

# Safe Stacking and Storage

# ARCHIVE

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## Introduction and Scope

Whatever the nature of your business, it is likely to involve the stacking and storage of goods and materials. Every year accidents occur while goods are being stacked or destacked and put into or taken out of storage. Many of these accidents are serious—some are fatal.

This booklet is designed to help employers and employees to develop safe and effective methods for stacking and storage and so meet their obligations under health and safety legislation.

There is an enormous variety of storage systems and stacking methods in use today. Materials handling equipment, too, is extremely diverse, ranging from hand trolleys through various types of forklift truck to sophisticated warehouse robots.

Obviously, this booklet cannot deal with all these in detail. However, it does set out the general requirements and principles for safe stacking and storage which apply

irrespective of the particular systems used.

The advice in this booklet is intended to cover all types of goods and materials, with the exception of timber and loose bulk materials such as sand or grain, which are the subject of separate publications issued by the Department of Labour. Also, it does not cover the storage of dangerous goods and explosives which are subject to:

- The Dangerous Goods Act 1974
- The Dangerous Goods Regulations 1958
- The Dangerous Goods Class 2 Gases Regulations 1980
- The Explosives Act 1957
- The Explosives Regulations 1959.

Advice on the legislative provisions covering these goods can be obtained from the Occupational Safety and Health Service.

Dangerous substances not falling within the above legislation, should be stored in accordance with these guidelines.



Platform truck



Hand truck

# A Safe Work System

**E**mployers must take all reasonable steps to ensure that all goods, materials, substances and equipment in workplaces are so stacked, stored, secured, and kept that they do not constitute a danger to persons in their vicinity during the course of daily operations and in an earthquake.

Such steps should ensure these items cannot, whether of their own accord, or by virtue of any external force (intentionally applied or otherwise), so flow, move, roll, or collapse, as to constitute a danger to persons in their vicinity.

All workers who are or may be responsible for stacking, storing, securing, or keeping any goods, materials, substances, or equipment require full training in safe methods of doing so.

Given the great diversity of goods and materials to be stored, and the wide range of storage methods and handling equipment in use, how can these obligations best be met?

The answer lies in developing a safe system of work that will integrate the three main components of people, materials and machinery within a safe and healthy working environment. We shall look at each of these in turn.

## PEOPLE

People, of course, are the critical factor. In safety and health we are looking mainly at injury and damage to people (concepts of loss control and risk management are not forgotten). Also, it is largely people who perpetrate such injury and damage.

A safe work system relies on:

- (a) Adequate training and instruction for all the workforce;
- (b) Comprehensive planning, incorporating the views and opinions of those who will operate the systems whenever possible;
- (c) Adequate supervision and control; and
- (d) Adequate information to enable the workforce to carry out their tasks in a safe and healthy manner.

One way of covering the above is to determine the important criteria for safety and to set specific parameters which may be used, such as planning, the provision of information, training and instruction, and to set the framework for supervision and control.

## MATERIALS

The basic materials handling and storage systems common to a wide range of stores and warehouses are pallets and racking systems.

Accidents associated directly with pallets occur for five main reasons:

- (a) Poor pallet design;
- (b) Poor pallet construction;
- (c) Use of an unsuitable pallet for the load or storage method;
- (d) Continued use of damaged pallet; and
- (e) Bad handling.

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

- (a) Design fault i.e. rack is inherently unsafe;
- (b) Installation fault;
- (c) Materials handling equipment fault;
- (d) Materials handling equipment operator fault;
- (e) Supervision and control fault; and
- (f) Store or warehouse structural fault.

### EQUIPMENT

Because of the bewildering range of equipment available in an increasingly competitive market, it is better to simplify the reasons for failure. Basically, accidents occur because of the wrong equipment

being used in the wrong place by the wrong people.

### ENVIRONMENT

The essential need is to incorporate environmental considerations such as heating, lighting and ventilation into the overall work system.

### CODE OF PRACTICE

Not all recommendations for safe stacking and storage in this booklet may be relevant to your workplace. And, there may be special conditions or requirements in your workplace that this booklet does not cover in detail. It is recommended that companies prepare their own in-house code of practice for stacking and storage, taking into account the particular materials handling and storage systems in use.

## *Floors and Supporting Surfaces*

**T**he 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 through rain or after extinguishing a fire, due allowance should be made for this extra weight. The supporting surface should also be sufficiently strong to withstand the effects of any damage to or deterioration of stored materials.

