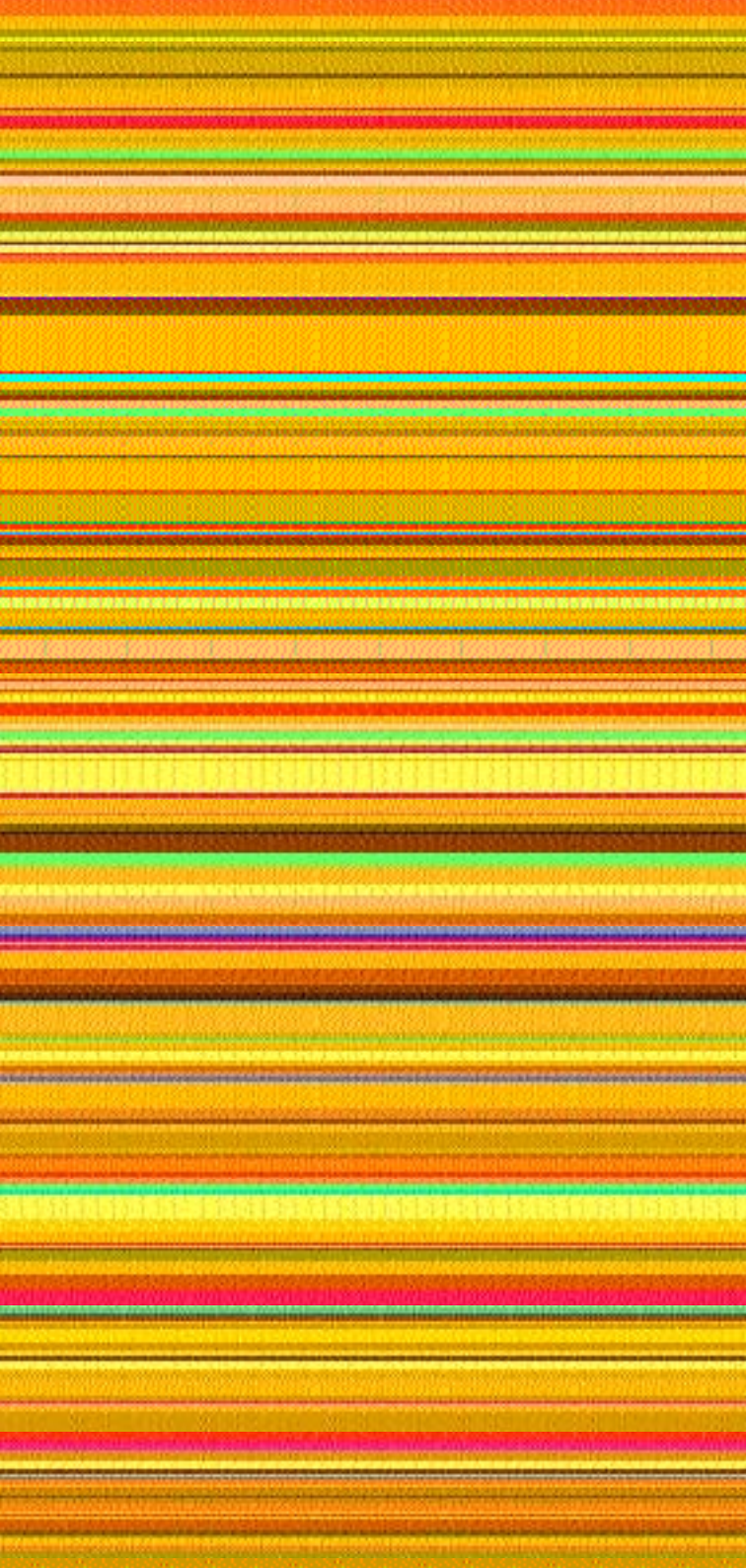


Guidelines

for
the safe
warehousing of
crop protection
products

3





Guidelines


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FOREWORD

The plant science industry, represented by CropLife International, is actively involved in and committed to programmes that promote the effective management and responsible use of crop protection products. This is achieved through support of stewardship - the responsible and ethical management of a crop protection product throughout its lifecycle - from the initial research and development, through distribution and use, to the eventual disposal of any waste.

As part of this commitment to stewardship, CropLife International has published a number of guidelines covering different aspects of the management of crop protection products. This booklet is the third in the series and covers the important area of warehousing and storage of products. It includes advice of construction and operation of facilities, as well as procedures in case of emergency.

The guidelines are an update of those originally produced by CropLife International's predecessor organisations (GIFAP, later GCPF) and serve both as an information source and training material. The effort to improve the knowledge and advice in this area is very much in the spirit of the FAO International Code of Conduct on the Distribution and Use of Pesticides and I recommend these guidelines to all concerned with the responsible and effective use of crop protection products.



C. Verschueren
Director General,
CropLife International

These guidelines are intended to complement the requirements of any local and national laws and regulations, as well as the FAO International Code of Conduct on the Distribution and Use of Pesticides.

The information contained in this booklet is accurate to the best of the knowledge of CropLife International. No liability whatsoever can be accepted in respect of the use of this information nor in respect of any advice contained herein.

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INTRODUCTION

These guidelines deal with the safe warehousing of packaged crop protection products in quantities of 10 tonnes or more. However, it is recommended that the basic principles should be followed, if smaller amounts are stored. These guidelines deal only with the passive storage of packed products, i.e. they do not cover production or filling activities in a warehouse.

It should also be recognised that a number of guidelines for the safe storage of crop protection products have been prepared by individual companies and trade or industrial associations involved in the supply of their products.

The information provided in this booklet is based on common good practice and combines the advice of existing documents with the lessons learnt from past incidents that have occurred. The advice given should help to ensure that crop protection products are stored and handled in a safe manner during normal operations.

The booklet also provides recommendations for the prevention of incidents and for the preparation of emergency plans.

The guidelines are intended mainly for managers of warehouses and stores, distributors of crop protection products, fire brigades and national regulatory and local authorities.

In the guidelines, the word 'must' is used to indicate the minimum standard acceptable, and the words 'should' and 'recommended' to indicate proven good practices.

To help managers and others carry out effective 'self audits', a checklist has been included at the back of the booklet.



Whenever this sign appears it indicates bad practices, which should be avoided.

Any decision about equipment or the management of a warehouse should not be taken without the prior agreement of the relevant authorities and the responsible fire departments. The guidelines therefore recommend close collaboration with authorities and fire departments, that they be informed of the nature of the goods stored and the preparation of emergency plans in case the recommended preventive measures listed in these guidelines should prove insufficient.



Target groups for these guidelines

IRRESPECTIVE OF THE RECOMMENDATIONS GIVEN, IT IS THE RESPONSIBILITY OF THE WAREHOUSE MANAGEMENT AND THE WAREHOUSE OWNER TO CONSIDER ALL APPLICABLE LEGAL REQUIREMENTS AND RESTRICTIONS FOR THE OPERATION OF THEIR BUSINESS.

'Crop protection products' is the general name used to cover the group of chemical products that includes insecticides, acaricides, molluscicides, rodenticides, nematicides, anthelmintics, plant growth regulators, fungicides and herbicides.

The same principles described in these guidelines apply for materials that are used for the production (formulation, synthesis) of crop protection products.

1. HAZARDS

Product hazards

Knowledge of product hazards is an essential prerequisite for the safe warehousing of all chemicals. Essential information is available from the Material Safety Data Sheets (MSDS) and labels (e.g. Transport Hazard Symbols). While storing crop protection products, hazards are likely to be encountered with products that are flammable, combustible, toxic, corrosive and reactive or that may be oxidising agents.

A more detailed product classification is given in Appendix 1, where the Hazard Classes and Hazard Symbols following the UN Classification for Dangerous Goods are named.

The classification of the products is given by the producer/supplier and should be marked on the labels. Information about the hazards and the classification are given in the MSDS, which should be available for all crop protection products.

Flammable:

These are substances that can produce flammable vapour/air mixtures and that are therefore potential sources of fire or explosion. General definitions are:

- **Flammable liquids:**

Classification of flammable liquids is determined by their flash point. For warehouses, goods with a flash point of 61°C and below are considered flammable (Note: This figure may differ slightly according to local legal requirements or the classification system).

- **Combustible liquids:**

Liquids with a flash point higher than 61°C are considered to be combustible if they burn once ignited (not applicable if they are water-based).

- **Flammable solids:**

These are readily ignitable solids or materials that cause a fast propagation of a fire, once ignited.

- **Combustible solids:**

Solid products that burn once ignited.

- **Dangerous when wet:**

products which produce flammable gases with water.

For safety reasons, most crop protection product formulations should be regarded as flammable.

Toxic:

These are materials which may be toxic to people by way of ingestion, inhalation or skin absorption.

- **Skin contact** is the most common route by which poisoning can occur. Many chemicals can readily pass through the skin into the body.
- **Inhalation** of dust and vapours can produce a particularly fast reaction due to the ease with which such contaminants can enter the bloodstream through the lungs.
- **Ingestion** is perhaps the least common cause of accidental poisoning and is most likely to be associated with eating, drinking and smoking without having first washed the hands.

Hazardous to the environment:

Products are classified as hazardous to the environment on the basis of the acute toxicity data and/or environmental fate data – degradability and bioaccumulation data. Often, this property is focused on the aquatic environment.

Corrosive:

Such substances will attack skin, or materials such as wood or metal. Therefore, leakage can corrode other packages and structures. The packaging material used for a product should be resistant to degradation.

Oxidising:

Oxidising agents will increase the rate at which a fire can develop. They may also react violently with other stored materials and can be the cause of spontaneous ignition.

Dangerous when wet:

Within the range of common crop protection products, some dithiocarbamates are known to react adversely with moisture to produce carbon disulphide, a toxic, volatile and extremely flammable liquid. Spontaneous ignition of this group of chemicals is also known to occur.

The type and amount of packaging material, which may also be combustible, should be considered when the hazards in a warehouse are being assessed.



