These clearances may need to be extended for stacks of readily combustible materials.

Smoking should not be allowed within 6 metres of stacks. Incinerators should be sited well clear of the storage area and combustible materials.

Undergrowth around outdoor stacks should be kept down.
If the type of emergency is known, managers and emergency services shall be notified of the situation and appropriate assistance dispatched. If an emergency situation is unable to be confirmed, managers should be sent to investigate in the first instance if possible, or alternatively, emergency services called.

Appendix B: References

SafeWork NSW (2017) Pallet Racking Fact Sheet. <http://www.safework.nsw.gov.au/media/publications/health-and-safety/pallet-racking-guide>

WorkSafe (1999) Safe Stacking and Storage. <http://www.worksafe.govt.nz/worksafe/information-guidance/all-guidance-items/safe-stacking-and-storage/safestacking.pdf>