## Stock Holding Structures

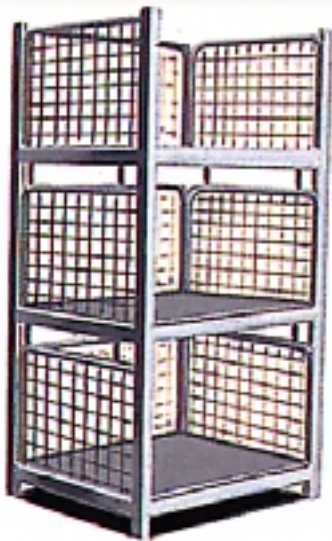
**R**acks, shelving, bins, hoppers and other structures for the storage of materials should be adequately designed to support and contain the materials for which they are used. Allowance should be made for the possibility of stored materials becoming waterlogged, and for shock loads from placing materials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

When partitions are used to increase storage capacity, or to

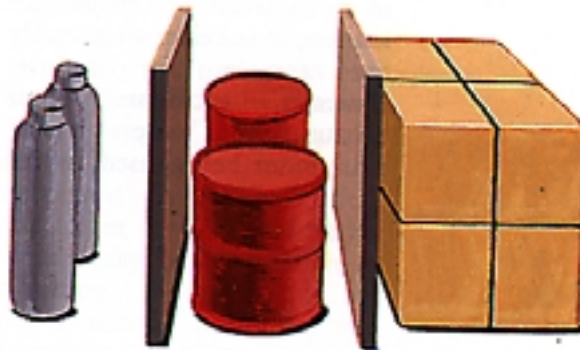
separate stored materials, they should be adequately designed and be of sufficient strength to contain the stored material safely.

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 from damage by forklift trucks or mechanised equipment by steel posts, angle irons or other means.



Storage bin



Fire-protective partitions

## Pallet Construction and Loading

**P**allets should be of sound construction, and be of adequate strength for the loads and conditions under which they are used. 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.



Pallet



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.

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

Reference should be made to NZS 2010: 1970 *Specification for flat pallets for materials handling*.

## Positioning of Stacks

Stacks should not be built within 450 mm 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 mm gap between the stack and the wall also enables the construction and the condition of stacks to be checked.

Stacks should not be created where any part will be within 1.5 m of a rail track. This clearance should be continued all the way along the stack.

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



Access for loading



Care should also be taken in stacking material in the vicinity of machinery or operations which cause vibrations. Some objects are liable to creep and lose stability under the influence of vibration. Sacks or bales made of synthetic materials are particularly susceptible, especially when first used. (Impregnation with wax can help to overcome this problem.)

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

Storage areas should be specifically designated, be clearly marked, and be in the charge of a responsible employee. Aisles should be clearly marked, be of ample width for the type of storage, and be kept free from obstacles and waste materials. Stacks should not be created which will block gangways, aisles, walkways, thoroughfares, and

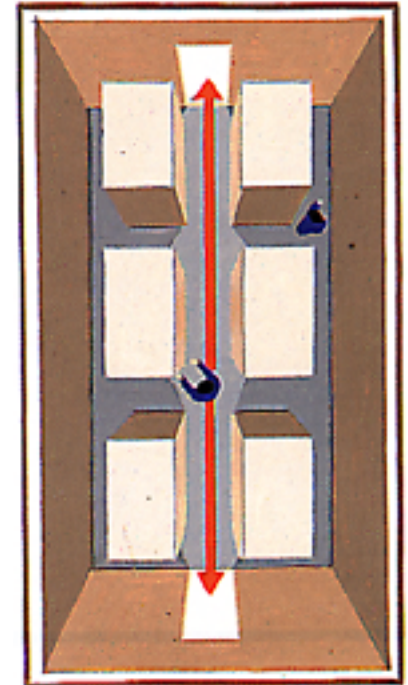
particularly doors and exits.

Stacks should have clear spaces of at least 1 m on all sides, apart from walls, where a 450 mm space should be allowed. Goods must not be stacked within 1 m of the ceiling, roof or sprinkler heads.