Danger signs* of stored goods

*Note: hand drawn signs must not be used.
Size and quality of signs are defined by regulations

Health hazards

Improper handling of crop protection products may cause adverse health effects; such effects may result from skin contact, inhalation or ingestion.

Therefore, effective controls have to be used to minimise the risks to people. This should be achieved by preventing product releases (spills, leakages), minimising effects (ventilation, retention), and the use of appropriate personal protection equipment (PPE) and good hygiene measures.

Fire and explosion hazards

Fire and explosion hazards occur if flammable or combustible products, sufficient oxygen (from air) and an effective ignition source come together.

The **fire hazard** of a product is determined by its flammability (ignitability), burning velocity and mobility.

Explosion hazards occur when flammable gases, vapours or dust clouds are generated.

Effective ignition sources can be hot surfaces (such as heating appliances, electrical equipment), open flames (e.g. welding), mechanical sparks (caused e.g. by grinding), electric sparks, and electrostatic discharges. Even inductive discharges generated by transmitting mobile phones are an effective ignition source and can initiate an explosion.

Environmental hazards

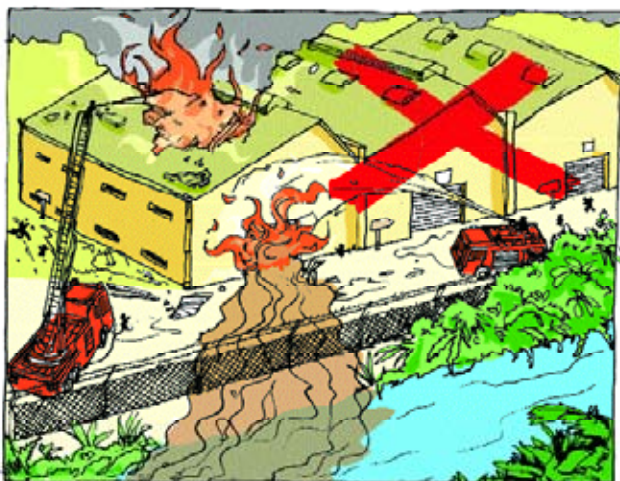
As crop protection products can be environmentally detrimental, the effects of their uncontrolled release or of a fire in a crop protection product store may severely damage the environment.

This can happen by

- Insufficient retention of product that has been spilled or leaked from containers
- Combustion gases
- Insufficient retention of fire fighting water

- Flooding
- Inappropriate storage and disposal of containers, equipment or contaminated waste
- Residues of crop protection products from washing containers and equipment.

The escape of contaminated fire fighting water is a significant risk. It can heavily pollute the area surrounding the warehouse, streams, rivers or lakes, and is a particular threat to ground water used for drinking, irrigation and industry.



Do not let fire fighting water escape

The clean-up of such contaminated water following a fire can be a lengthy and difficult task, and extremely costly. Some recommendations on how to cope with contaminated fire fighting water are given in chapter 6 'Emergency Management'.

2. WAREHOUSE SAFETY

Location

When evaluating the suitability of a site for a warehouse any risks that arise from the warehouse to the surrounding neighbourhood, as well as risk of the surrounding neighbourhood to the warehouse, **must** be considered. The building should be on a site that minimises the risk of contaminated water reaching watercourses, groundwater or the public drainage system. It is strongly recommended that the rainwater drainage system be constructed in such a way that it can be blocked conveniently if the necessity arises.

Areas of special risk are: (see also CropLife International's 'Guidelines for the safe and effective use of crop protection products')

- Water sources, such as wells, ponds and water courses, especially if the water is used for drinking (danger to people and animals) or for irrigation (danger to other crops)
- Sensitive sites, such as nature conservation areas

When choosing a site for a new store, avoid close proximity to facilities that are difficult to evacuate, such as houses, schools, hospitals, nursing homes, shopping areas, food manufacturing or storage premises or other populated places. The store should be sited well away from boreholes and wells (suggested distance is greater than 250 m) and open water sources, such as ponds, dams, rivers (suggested distance is greater than 500 m).

It should also be well away from areas used for the storage of fertilizers, fuel and other combustible goods.

Preference should be given to sites devoted to industrial development or to isolated locations.

It is also recommended to avoid areas that are subject to potential environmental hazards, such as flooding or water catchment areas.

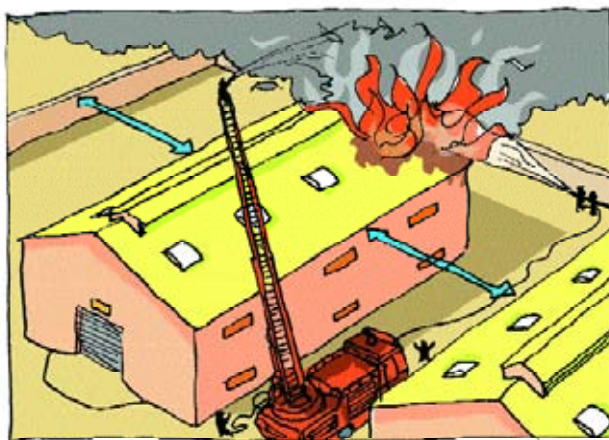
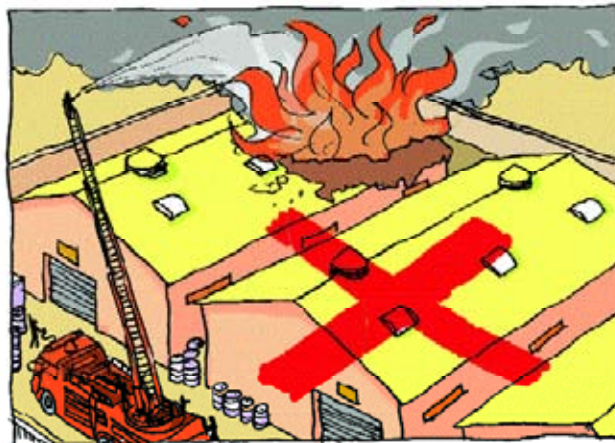
For large quantities of crop protection products, a detached, enclosed store is preferred. Where this is not practicable, crop protection products may be kept in a segregated, dedicated storeroom which is part of a larger building provided the building does not contain a staff room, vehicle store, workshop, office or area used in any way for food.

Site access

The site **must** provide suitable access for safe delivery and collection with a reasonable working area for loading and unloading of delivery vehicles. Ideally, the building should stand alone with a space of at least 10 metres between it and the surrounding property. The distance depends on the applicable building codes and fire protection codes and on local legislation, e.g. if the warehouse contains flammables, the amount of material stored and the rating of the fire wall can determine how far away other structures **must** be. As a consequence, more buffers to the neighbouring property line may be needed.

Access for emergency vehicles should preferably be available from two sides. The emergency response vehicles (e.g. firefighters) should be able to take a route that cannot be blocked.

The response to an emergency should be planned in advance, especially if it is known that the approach to the building might be restricted for any reason.



Provide suitable access for fire fighting

Construction

Avoid materials that are combustible and that could contribute to the spread of a fire. Building Insulation materials should be non-combustible, e.g. glass fibre.

Reinforced concrete frames are preferred to unprotected steel frames. Load-bearing steel members, especially in fire walls, should be protected from heat by means of insulation, for example sprayed with vermiculite cement.

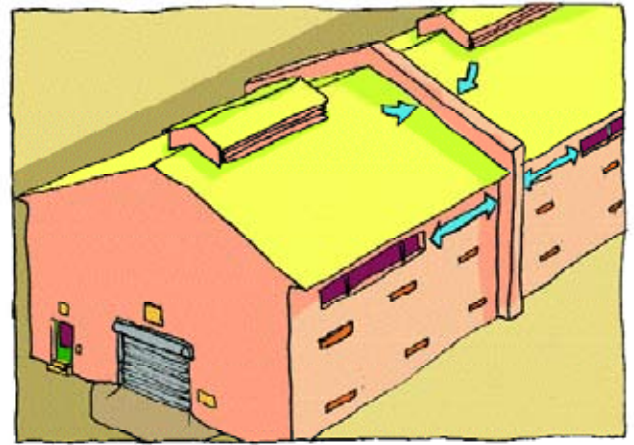
When the erection/installation of a new warehouse is being planned, it **must** have **planning approval** from the relevant local authorities (e.g. an environment agency, health authority, fire authority, municipality or other governmental agency). It is recommended to consult insurance company experts on these matters.

1. WALLS

If there is a fire risk to external walls, they should be made of solid construction; otherwise, they can be clad with steel or similar sheeting.

Preferably, there should be no windows in the store. If there are windows, they **must** be fully secured, placed as high as possible, but placed so as not to allow too much sunlight to penetrate the area, as this may cause deterioration of plastic containers and labels.

Internal dividing walls, designed to act as **fire walls** (fire break walls), **must** provide at least 90 minutes fire resistance and should extend to a height of 1 m above the roof or have other means of preventing a fire from spreading. No openings, e.g. doors, should be within 2 m of the connection between the dividing wall and the main wall.



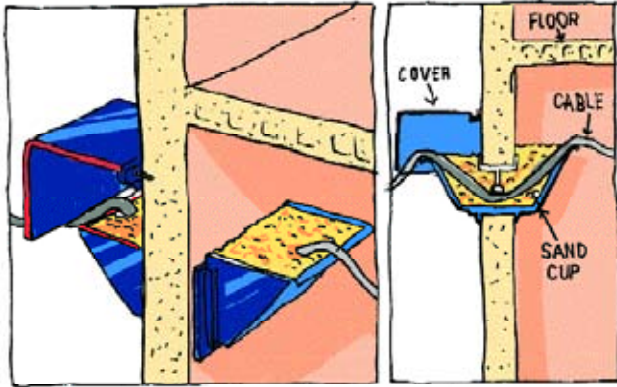
Firebreak walls should extend beyond the roof

The materials best suited to combine fire resistance with physical strength and stability are concrete, solid brick or concrete blocks.