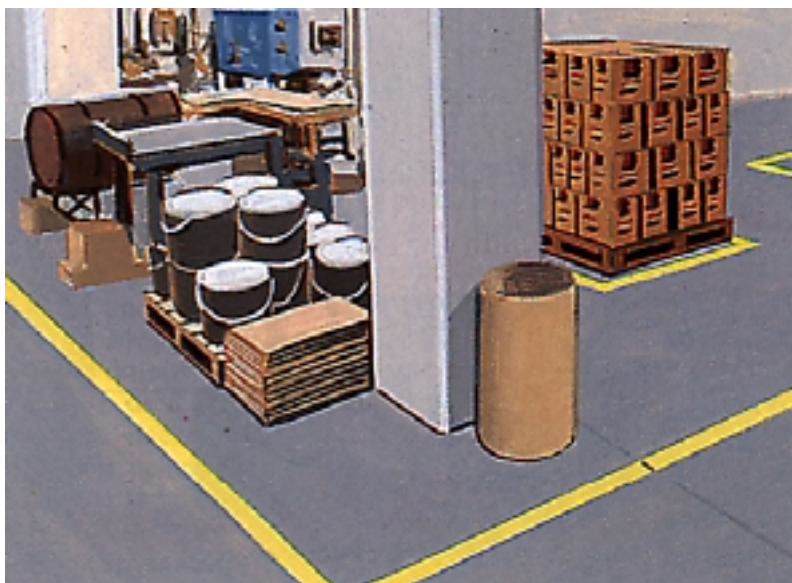
Base areas and heights of stacks should be kept as small as circumstances permit. Goods should be kept well clear of light fittings, heating pipes and appliances, firefighting and alarm equipment, and doors.

No stack, shelving, fixture or other means of storage should be placed in a position, or extended in height, so that a person climbing on to 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



Clearways in a store: exits are sited at each end



Lane and aisle markings

machinery or wiring is isolated or made safe.

Storage racks and shelves should preferably be non-combustible and not prone to retain water.

Where unpalletised material, which is otherwise secure, is handled by a crane or forklift truck, 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 on structures and/or stored material. Corners of stored material should be clearly marked.

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 occasions, it may be necessary to erect scaffolding.

Safety belts are useful aids when dealing with high stacks and awkward shapes.

Work platforms used in conjunction with forklift trucks to elevate workers should be designed and constructed in accordance with NZS 5426: 1980 Part 1 *Work platforms—low-lift and high-lift trucks*.

Markings on labels and signs for the identification and selection of materials and goods should be clear and easy to read.

## Size and Shape of Stacks

The size and shape of a stack depends on the storage space available and on the size, shape, bulk, weight, rigidity or fragility of the articles to be stored.

The following are the commonest forms of stack:

**Column**—Single articles placed one above the other.

**Square**—Any stack, other than a column, with all sides vertical. (Note the stack does not have to be ‘square’ in the ordinary sense of the word.)

**Pyramid**—A stack in which the plan area is reduced in every succeeding tier.

**Stepped**—Stacks with two or more adjacent tiers of the same area and each succeeding group of tiers of a smaller area than the group on which it is set.

**Triangular**—Stacks in pyramid or stepped form on two



Column stack



Square stack



Pyramid stack

opposite sides, the other two sides being vertical.

**Lean-to—Pyramid** or stepped on one side and vertical on the other three sides. (Note the term does not mean that the stack actually leans against a support.)

It is important to remember that the aggregate weight of the stack is borne by the lowest tier, which, of

course should be strong enough to bear the superimposed load.

Untidy stacks offend the eye and are rarely safe by construction, since it is usually bad methods of construction that cause the untidiness.

If a stack appears to be unstable, it should be immediately broken down and rebuilt properly.



Stepped stack



Triangular stack



Lean-to stack

## *Stability and Bonding of Stacks*

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

- Safe relation of height to dimension of base;
- Sound interlocking of the goods;
- Contents of the sacks or cartons;
- Compact construction and avoidance of transfer stress in any dunnage used for artificial bonding;
- Shape of articles e.g. meat carcasses;
- Determination of the aggregate weight to be borne by the components in the lowest tier of the stack;
- Good placing 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.

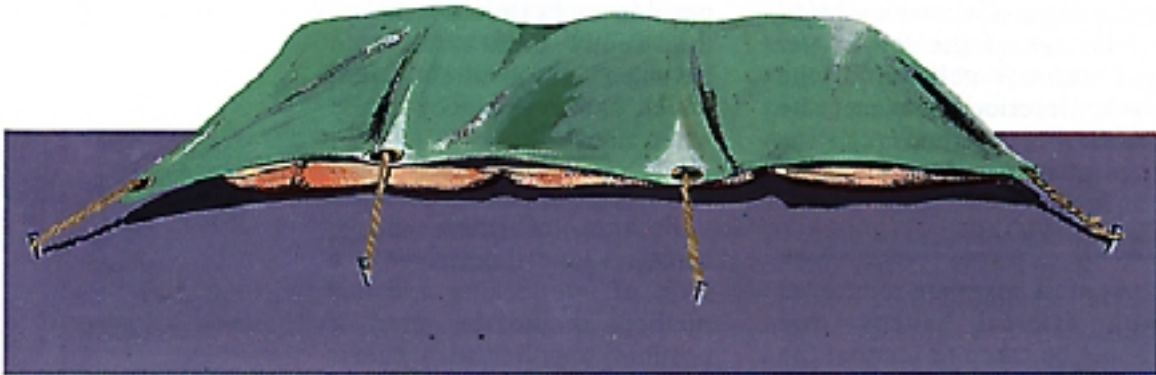
Resistance to collapse, strength and the stability of stacks should be maintained by bonding, stepping, tying or other means. The ratio of height to base dimensions of large stacks should be correctly proportioned so that failure of part or whole of the stack does not occur.

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 be safely increased to 4:1.

The shape of goods or packages to be stacked will have a great bearing on the type of bonding used. When one dimension is appreciably greater than the other two, it will be possible to use natural bonding, i.e. to secure stability by interlocking the articles themselves. In other circumstances it will be necessary to introduce other materials (e.g. canvas sheets, battens, piling sticks, etc.) to prevent movement of the articles stacked: this is known as artificial bonding.

Outdoor stacks are affected by weather conditions such as rain, wind, frost and sun. These conditions can greatly influence the stability of stacks over time and should be taken into consideration.

Materials which could be dislodged or blown off the top of a stack under windy conditions should be tied down or otherwise restrained. If tarpaulins are used to secure or protect the stacks, they should be fastened to independent anchorage, not to the stack itself.



An outdoor stack secured by tarpaulins

## *Stacking Different Types of Goods*

### ***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.

Bagged material of differing sizes and shapes (e.g. seeds, granules, pellets etc.) 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 such movement or if it is intended or necessary to stack high.

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





Stacking bagged goods

## 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 (BOXES)

As most boxes are reinforced with external battens, care should be taken to see that the battens bear the weight, not the box.

## BALES

Bales should be stacked with care to ensure their stability. Attention should be paid to possible vibration, and if possible stacks should lean into their centre. Extra care should be taken with synthetic bales, which have a tendency to slip when new.

## FROZEN CARCASSES

Because of their shape, carcasses lend themselves to a form of interlocking and this method should be used if possible, together with pallets with spacers or some



Frozen meat store

form of horizontal bonding. A suitable type of mesh netting can be used to retain carcasses on pallets if necessary, provided it meets hygiene requirements.

## ***COILED WIRE***

Coiled wire may be stacked horizontally or vertically. Wedges or other supports must be used to prevent the stack from spreading.

## ***GLASS BOTTLES AND JARS***

Care should be taken stacking bottles and jars, whether full or empty. Small quantities can be laid on their sides on top of each other, using wedges as necessary. Otherwise they should be stacked in cases, boxes, cartons or racks designed to hold them.

If pallets are used, spacers or some form of horizontal bonding should be incorporated. The overall weight of stacks should not be borne by the glass itself.

## ***DRUMS, CASKS AND CYLINDERS***

Drums, casks and cylinders may be stacked on their sides or ends unless specifically required to stand

upright on instructions from their manufacturer or supplier, e.g. acetylene cylinders. If stacked on their sides, wedges should be fixed at the ends of each row to prevent movement.