To achieve the desired fire resistance, reinforced concrete walls should be at least 15 cm thick and brick walls should be at least 23 cm thick. Hollow brick is not suitable. Concrete blocks without reinforcement require a minimum thickness of 30 cm in order to achieve the requisite strength and stability.

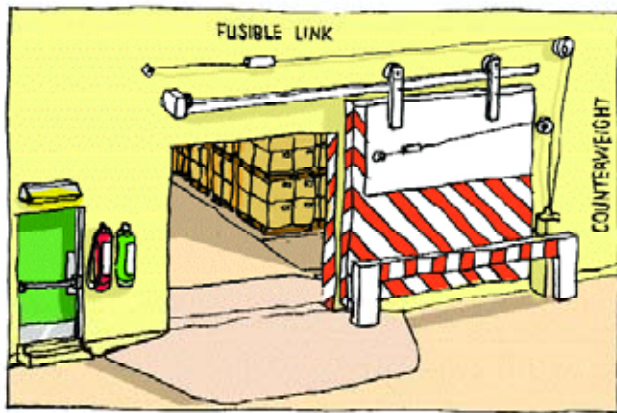
To achieve greater structural stability, it is recommended to use reinforced columns (pilasters) in the fire wall. The fire wall should be independent of the adjoining structure so that it will not collapse in the event of fire.

Fire walls should not be breached by electrical cables, tubes or other **conduits**; where this is unavoidable, the possibility of fire spreading **must** be prevented, e.g. by placing them in fire retardant sand cups or by filling holes with special fire resistant sealing materials.



Sand cups to protect a cable in the fire wall

Doors in firebreak walls should be as fire resistant as the wall itself (minimum 30 min; T30 quality). They **must** close automatically in the event of fire, e.g. with a fusible link. The doors should be protected from vehicle damage (and any damage that does occur **must** be repaired promptly as this could assist in the spread of fire). Stored goods **must not** obstruct the doors' closure.



Fire doors must be free to move at all times and tested periodically

2. ROOF

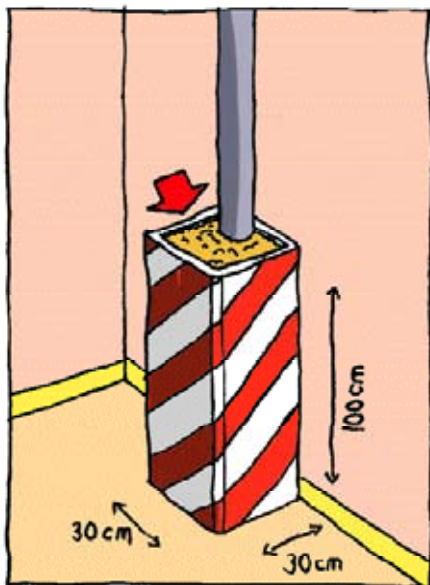
The supporting structure of the roof should be made of non-combustible materials. Hardwood or treated wood frames are acceptable, provided the roof covering itself is non-flammable. Fire walls should extend to a height of 1 m above the roof.

The roof covering of stores containing crop protection products may be of a lightweight, friable construction that will readily fail in the event of a fire and thus provide relief of smoke and heat. However, the responsible fire authorities should be consulted and their agreement sought for this type of construction.

Where the roof is of solid construction, smoke and heat relief **must** be provided with either low melting transparent panels or ventilation panels with an available opening of at least 2% of the floor area. Ventilation panels **must** either be permanently open or **must** be able to be opened by hand or they **must** open automatically in the event of a fire. This decision should be made in cooperation with the responsible fire brigade.

Early relief of smoke and heat will improve visibility of the source of the fire and retard lateral spread.

Where storm water from the roof drains inside the building, the down pipes **must** be sealed by constructing a brick or concrete kerb around the pipe at the point where it enters the floor to a height above the level of the retaining bund (see retention page 23). This will also protect the pipe from accidental damage by vehicle and pallet movements. External down pipes should also be sealed at ground level.



Seal and protect roof drains inside buildings

3. FLOORS

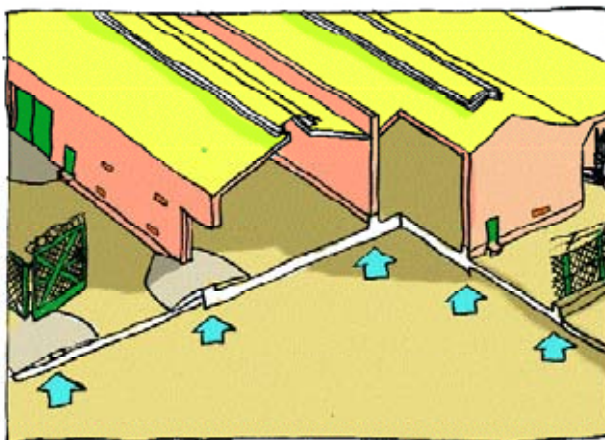
Floors **must** be crack-free (or sealed), non-slip and impervious to liquids, and should have a smooth finish for ease of cleaning. Also, floors need to be sufficiently resistant to mechanical stress caused, for example, by the weight of forklift trucks or shelving. It should be checked regularly to ensure it is in good condition and repaired in case of cracks.

The floor of the store **must not** have open drains. This is imperative in order to prevent the uncontrolled release of spilled product or contaminated fire fighting water.

Retention

There **must** be the means to retain any spillages and all the fire fighting water. The volume to be expected in fighting a fire can be several m³ of water per ton of product stored, unless special precautions are provided such as sprinklers, foam systems, or automatic alarms, which ensure a quick response by the fire brigade. Generally, volume of the water retention should be calculated as $m^2(\text{floor size}) \times 0.3 = V(m^3)$

Some retention can be achieved within the store by enclosing the floor area with ramps or sills at all entry points. Store walls can be sited on bunds, lined with impervious material to a height of 14 cm and/or a bund can be constructed around the building.



Bunds around the warehouse and at the site perimeter

Retention of spillages

The floor of the warehouse **must** be liquid-tight and resistant to spilled product for a sufficient time in which spillages/leakages can be detected and removed before they cause major damage to the floor and the soil below.

As the package size of crop protection products is relatively small (mostly 1 - 200 l), the amount of spilled product in the case of a leakage can be retained under normal circumstances.

Retention of fire fighting water

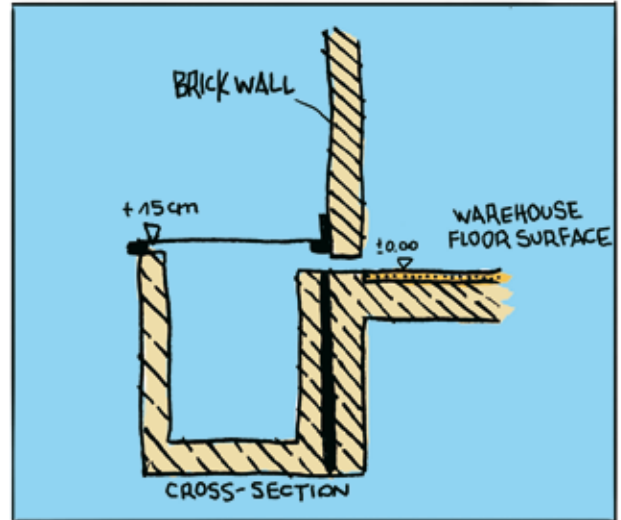
The thresholds should be at least 14 cm above finished floor level with ramps inclined to a gradient of not greater than 1 in 10 (10%, 5.7°) for access of forklift trucks. It is recommended that arrangements be made to increase the threshold height by fitting boards or sand bags in case of emergency.

Enclosing the loading and unloading area and other paved ground outside the warehouse can sometimes provide additional retention volume. If this is done, facilities **must** be installed either to pump away rainwater or to shut existing drains in the event of fire.

For warehouses with a floor area larger than 250 m², it is recommended to have a retention volume of at least 200 m³. Retaining the total expected volume of fire fighting water generally requires a catchment basin. This can be shared between various warehouses or sections separated by a fire wall, as it is not likely that more than one section will catch fire at any one time.

It is recommended to have a pit outside the warehouse to collect the fire fighting water/effluent. From there it should be pumped into a larger collection pond.

If it is difficult in existing warehouses to provide a sufficiently large catchment volume, it is recommended to reduce the expected volume of fire fighting water, e.g. by automatic alarms or extinguishing systems or by making provisions to cease fire fighting once the available capacity has been reached.



Pit as part of a water retention system

Safety equipment

1. FIRE PROTECTION

1a. Fire prevention

Former incidents reveal that crop protection products that are exposed to the heat of a fire can become hazardous to fire fighters and others in the vicinity, as well as give rise to a serious environmental threat.

Prevention of such incidents **must** be the primary concern of all store operators.

Free areas/space between or around the warehouse should be kept clear of combustible material as this may contribute to a fire once ignited.

All external walls **must** be kept clear of stored pallets and other combustible materials, which could be misused as ready fuel by potential arsonists.

All electrical equipment **must** be installed and maintained by a qualified electrician. Further information is given in the chapter 'Electrical equipment' on page 32.

Smoking

For reasons of hygiene as well as fire prevention, smoking in crop protection product stores **must** be prohibited. The rule **must** be strictly observed and enforced for all employees as well as customers, contractors or any visitors on site.



Do not allow smoking in the warehouse

Sparks from forklift trucks

Where highly flammable goods are stored and an explosive atmosphere could occur, the presence of an ignition source **must** be excluded. Certified spark-proof forklift trucks are recommended. If forklift trucks that are not spark-proof have to enter such warehouse areas, the following conditions **must** be met:

- Before entering the warehouse it **must** be assured following a thorough investigation (checking for leakages or smells) that the atmosphere is not potentially explosive. If it is - do not enter!
- Forklift trucks that are not spark-proof should be used only for short periods and should leave the warehouse as soon as possible after completing the operation.