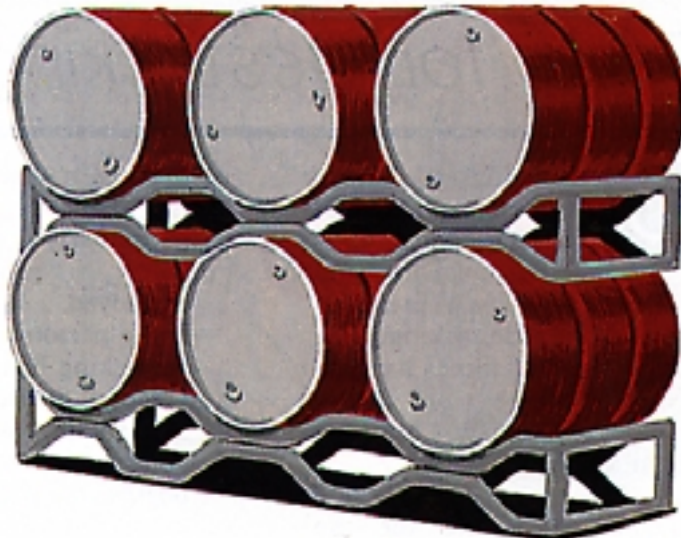
If gas cylinders are stored on end, restraining chains should be fitted to prevent them toppling. The valves of gas cylinders under pressure must always be protected.

Power-operated clamps on forklift trucks enable cylindrical objects such as cable drums or pipes to be stacked on end, allowing greater economy of space and greater stability.

## ***SHEET MATERIALS***

Sheet materials, including glass, may be stacked flat or on 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.



Drum rack

**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.

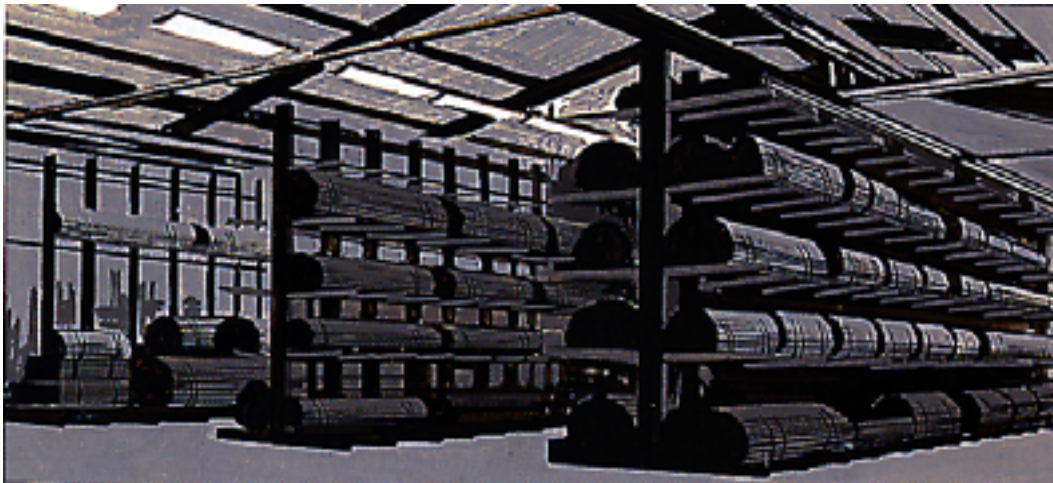
Wedges, chocks, stakes or other means should be used to restrain the bottom tier of round objects which are stacked or tiered and which could cause the stack to collapse by rolling or moving.

Where successive tiers are not nested but rest on battens, planks or other flat surfaces, they should be restrained from moving by wedges secured to the battens or planks.



Pipe storage

Where the collapse of a stack or tiers of round objects could cause damage or injury, material to be removed should always be taken from the top of the stack or from the top tier first.



Steel storage

*Rules for Destacking*

**D**estacking is largely the reverse process of stacking. Most accidents involving the collapse of stacked materials occur during destacking. The prime cause of this is haphazard removal.

Basic rules for breaking down stacks are:

- One person only should be responsible for the manner in

which the stack is reduced. This is particularly important where gangs are employed.

- If the person in charge of destacking had no part in erecting the stack, he or she should ascertain its construction before work begins.