Ancillary equipment

Where used, ancillary electrical or fuel-driven equipment **must** be kept well away from the stored product and an isolation switch placed conveniently close to the equipment **must** be provided.

Battery chargers and shrink wrappers should be placed outside the warehouse or in a separate room.

1b. Fire detection

Alarm systems

Larger crop protection product warehouses **must** be equipped with an internally audible alarm and all warehouses **must** have the means to alert the fire brigade, e.g. telephones, push buttons, etc.

Automatic alarm systems should be considered if a real advantage could be gained, i.e. if the fire brigade receiving the alarm could take effective action in less than 15 minutes.

The effectiveness of automatic alarm systems using smoke, flame or heat sensors, should be carefully evaluated in each individual case and verified by trials on the spot.

The supplier should ensure proper maintenance and service.

- Optical smoke sensors should be preferred. They detect light scattered by smoke particles which are $> 0.3 \mu\text{m}$ (visible smoke)
- Heat sensors detect the rapid increase of temperature typical of an open fire
- Flame sensors react on the infrared waves of open flames. They are not suitable for the detection of smouldering fires
- Ionisation smoke detectors detect smoke particles $< 0.3 \mu\text{m}$.

Sprinkler systems **must always** trigger an alarm when activated, i.e. in a sprinklered facility usually no other alarm systems are needed, except for the manual devices mentioned above (push buttons, etc.).

1c. Fire fighting

The level of installations for fire fighting measures in a warehouse depends on the size of the warehouse, the type and amount of the products stored and the size, equipment, performance and reaction time of the responsible fire brigade.

Fire fighting water supply

The supply of fire fighting water **must** be reliable and sufficient.

The necessary amount of fire fighting water depends on the storage capacity of the building, the amount and type of the stored products and the location. It should be decided on in co-operation with the local fire fighting authorities and the responsible fire brigade, respectively.

A water supply of 800 l/min (for small warehouses) up to 3,200 l/min (for larger warehouses) for approximately 120 minutes should be available. The capacity of the fire fighting water pump and the respective pipes and hoses need to be appropriate. It is of advantage that the pipes supplying fire fighting water (including sprinkler systems) are designed as a loop system ('continuous site fire loop') and that the capacity of the pipes be sufficient to support the facility with only one portion of the fire loop operational.

The fire fighting water pump **must** be reliable.

For larger warehouses, a set of two pumps (e.g. one diesel-driven and one electrical) is recommended. They should be checked (started) frequently and maintained regularly. If only a single pump is available, it should be checked and maintained more frequently. The check of the water pump should be documented.

Fire extinguishers

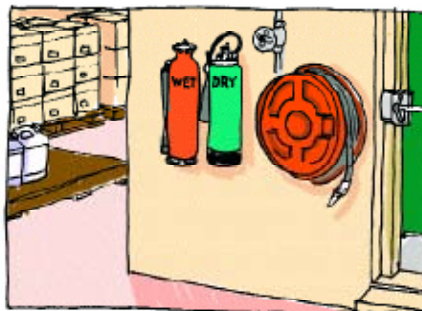
Mobile or portable fire extinguishers should be positioned on each floor near the normal entry/exit doors. The place should be kept clear and marked with a prominent sign. The number, size and type of extinguishers should be discussed and agreed with the local fire brigade and fire insurers. Foam (5%) should be available for flammable materials. Dry powder extinguishers are also effective for fighting solvent fires and may be used safely in any situation, including fires in electrical installations, but be aware of possible re-ignition or flashback. Water-filled extinguishers are most suited for fighting fires of packing materials. Two 10-12 kg water-based or dry powder extinguishers **must** be available for the first 50 m² of floor space, with an additional extinguisher for every additional 100 m² of floor space.

Additionally, in warehouses of more than 500 m², one mobile dry powder extinguisher of 50 to 100 kg is recommended.

The available fire extinguishers have to be visibly marked and be easily accessible (See table 1 on page 30).

In battery-charging and electrical switch-rooms, at least one 6 kg CO₂ extinguisher **must** be provided.

Check and maintain fire extinguishers at least once a year. Partially-used extinguishers **must** be exchanged.



Position fire extinguishers close to the exit and keep them clear of obstructions

Table 1: Required fire extinguisher according to type of fire

DECIDE THE TYPE OF FIRE YOU ARE FIGHTING	MATCH UP CORRECT EXTINGUISHER WITH TYPE OF FIRE SHOWN						
	Foam	Carbon Dioxide	Water-based	Pump tank	Gas cartridge	Multi-purpose dry chemical	Ordinary dry chemical
TYPE Ordinary combustibles Wool, paper, cloth	YES	NO	YES	YES	YES	YES	NO
TYPE Flammable liquids, Gasoline, Paints, Oils, etc.	YES	YES	NO	NO	NO	YES	YES
TYPE Electrical equipment, Motors, Switches, etc.	NO	YES	NO	NO	NO	YES	YES

Hydrants, hose lines

Where hose reels are used, it **must** be possible to reach any part of the warehouse with the discharge from at least one hose line. Internal hose reel cabinets are recommended; otherwise, outside hydrants are considered sufficient. Water nozzles should be convertible to be able to produce a spray as well as a full jet.

Location, placement and design of hydrants should be agreed with the local fire authority to ensure compatibility of equipment (identical hose couplings, etc.). Where large amounts of flammable crop protection products are stored, it may be advantageous to stock foam concentrate and foam-making equipment to be used by the local fire brigade. Warehouse personnel that use foam-making equipment should be given special training. Alcohol resistant foam is required for water miscible solvents or emulsifiable concentrates. Foam concentrates may deteriorate with age, so they should be checked for obsolescence according to the manufacturer's instructions.

Sprinkler systems

The effectiveness of sprinkler systems is severely limited in block storage (see 'block storage' page 48), if the blocks are too compact. Correctly positioned sprinklers over blocks with inspection aisles can generally control a fire. Sprinkler systems are most effective in racked storage facilities when the sprinkler heads are installed within the racks.

In storage racks more than 6 m high, sprinklers should always be installed. Sprinkler systems **must** be installed by a supplier with expert knowledge and maintenance **must** be in accordance with manufacturer's specifications.

2. ELECTRICAL EQUIPMENT

All electrical equipment, including wiring, **must** be installed and maintained by a qualified electrician. Temporary electrical installations should be avoided, but if they prove necessary, they **must** be installed to a high standard, by qualified personnel. All electrical equipment **must** be positioned so as to avoid accidental damage by vehicle or pallet movements or any contact with water. Equipment **must** be adequately grounded and provided with suitable overload protection.

Provided that the ventilation in the warehouse is good (air exchange of more than 2 per hour) or if non-flammable products are stored, it is generally accepted that flameproof electrical equipment is not normally required in storage areas. When air exchange is below this recommendation, and when flammable products are stored, it is recommended to install flame-proof electrical equipment from the floor up to a height of approximately 1.5 m.

In special cases when aerosol cans (flammable gas) or highly flammable liquids are present, it may be necessary for all electrical equipment to be flame-proof. The decision depends on the nature of the products, their flash point, the normal ambient temperature and the quality of the ventilation (See table 2 on page 33).

In outdoor type warehouses, waterproof fittings are recommended. Where regular fittings are installed, it is recommended to have switches on the outside of the warehouse or in a room with access only from the outside and to have no electrical outlets within the store.

The local legislation has to be checked and fulfilled. The electrical equipment should be maintained and checked periodically. The checks have to be documented.

2a. Lighting

Light levels (natural or artificial) **must** allow for the routine inspection of stored products and provide sufficient light for easy reading of marking, product labels and instruction signs.

If warehousing operations are carried out only during daytime, natural lighting may be adequate and may even be improved by inserting transparent panels in the roof.

Table 2: Requirement for flame-proof electrical equipment

Electrical equipment	Flammable liquids (Flash Point < 61°C)		Flammable Gas (Aerosol cans < 1 l)	
	Ventilation 0,4/h	Ventilation 2/h	Ventilation 0,4/h	Ventilation 2/h
Fixed Installation - up to 1.5 m - above 1.5 m	YES	YES	YES	YES
	NO	NO	YES	NO
Mobile equipment - up to 1.5 m - above 1.5 m	YES	NO	YES	NO
	NO	NO	YES	NO

Artificial lighting should be installed above aiseways and at least 1 m above the topmost stored product to prevent heating of product by the lights and damage to the lights during mechanical handling operations.

Container stacking should not obscure natural and artificial light.

2b. Forklift truck charging

Battery charging facilities for forklift trucks should be outside or in an open area, well away from the stored products. If the charging is done in an enclosed room, there **must** be a high-level vent for the release of the hydrogen generated, which is lighter than air.



Keep battery charging facilities away from stored goods

3. LIGHTNING

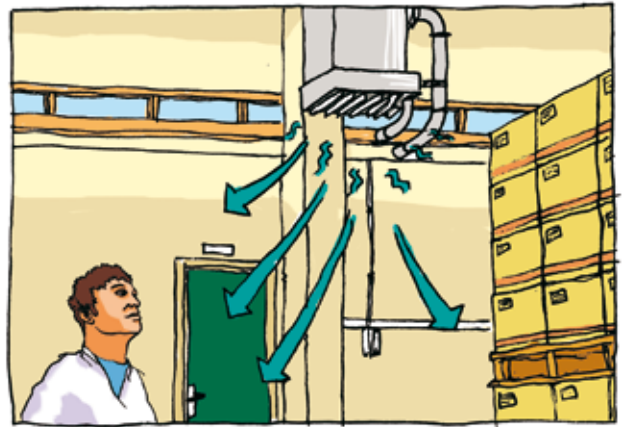
All warehouses should be fitted with a lightning conductor. The installation should be in accordance with the local legislation.

4. HEATING

In cold climates it may be necessary to provide heating within the warehouse.

Heating systems should be based on steam or hot water and the heat source **must** be segregated from the storage area. Hot water radiators or steam pipes **must** be located to avoid direct heating of a stored product.

Portable heating units should not be used; those with open flames **must** be prohibited.



Heating must be directed to avoid heating of stored products



Heaters with open flames must be prohibited

5. VENTILATION

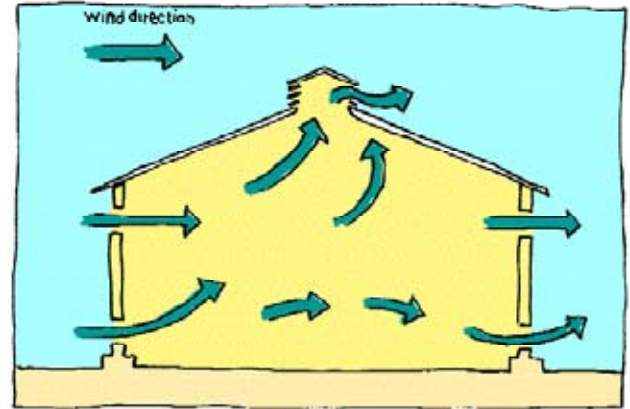
The warehouse should be well-ventilated to prevent the formation of hazardous and flammable atmospheres and to ensure proper health and hygiene conditions. Natural ventilation should be provided where possible, e.g. by vents located in the upper and lower walls and in the roof. The lower vent **must** be positioned above the water retention level. All vents should be designed or protected in a way to prevent entry by birds or bugs. A natural ventilation generally ensures an air exchange rate > 0.4 per hour.

An air exchange rate of approximately 2 per hour is recommended for compartments to avoid formation of an explosive atmosphere during the (passive) storage of flammable liquids or flammable gases.

Air bricks, louvres or extractor fans with direct access to outside air can be used.

Vents passing firebreak walls have to be equipped with fire protection valves.

High ceilings or roofs improve ventilation. For good air circulation in warehouses, it is recommended that a clear space of 1 m be maintained between the topmost products and the roof, as well as between the goods and the walls.



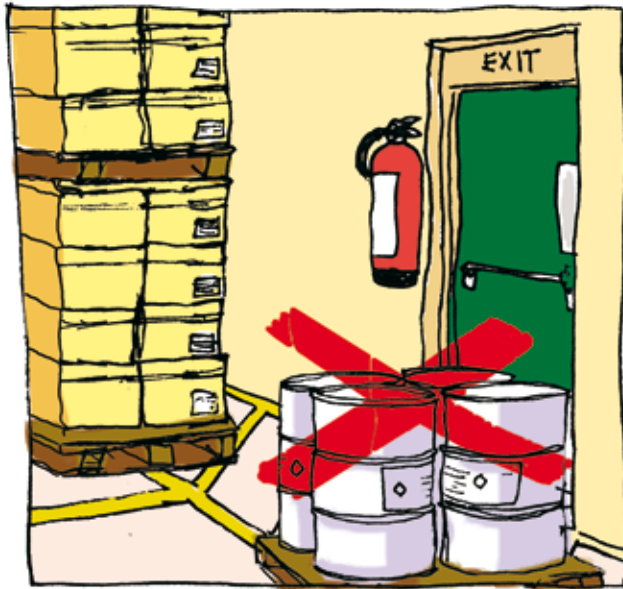
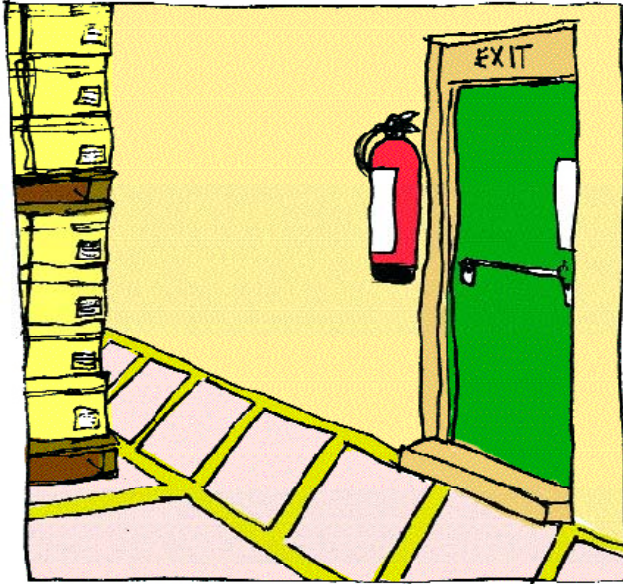
Roof and wall vents together give good ventilation

6. EMERGENCY EXITS

Exits other than the main doors **must** be available for emergency purposes. Ideally, there should be access doors on every side of the building. These should not be positioned more than 30 m from anywhere within the warehouse in order to prevent anyone being trapped inside.

Emergency exits **must** be clearly marked and kept clear. They **must** be designed so that they can be easily opened from the inside at all times. They should preferably be provided with panic bars. Emergency exits **must not** be locked at any time.

Training and drills **must** be carried out frequently and recorded on file.



Keep emergency exits and inspection lanes free

7. SMOKE AND HEAT VENTILATION

Smoke and heat ventilation systems are to:

- Improve the visibility for the fire fighters by smoke ventilation
- Prevent/mitigate by heat ventilation a build-up of heat which could lead to a forced fire spread.

Smoke and heat ventilation can be provided as:

- Permanent openings in the roof area or in the upper part of the building
- Ventilation flaps that can be opened automatically or manually when needed.

Usually, approximately 2% of the roof area should be constructed such that it can be opened.

Documentation

Building and site floor plans **must** be available showing channels, sewers, fire fighting pipes, hydrants, etc.

Furthermore, it is recommended to produce floor plans that show the location of safety equipment such as:

- Eye and safety showers
- Fire extinguishers
- Clean-up kits
- Emergency exits.

The floor plans should also show evacuation routes and assembling areas. These should be prominently displayed.

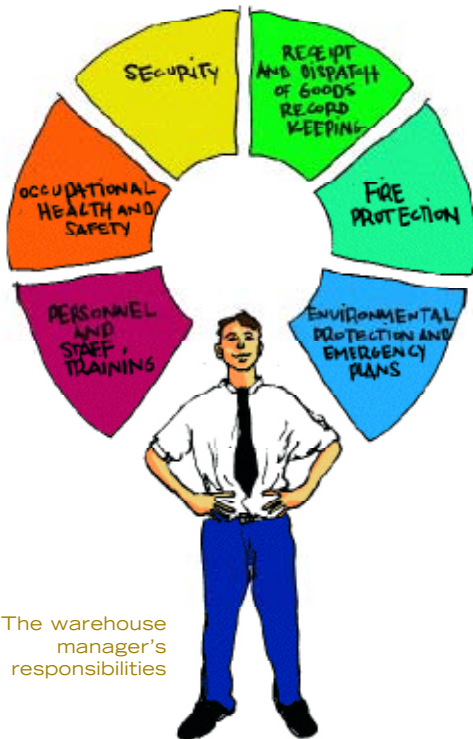
3. WAREHOUSE MANAGEMENT

Responsibilities

The overall responsibility for a warehouse or store lies with the store manager. He/she **must** understand that he/she is personally responsible for:

- The safe handling of products into, within and out of the store and the maintenance of records relating to such movements
- The occupational health and safety of the operational staff
- The training of staff and personnel
- The maintenance of suitable storage conditions
- The protection of the environment
- The planning of emergency procedures
- Fire prevention and contact with authorities.

Responsibility for separate parts of the operation may be delegated to qualified subordinates, but they **must** clearly understand their responsibilities. This delegation should be correctly documented and signed.



The warehouse manager's responsibilities

Security

Theft, robbery, product contamination, sabotage, vandalism and arson can be significant risks for a warehouse. Therefore, securing the warehouse or store is extremely important. Also, due to the amount and value of stored products, site security has to be considered as a major task.

Security arrangements **must** be initiated to prevent unauthorised entry to the warehouse and burglary:

- During working hours, by limiting access via a controlled entry system
- During off-duty hours, by locking doors and windows in the warehouse and in adjoining offices
- In large warehouses it is recommended to include intruder alarms, if fast response by security personnel can be reasonably guaranteed.

The **site** should be surrounded by a secure wall or fence.

Where the wall of the warehouse forms a boundary wall, care **must** be taken to ensure that entry cannot be gained via ventilation openings, the roof or adjacent buildings.

Entry gates should be limited to the minimum required for proper operation. However, there should be access from at least two sides in the event of fire or other emergency.

The **building** itself should be constructed so as to give basic mechanical security - secure doors, windows burglar barred, walls intact, roof intact, vents inaccessible.

- All doors (also internal doors, e.g. to the office area) should be mechanically stable and lockable.
- A lock/key system should be installed.
- The key holders should be registered, handing-over should be documented and the availability/inventory of keys should be checked periodically.
- If alternative means of ventilation and lighting are provided, it is better not to have **windows** at all. If they are present, they should be positioned high, barred against unauthorised entry and shaded.

Keys to the warehouse should be located out of view, in the office or guardhouse and should be properly labelled and accessible in case of an emergency.

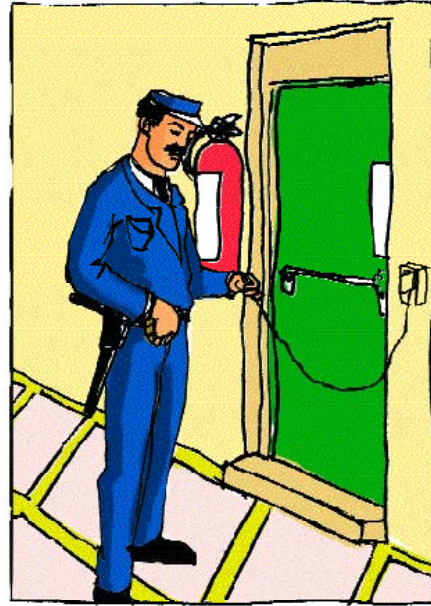
Control of access during off-duty hours

Outside lighting is often a useful deterrent to intruders. Patrolling the warehouse with guards is also effective and can help in securing against burglary and in detecting fires at an early stage. The patrols have to be defined concerning route, frequency and objective. It is recommended that a 'key and clock' system should be enforced to record the time and place when the inspection was actually made. The security staff should be trained appropriately.