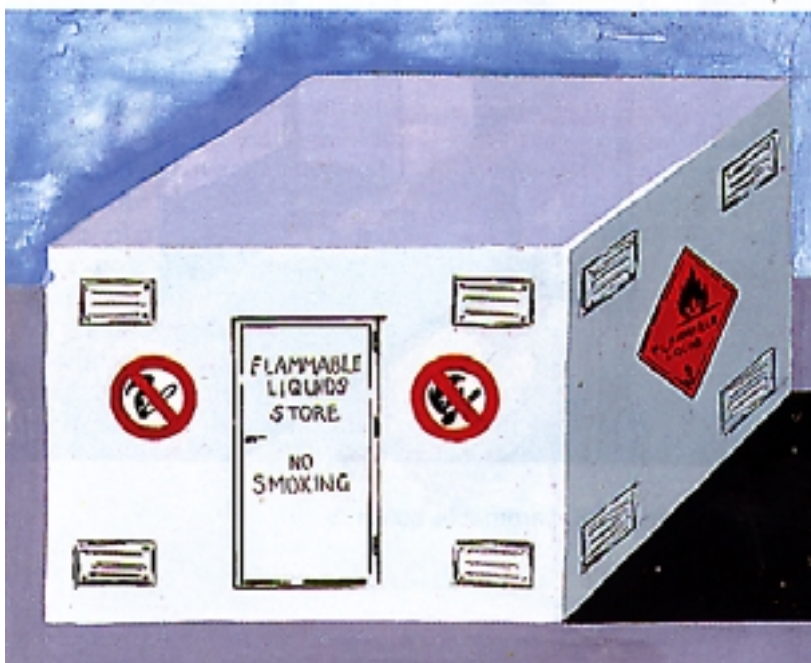
- The stack should be taken down tier by tier, so that no part is in danger, as would happen if the stack were bitten into locally.
- When a large stack has been given a natural fence by building the periphery higher than the centre, this fence should be maintained during destacking. The work should be done outward 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.
  - Care should be taken to ensure that people working on stacks are at all times clear of overhead travelling cranes. Proper signalling arrangements should be made and a lookout should be posted.
  - All stacking and destacking should be carried out under competent supervision.

## *Segregation of Stock*

**F**lammable liquids, gas cylinders, aerosols, materials liable to spontaneous combustion and hazardous chemicals should not be

stored in the same area as other goods.

Chemicals liable to react with each other or other materials should



Flammable liquid storage

not be stored together unless adequately protected from contacting each other, either directly or by spillage. (The chart in Appendix 1 gives a guide to chemicals which should not normally be stored together.)

Acids should not be stored in plastic containers for long periods or in direct sunlight.

Flammable liquids in drums, cans or similar containers should be stored separately in a separate area or building constructed for the purpose. Similar provision is recommended when storing toxic or poisonous chemicals or substances.

The storage area or building should be signposted to indicate that it contains flammable or hazardous chemical materials and that smoking and naked flames are prohibited.

Electrical equipment used in or

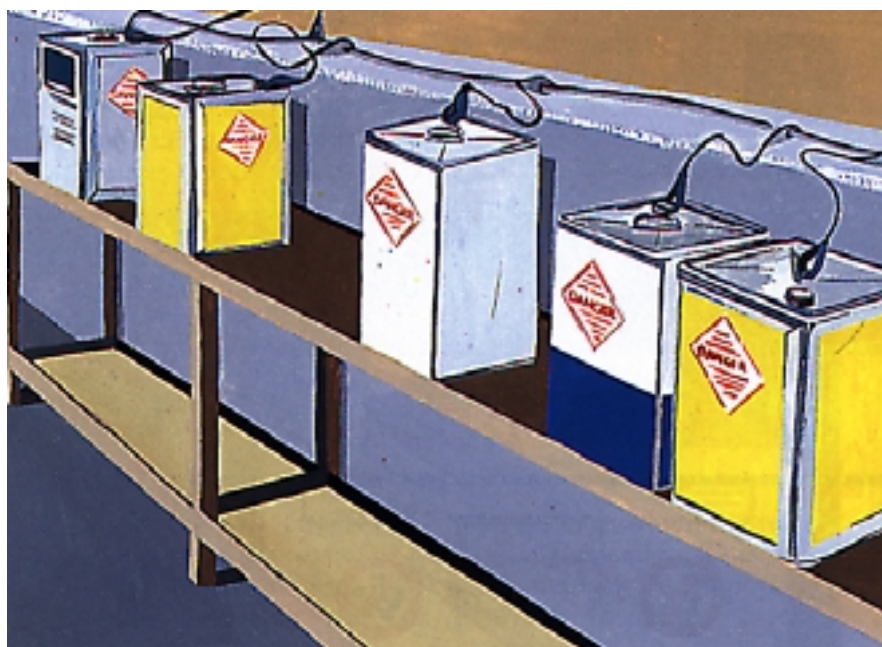
around the storage area or building should be suitably explosion-protected, and protective equipment should be provided nearby for use in emergencies.

Workers handling corrosive or hazardous chemicals should be provided with suitable protective clothing, or other necessary safeguards.

Liquefied and compressed gas cylinders should be stored in well ventilated areas, out of direct sunlight and well away from possible sources of ignition, especially electrical fittings or fuse boxes.

All containers, drums and cans should be clearly labelled with their contents.

Earthing or bonding should be used to eliminate the possible build-up of static electricity.



Earthed containers for storing flammable solvents

## Fire Safety

**F**ire instruction notices should be prominently displayed in all storage areas. Workers should be thoroughly trained in the operation of the fire alarms to prevent delays in evacuating the premises and calling the fire brigade in the event of a fire. They should also be trained to operate firefighting equipment to deal with small fires.

A 'No Smoking' rule should be strictly enforced in all storage areas.

If a shrink-wrapping operation is used, it is important to train operators to ensure that the plastic shroud is cut large enough to completely cover the goods during the shrinkage process. If the plastic shroud shrinks and exposes the bottom part of the goods, the sewn edges of the sacks or 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 any 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 goods and quantities stored at least on a weekly basis. Large movements

of such goods, inwards or outwards, should be notified to the local fire brigade immediately.

Bulk storage of combustibles should be sited so as to, minimise the risk of fire occurring within the stack or spreading from adjacent areas. In general, stacks should be at least 2 m clear of perimeter boundaries and be divided by cleared

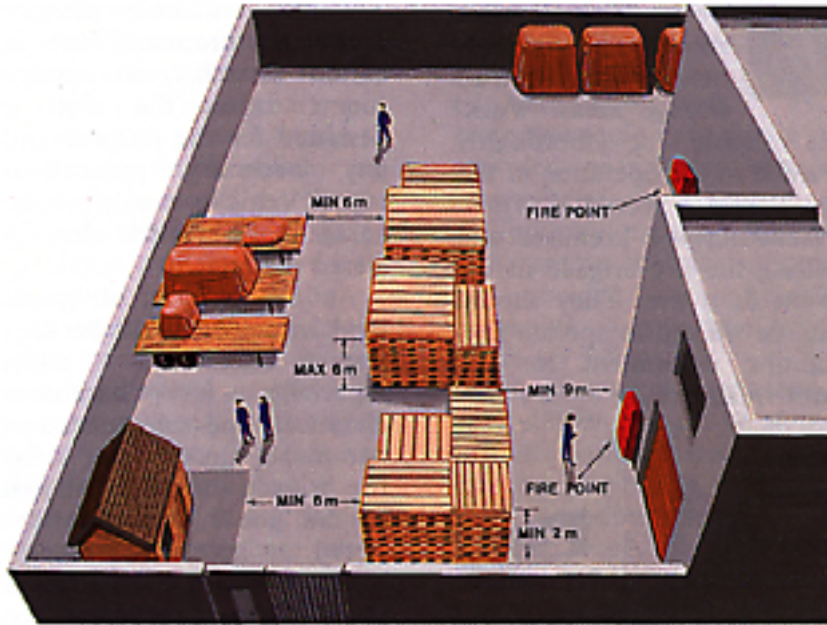


Fire-fighting equipment and emergency route sign

gangways of at least 1 m. These clearances may need to be extended for stacks of readily combustible materials.

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

Undergrowth around outdoor stacks should be kept down, although never by burning or by using weed killers which aid combustion (e.g. sodium chlorate).



Outdoor storage area showing minimum distances for storing items vulnerable to fire

## *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 be carefully inspected for damage of any kind before being placed in store.

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

Any damaged or defective

equipment should be taken out of service until repaired. Fencing off or isolation of such equipment may be necessary to prevent its use. 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 closely supervised to ensure the safety of workers and other people on the premises.

Use of equipment likely to give rise to a fire hazard should be closely monitored, and the use of a hot work permit system is recommended.



# Materials Handling Equipment



Block and tackle

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

Mechanical equipment such as cranes, hoists, scoops, stackers, forklift trucks and ladders used in stacking, moving or loading materials should be kept in a safe and serviceable condition, and should be regularly 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 heat generated by accumulations of grease and dirt. Fires involving forklift trucks can be caused by equipment failure due to lack of maintenance.



Platform truck



Drum-handling truck



Bag truck



Hoist



Dolly

All such equipment should be inspected regularly and maintained in good working order. A system of regularly scheduled maintenance based on engine-hour or motor-hour use is recommended.