It is desirable to have an electronic burglary control/detection system, which includes motion detectors inside the building and contact switches at the doors, gates and windows. Video systems with motion sensors can also be an option. The burglary control system should be connected to a security company or to a police station.

Access to the product store is permitted only to those **authorised personnel** who have been properly trained or to persons under strict supervision of trained personnel. A list of authorised personnel **must** be placed outside the product store.

Access to the site and to the warehouse has to be effectively controlled.



Patrolling guards can check for intruders and fires

If wireless data transfer systems are used for the warehouse management and operation, the system should be encoded.

External personnel should not be authorised to move uncontrolled:

- It **must** be easily and clearly recognisable for a visitor where to register
- The doors and gates should be closed during daytime, if no warehouse staff is present
- External personnel (e.g. drivers, accompanying persons) should not be left unattended in the warehouse.

Supervision and training

Warehousing operations can only be conducted safely if they are based on planned procedures that are well understood and obeyed by everyone.

All personnel working in the warehouse **must** be thoroughly trained. A permanent record of the training provided should be kept.

Training should include:

- Knowledge of the product hazards
- General safety operating procedures and operation of equipment
- Procedures to follow in case of emergency.



Thorough training means understanding the job

Warehouse structure

The following areas should be distinguished for planning and operation of warehouses:

- Storage room
- Receipt and dispatch area including areas for commissioning operations
- Loading area
- Area for administration and ancillary operations
- Protective equipment storage, equipment room
- Amenities (civilian clothing storage, shower & toilet).

1. STORAGE ROOM

The chemical storage area should be separate room(s)/ compartment(s) for keeping crop protection products. The number and the size of the warehouse compartments are based on the type and amount of products to be stored and the available safety equipment.

The products **must** be stored only in the intended areas, in racks and – if necessary – safety closets.

2. RECEIPT AND DISPATCH AREA

In the receipt and dispatch area, the products are received and controlled when arriving in the warehouse, products are consigned for transport to the customer and allocated/prepared for subsequent transport.

When receiving goods in the warehouse, identity, quantity and labelling of the goods **must** be checked against the transport documents. Package integrity should be established. Any leaking or damaged packs **must** be isolated and dealt with immediately. Packs with defaced or missing labels should be set aside for re-labelling or identification. The goods delivered should match the delivery note with respect to type, quantity and condition of the goods. Any comments can be written on the delivery note for later action by the management.

Receipt and dispatch recommendations are given in CropLife International's brochure 'Guidelines for the safe transport of crop protection products'.

Material Safety Data Sheets (MSDS) **must** be available for all the goods in storage.

There **must** be a receipt and dispatch control system in place, covering the dealing with products when they arrive, while they are in storage, when they are issued for use, and for returned or unused products.

3. LOADING AREA

The area where trucks/vehicles are loaded or unloaded should be surfaced or paved. A ramp can be a part of the loading area.

Precautions for retaining spillages/leakages have to be taken. Any drainage for rainwater should have installations to retain the water if necessary.

4. AREA FOR ADMINISTRATION AND ANCILLARY OPERATIONS

The following rooms may be needed for the warehouse operation:

- **Offices**
- **Equipment room:** for storing equipment, tools, spare parts, personal protective equipment e.g. waterproofs, gloves, and respirators, all appropriately numbered on numbered pegs; signs including 'Wear Protective Clothing', 'No Eating or Drinking', 'No Smoking', 'Wash Equipment before Storing' should be prominently displayed.
Wash down area: for the equipment, such as knapsack and tractor sprayers a concrete slab with walls to prevent drift and sills to prevent spills; drain to sump; running water and hoses; signed 'Keep Out', 'Not a Drinking Point'.
- **Rooms for electrical installation**
- **Room for central heating system**
- **Room for forklift truck/battery charging**
- **Amenities** including:
 - Changing room:** numbered pegs or areas for overalls and boots; separate area for everyday clothes; direct access to shower; sign that says 'Wash before Leaving'.
 - Shower and basin:** supplied with soap and towels.
 - Toilet:** with paper, and signs 'wash hands before using toilet' and 'wash hands after using toilet'.
 - A separate washbasin** for washing personal protective equipment (clothing), within a fenced-off drying area.

Whenever possible, offices and amenities should be located away from the main building of the warehouse. If such facilities are located within the warehouse structure, they **must** be segregated from the store and the construction should be designed to provide at least one hour of fire resistance. A means of exit other than via the warehouse **must** also be provided.

If smoking is allowed in the office or amenity rooms, metal or glass ashtrays **must** be provided and these **must** be routinely emptied in a safe manner. Ashtrays **must not** be emptied into waste paper bins; this has been a frequent, yet obvious and common source of fires.

5. STORAGE TECHNIQUES

Crop protection products **must not** be stored directly on the floor. They **must** be stored off or above the floor. They are best stored on shelves or on pallets off the floor, to avoid damage of containers caused by damp and so that there is more efficient use of space in the store. Shelves should be made of non-absorbent materials such as metal to avoid contamination. Wooden pallets should be sealed to prevent absorption of liquid. If not possible contaminated wooden pallets should be disposed as hazardous waste. Do not store different products or package types on top of each other.

5a. Outdoor storage

In general, all crop protection products should be stored under a roof. Weather-proof packs such as 200 litre drums may be temporarily stored in the open provided their contents are not sensitive to temperature extremes and security can be guaranteed.



Outdoor storage on a firm base surrounded by a sill

Storage areas should have a firm, impermeable base surrounded by a containment bund. Asphalt is not recommended because it softens in hot climates and under the influence of certain solvents. If the area is not covered by a roof, there **must** be adequate facilities for the disposal of collected rainwater.

It's recommended that stored drums are placed upright on pallets. Drums stored on the roll **must** be chocked. All drums **must** be stored in such a way that there is always sufficient space for fire fighting access.

5b. Block storage

Block storage means storage in parallel rows. An inspection aisle of at least 0.5 m between blocks and a 1m gap along the wall should be included. Limit the blocks to a width of 2 pallets; for practical reasons, their length should not exceed 8 pallets.

The maximum number of pallets piled up one on top of another, depends on the fire codes and on structural limitations of the packaging systems. Damage of lower packs due to too high load should be avoided.

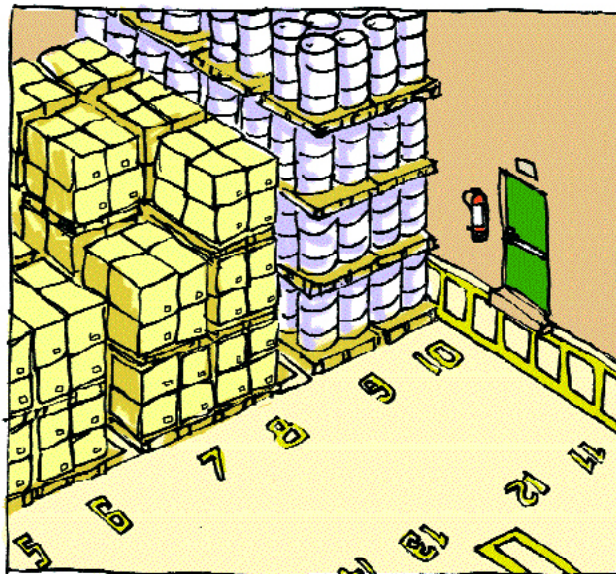
Mark the position of the blocks and inspection aisles on the floor and number each bay.

Access for forklift trucks or lifting devices need only be from the narrow end of the block.

Block storage can make access for fire fighting difficult. The dimensions of the blocks with flammable materials **must** therefore be restricted as described above.

Restricting the dimensions of blocks of combustible goods is also recommended.

If sprinklers are installed, they should be positioned at least 1 m above the top of the stack.



Mark aisle and number each storage bay

5c. Rack storage

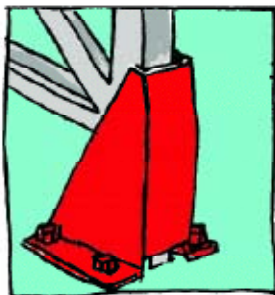
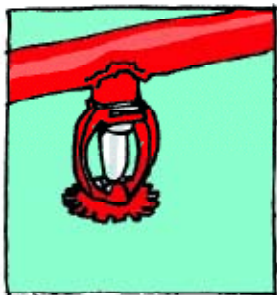
For storage in racks or shelves, the following issues have to be considered:

- Stability of the racking
- Load capacity
- Suitability of forklift trucks and other equipment
- Higher specific amount of products per square metre.

Metal racks or frame pallets allow better use of available height, but need specialised forklift trucks as normal forklift trucks would need too much floor space.

The advantages of racks over block storage are:

- More stable storage with less damage to the lower layer of packs
- Better stock control and easier order picking
- Better access to each pallet and good visual inspection
- Efficient sprinkler systems can be installed close to the goods within the racks.



Efficient sprinklers can be installed in racks

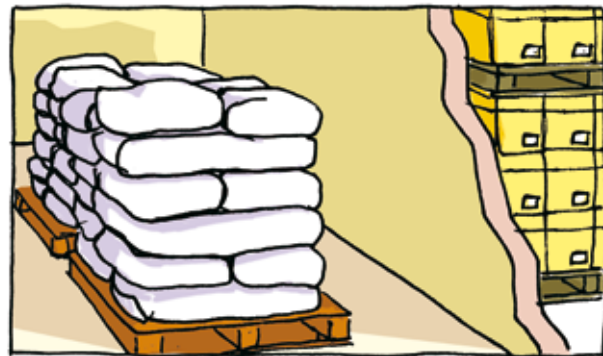
Storage considering/depending on product properties

Due to their potentially hazardous nature, crop protection products **must not** be stored in the same warehouse as foodstuffs, animal feeds or other materials such as clothing, tobacco, cosmetics, etc.

If it is unavoidable that goods, other than those mentioned above, have to be stored together with crop protection products in a single warehouse, the former **must** be segregated from the crop protection products and be stored in a different room.

Product segregation and separation

<p>Segregation means storing products separately in different rooms with a fire wall as a barrier.</p>	<p>Separation means storing products separately in different parts of the same room. This can be achieved by spacing the products or by using a non-combustible crop protection product as a barrier between combustible products.</p>
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Segregation with a fire wall as a barrier.

Crop protection products should be stored in groups corresponding to their different hazard categories, e.g. flammability, combustibility, corrosivity, toxicity, oxidising potential, etc.

Incompatible products or goods should be segregated from one another so as to minimise hazards effectively. For the purposes of segregation, substances or articles are considered mutually incompatible when their storage together may result in undue hazards in the case of fire, leakage, spill or any other incident.

Whenever dangerous goods are stored together, the most stringent separation or segregation provisions for any of the goods should be applied.



The principal benefit of these measures is:




- To minimise the risks and consequences of a fire
- To implement specific safety measures for fire fighting appropriate to the risk level.

It is acceptable merely to separate small amounts of products of different categories. However, it is strongly recommended to segregate large amounts of each of the various groups.

Compatibility guide for storage of crop protection products.

	Flammable liquids	Flammable solids	Combustible liquids	Combustible solids	Toxic substances - Combustible	Toxic substances – Non-Combustible	Corrosive substances	Oxidising substances	Dangerous when wet
Flammable liquids	1		1						
Flammable solids		1	2	2			2		
Combustible liquids	1	2							
Combustible solids		2							2
Toxic substances - Combustible									
Toxic substances – Non-Combustible									
Corrosive substances		2							2
Oxidising substances									
Dangerous when wet				2			2		

-  Joint storage permitted
-  Reduced joint storage permitted
 - 1) Limited amounts
 - 2) Separation required

-  Segregation required
-  Segregation recommended due to fire fighting water contamination
-  Common storage following special legal requirements

Storage plan - stock control system

The storage quantity of flammable liquid goods with a flash point below 61°C within one compartment **must not** exceed 250 tonnes unless the storage room is equipped with special fire protection (automatic alarm in combination with a quick fire brigade response or sprinkler or other automatic fire-extinguishing systems). Segregation by a fire wall is necessary for larger quantities.

It is also recommended to limit liquids with a flash point above 61°C to 250 tonnes, if no special fire protection is provided.



Separation can be achieved by spacing or by placing a non-hazardous product between hazardous ones.

Combustible packaging materials should be separated from other goods, as they can contribute significantly to a fire and are often readily ignited. They should not be stored in separation space between products.

If a site contains several storage positions, each one should be separately numbered for easy identification. The numbers should be recorded on a **site storage plan**, designating where which groups and which amounts of crop protection products are stored. This is of use in case of accidents, fire or other disaster. It should be kept outside the warehouse at a safe place where the fire brigade can get access to it when needed.

Stock control systems

The stock control system **must** guarantee knowledge of the quantity and location of goods in the warehouse at all times. An inventory, a plan of positions of the goods and the required MSDS, which can be referred to in case of a fire or emergency, **must** be available in a safe place away from the storage area. The following information should be available:

- Product name
- Amount
- Storage place in the warehouse
- Suitable fire fighting media (and, if appropriate, what media cannot be used).

The stock control list needs to be updated in the event of significant changes in the stock or at least weekly. It also has to be kept in a safe place where it is available/accessible in case of an emergency.

Stock Checks

It is important to carry out regular stock checks, to ensure that:

- Product use by dates do not expire before use
- Products are still valid with regard to current spray programmes
- Products are still legal
- A **first-in, first-out** stock use system is working
- Records are up to date and complete
- Any deterioration of containers is detected early and dealt with
- Slow moving products are noted.

Ancillary and non-routine operations

Record keeping is a very important aspect of store keeping. The stock records are used to monitor stock levels so that the product supply is not exhausted or products are not over ordered; to check on security; to provide information on chemical usage. Records are only useful if they are accurate, complete, up to date, presented clearly and legibly, and there is a system of records inside the store backed up by a system in the office. All records should be signed by the deliverer and the receiver.

Requisitions for products should be given in writing to ensure correct issuing and attributing responsibility and accountability to the relevant staff members.

Warning Signs

Each warehouse compartment **must** be equipped with adequate **warning signs** concerning the properties of the stored products or other risks or equipment to be considered at each section or respective place, e.g.:

- Marking of storage and transport areas
- Marking of emergency exits
- Hazard signs and warnings like:
 - Signs concerning height/number of pallets stored on top of each other, floor or rack strength/stability
 - Information about product hazard.

The warning signs should be easily understood by handlers, drivers and any persons working on the site or in the warehouse and **must** be prominently displayed. Typical signs include:

- 'Danger' (with skull & crossbones)
- 'Crop Protection Product Store'
- 'No Unauthorised Entry'
- 'Wear Protective Clothing'
- 'No Eating or Drinking'
- 'Fire Hazard'
- 'No Smoking'.

In addition, a list of authorised personnel, as well as emergency services' contact details **must** be displayed. It also makes sense to display **wall charts and posters** on safe handling of crop protection products.

Contractors and visitors

Visitors should not be allowed to enter the warehouse unaccompanied and they **must** be informed of emergency procedures, and other relevant rules, such as 'NO SMOKING'.

Contractors who may have to work in the store **must** be similarly informed. For them, a formal work permit **must** be issued before such work commences (see this chapter, paragraph 'non-routine activities').

Activities other than warehousing should be avoided in storage area.



Avoid all other activities in the storage area

Re-packing or refilling facilities may be necessary, but these **must** be located in a segregated area, free of stored products.

Vehicle maintenance and the overnight garaging of vehicles, other than electric forklift trucks, should not be permitted unless fitted with a battery isolation switch.

Stretch **wrapping** is a safer alternative to shrink wrapping, when some form of pallet covering is necessary. Electrostatic charging during the wrapping operation has to be considered and should be avoided in stores of flammable goods.

4. HYGIENE AND PERSONAL SAFETY

Housekeeping

Good housekeeping goes hand in hand with an efficient and safe operation. Poor housekeeping is not only an indication of a poor work attitude, but also provides the potential for an unsafe operation.

Good standards of hygiene should be maintained, including:

- Regular and systematic cleaning of floors and shelves, preferably using an industrial vacuum cleaner
- Washing facilities (amenities) for employees **must** be provided and, if feasible, with separation into 'clean and dirty' areas. The company should provide towels and soap
- Work clothing should be provided in a sufficient supply to be able to be changed, preferably daily, but at least weekly, and, if contaminated
- Workers **must not** be allowed to take their contaminated protective clothing home for washing. Instead, it should be washed on site or by an external washing company. The laundry company should be able to deal with (potentially) contaminated clothes and the washing water should be treated/disposed of adequately. Regular checks of the laundry should be made.

Personal protective equipment (PPE)

When handling crop protection products, it is important that appropriate protective equipment is worn.

Specific PPE (eye protection, gloves, protective suits, respiratory protection) has to be selected following a risk assessment of the work to be carried out and products handled and stored. Information from the product MSDS will need to be taken into account. However, consultation with an Occupational Hygienist is advisable.

Shrink wrapping activities involving hot air systems **must** be carefully controlled. Equipment and goods **must** be given time to cool down before the end of the working day. Shrink wrapping with open flames is not recommended at all.

Forklift trucks

Only authorised and properly trained drivers **must** be allowed to operate forklift trucks. Traffic flow **must** be properly regulated.

Forklift trucks **must** travel with forks lowered and **must not** carry passengers. It is recommended that a suitable fire extinguisher is available on every forklift truck.

Non-routine activities

All precautions to ensure safe normal working procedures can be undermined if maintenance or construction activities, which can produce sources of ignition or other risks, are allowed.

All non-routine activities **must** be authorised in writing.

The written work permit **must**:

- Record that the immediate work area is cleared of combustible materials
- Warn of possible dangers and indicate precautions to ensure that the job can be done safely
- Record who is assigned with the task of observing that sparks are properly quenched.



Written permits are needed for all non-routine jobs

For certain work tasks the following should be considered in addition to the usual work clothing:

- Unloading and loading of delivery vehicles: safety boots, overalls, gloves, eye protection
- Storage of containers: safety boots, gloves, eye protection
- Spillages: PVC aprons, overalls or suits made of special materials such as non-woven polypropylene, appropriate gloves, appropriate eye protection (goggles or goggles and face shields), appropriate respiratory protection (against dust and/or vapours)

PPE **must** be inspected routinely, maintained in a clean, sound condition and replaced whenever necessary. All equipment **must** be washed thoroughly in warm soapy water and rinsed in clean water after use. Respirators will require replacement of the pre-filter at the time of cleaning, although it may be possible to use the main filter cartridge on more than one occasion. Alternatively, for powders, disposable dust masks are available for use on a 'once-only' basis. It is strongly recommended that all protective equipment be issued on a personal basis.

First aid

A first aid kit **must** be provided. A clearly visible sign should indicate its location. It is recommended that posters giving basic first aid advice and emergency telephone numbers should be prominently displayed (See also CropLife International's publication 'Guidelines for emergency measures in case of crop protection product poisoning').

1. SKIN CONTAMINATION

Any product contamination of the skin **must** be washed off without delay. The installation of an emergency shower including eyewash station should be considered. In all cases, washing with copious amounts of water is mandatory.

Soap should be used in certain circumstances to facilitate decontamination, e.g. organophosphates and carbamates, which are destroyed by alkaline soap, or products insoluble in water (e.g. pyrethroids in solvents). With other products, washing with soap should be undertaken only after thorough rinsing (decontamination) with water.