Forklift truck:

## *Safe Stock Movement*

**G**oods 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 responsible employee should be designated to direct traffic in the storage yard or area.

Good lighting is essential, and the wearing of reflective clothing will increase safety.

Forklift trucks should be fitted with horns and lights and these should be used, especially when reversing.

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

## Automated Storage

Where automated, computer or remote controls are used for racking, selection of materials or other stores functions, care should be taken that workers or other people in the area are not exposed to risk of injury through the operation of equipment.

Automated storage equipment is designed for machine access, which can create hazardous areas between moving equipment and fixed installations. Non-essential people should therefore be kept away from operating areas.

Automated equipment should be isolated, or manual control applied, before attempting to rectify faults, particularly if parts of the equipment are extended.

A means of access or egress from extended equipment must be provided to eliminate the need to escape through any racking system installed.

Controls should be such that, when switched from the disconnected “off” mode back to automatic, the previous cycle is unable to continue until a reset control has been operated.

Access to racks from other than the operating side should be prevented unless complete safety is assured.

Conveyors and elevators should be properly guarded and be capable of being isolated from automatic control.

## Housekeeping

Waste should not be allowed to accumulate. A regular and frequent waste removal and cleaning procedure should be adopted.

Storage areas should be kept clean and 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 in every part of an undertaking where workers are employed or pass. This includes outside yards and storage areas. Lighting in these areas should be such 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.

Appropriate lighting standards can be found in NZS 6703:1984 *Interior Lighting design*.

## Noise

Employers are required to take all practicable steps to protect workers from harmful noise, either by controlling the noise at source or by isolating or insulating the noisy activity or process. Where such controls are impossible or impracticable, or in the interim period while controls are being developed, the employer must provide, for each worker exposed, individual hearing protection of a type approved by OSH.

## Protective Clothing and Equipment

Protective clothing and equipment such as overalls, aprons, gloves, gauntlets, leggings, safety helmets, ear protection, eye protection (face shields and safety glasses), safety footwear, face masks, respirators, safety harnesses, belts or other equipment must be provided by the employer as and when necessary.

Employees must wear the protective clothing and equipment as and when necessary.

If hazardous chemicals or substances are stored, e.g. corrosive acids, an emergency shower and eye wash should be installed in each storage area.

## Training of Employees

Employees 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 and the precautions to be taken, protective clothing and equipment to be worn, and action to be taken in emergencies. Employees operating mechanical equipment need special training for the particular types of equipment used.

The correct method of dealing with breakages or spillages and neutralising hazardous chemicals and substances should also be explained.

Fire safety, including the use of fire-fighting equipment, should be part of all training.

# Appendix: Incompatible Chemicals

	Hydrochloric acid	Sulphuric acid	Phosphoric acid	Nitric acid	Perchloric acid	Acetic acid	Caustic soda	Sodium carbonate	Ammonia solution	Cyanides	Aluminium	Magnesium	Other metals	Acetone	Methyl ethyl ketone	Alcohols	Kerosine, white spirit	Toluene, xylene	Styrene	Other hydrocarbon solvents	Trichloroethylene	Methylene chloride	Formaldehyde	Phenol	Hydrogen peroxide	Organic peroxides	Nitrates	Chromates, dichromates	Chlorates, perchlorates	Potassium permanganate	Hypochlorites	Sawdust			
Hydrochloric acid																																			
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Acetic acid																																			
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Sodium carbonate																																			
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Aluminium																																			
Magnesium																																			
Other metals																																			
Acetone																																			
Methyl ethyl ketone																																			
Alcohols																																			
Kerosine, white spirit																																			
Toluene, xylene																																			
Styrene																																			
Other hydrocarbon solvents																																			
Trichloroethylene																																			
Methylene chloride																																			
Formaldehyde																																			
Phenol																																			
Hydrogen peroxide																																			
Organic peroxides																																			
Nitrates																																			
Chromates, dichromates																																			
Chlorates, perchlorates																																			
Potassium permanganate																																			
Hypochlorites																																			
Sawdust																																			

This chart is a guide only to chemicals which should not normally be stored together. It is not an all-inclusive list and certain factors such as strength of acidic solutions may alter the storage requirements. Sawdust is included purely to indicate that it should not be used to neutralise any spillage of the chemicals indicated or to pack them.