Contaminated clothing, including footwear, **must** be removed immediately and completely, if necessary under the emergency shower. Lightly contaminated clothing **must** be washed before re-use. Heavily contaminated clothing **must** be disposed of in the appropriate way (see CropLife International's publication 'Guidelines for the avoidance, limitation and disposal of crop protection product waste on the farm').



Remove contaminated clothing and wash skin immediately

Any severe contamination **must** be followed by prompt medical attention. The MSDS or the product label should be sent with the affected person to the doctor or hospital.

2. EYE CONTAMINATION

Contamination of the eyes **must** be followed immediately by thorough rinsing, using an eyewash solution or clean running water for at least 15 minutes and check the MSDS. If complaints persist, if the MSDS states eye irritation potential, or if corneal or conjunctival damage is visible, it is strongly recommended that this treatment be followed by professional attention from a doctor or at a hospital.

The use of improperly prepared or stored eyewash solution can cause damage to the eyes, so change the solution frequently (at least every 3 months).

3. INHALATION/INGESTION

Accidental ingestion of crop protection products **must**, in all cases, be referred immediately to a doctor or hospital. Inhalation of dusts and vapours, if suspected, should be treated similarly.

Specific measures (e.g. induced vomiting, gastric lavage, specific treatments) should be described in the MSDS.

For further information, refer to CropLife International's publication 'Guidelines for emergency measures in cases of crop protection product poisoning'.

5. SPILLAGES AND WASTE DISPOSAL

Spillages

Leakages and spills can be prevented easily by careful handling of crop protection product containers, good storage conditions, stock control and checks. However, in the unlikely event of a spillage or a leak, storekeepers should be well prepared to deal with the problem.

All spillages **must** be reported to a responsible person and dealt with promptly. Spilled product **must not** be allowed to accumulate or spread about the store.



Water **must not** be used to wash away liquid spills.

Equipment to deal with spills

The following equipment should be reserved for emergencies and placed on a pallet or cart kept in a readily accessible location and marked with a prominent sign. The number of items and quantities of materials required will depend on the store size and likelihood and potential size of spill:

- Containers of granular clay or other absorbent material
- Broom, flat shovel and rubber wiper
- Empty large heavy-duty plastic bags
- Empty open-head drums
- Cloth and bucket of water, for washing surfaces
- Optionally, bags of sand (enough to build a protective dam).

Clean-up

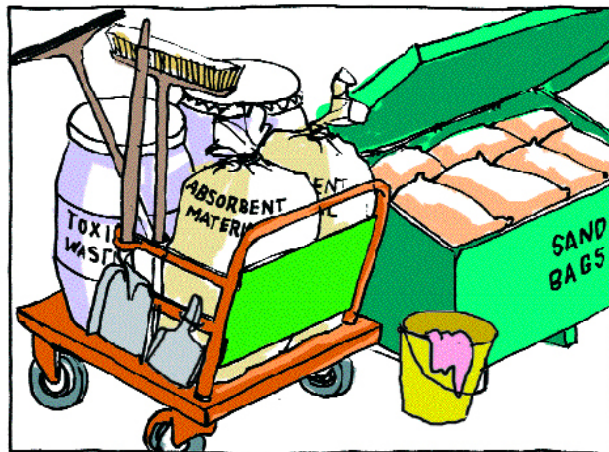
First put on protective clothing (always treat the product as hazardous until you have had a chance to check the label). Put the container on its side or upside down to stop the leak.

Spilled liquid products should first be absorbed onto sand or inert clay filler. Surround the spill with the sand or inert clay filler and then brush up by carefully mixing the spill with the absorbent material. Place the sweepings into a labelled, sealed container or strong plastic bag to await disposal.

Decant the remaining liquid crop protection product into a clean, labelled container, or reseal the container. Wash the contaminated floor thoroughly with water. Do not let the water run off; soak it up with more absorbent material as described above.

Powders and granules should be removed, preferably using an industrial quality vacuum cleaner fitted with both a primary and secondary filter. If a brush and shovel is used, airborne dust can be reduced by first spreading damp sand over the spillage. Then follow the same procedure as for spills.

Where outside drains exist, plugs or plastic bags filled with sand and water (including anti-freeze where necessary) **must** be positioned close to the drains to be able to block them.



Keep clean-up equipment for spills handy

Wastes for disposal

All chemical wastes **must** be disposed of in a safe manner. On no account **must** even small amounts of spillage be flushed into the surface water drainage system or sewers or any watercourses.

Chemical waste generated by a warehousing operation usually falls into three categories:

- Obsolete stocks
- Waste associated with spillage
- Contaminated packaging materials.

Waste associated with spillage will normally consist of:

- Collected spillage
- Contaminated absorbent material
- Contaminated empty containers.

Disposal methods

1. EMPTY CONTAINERS

Empty crop protection product containers **must not** be re-used. In special circumstances, e.g. for another formulation of the same active ingredient or where the container is regularly returned to the formulator for refilling, exceptions can be made. To prevent unauthorised re-use, containers **must** be thoroughly emptied, decontaminated by triple rinsing and punctured or crushed before disposal. Expert advice on all disposal questions should be obtained from the Material Safety Data Sheet (MSDS) or from the manufacturer.



Puncture and crush drums before disposal to prevent misuse

2. OBSOLETE STOCKS

Although waste associated with spillage tends to be disposed of fairly quickly, obsolete stocks are often simply left where they are. Prolonged inattention to obsolete stocks can lead to package deterioration and leakage at which point they can present a serious safety hazard. Moreover, after a long period they may become unidentifiable. These stocks should therefore be routinely and safely disposed of.

Advice on the disposal of obsolete stocks should always be sought from the supplier or from the local authorities.

1. INCINERATION

The recommended method for disposal of hazardous waste and contaminated materials is high-temperature incineration, operating at 1100°C with sufficient residence time (preferably > 2 sec) with integral combustion gas scrubbing facilities. It is also the most effective method of disposal for the majority of crop protection product waste types. The combustion gas/air mixture should have a 6% minimum oxygen content.

Destruction efficiency is dependent upon time as well as temperature and most licensed waste incinerators operate at higher temperatures and longer residence times. Often, cement kilns are used for such a purpose.

Incineration should only be undertaken in licensed facilities, suitable for the purpose.

Incineration of products containing mercury and iodine compounds can liberate dangerous gases/vapours and **must** therefore be disposed of via an alternative, approved disposal route. If in doubt, consult the appropriate MSDS or ask the supplier for expert advice.

2. DISPOSAL IN A WASTE LANDFILL

In the absence of high-temperature incineration, wastes for disposal should be directed to an appropriately licensed and approved landfill facility, which is suitable for the disposal of hazardous materials. If there are no other options available, controlled landfill may be undertaken. In these circumstances, disposal sites remote from watercourses should be selected and wherever possible, disposal operations should be supervised by a technically-competent person.

Any containers should have been emptied completely and, where possible, properly rinsed. Only approved landfills appropriate for the disposal of the waste should be used. The contamination of soil or groundwater due to the disposed waste **must** be avoided.

6. EMERGENCY MANAGEMENT

Emergency planning

All crop protection product wastes and crushed or punctured contaminated containers disposed of by this method **must** be immediately covered with soil to prevent contact exposure risk to humans, birds and animals.

Local waste disposal authorities or water disposal contractors may be able to advise on suitable sites for the disposal of collected spillage, contaminated absorbents and punctured empty contaminated or properly (triple-rinsed) containers.

Concentrated crop protection product wastes and unwanted products **must never** be disposed of to unlicensed, non-secure landfill sites, public rubbish tips or garbage dumps.

It is recommended to obtain a 'certificate of destruction' of the materials that have been transported out of the warehouse facility for destruction.

1. EMERGENCY PLANNING

An effective emergency plan will reduce the risk of injury to people and damage to property and environment. It should cover potential emergency situations including product contamination/poisoning, fire, flooding, leakage, accidents, tornado, hurricane, earthquake, criminal action.

Therefore it is vitally important to analyse what are the circumstances in which an emergency could occur, which measures have to be taken and who would make the appropriate decisions. An effective emergency plan includes an equipment plan, training and drills. Practising the plan will identify any difficulties or weaknesses and ensure that everyone knows what to do.

Any emergency plan should include collaboration and agreement with the local authorities. Also, it is highly recommended to establish co-operation with experts (e.g. environmental, medical) who can supply appropriate advice in case of necessity. A review of communication systems (e.g. mobile phones, Internet) also underlies effective emergency response.

Planning should not consider just the fire fighting arrangements, but also the consequences of smoke or fumes and the possible escape of fire fighting water. If during a fire, containment cannot be guaranteed and a serious threat to outside water courses becomes imminent, then, provided there is no immediate threat to people or other property, a decision to stop fire fighting may result in the least damage overall.

Other types of emergencies, which would require the involvement of other authorities, should be discussed and co-ordinated with the responsible body(ies) e.g. environmental authorities, hospitals, poison centres and police.



The emergency plan should show where to get help

2. EQUIPMENT PLAN

A plan showing the position of all fire fighting equipment including the location of all fire fighting pipes, hydrants and hoses, and all protective devices on site should be displayed in at least two places, one of which should be the store manager's office. A copy of the plan should be displayed at the same place.

Emergency training

Emergency training/drill

The staff of the warehouse/site should be trained in how to act in case of an emergency e.g. significant leakage or fire. Fire drills should be carried out together with the responsible local fire brigade. Drills should not only focus on fire fighting, but also on dealing with leakages.

Fire emergency plans must be practiced regularly to familiarise fire fighters with procedures and to test the equipment.

Fire drills should be supervised by line management and, if possible, also by the fire brigade.

It is important that drills should be carried out on site and that equipment is actually used, i.e. they should simulate an actual fire emergency.

All employees should be trained in the use of all types of fire fighting equipment present on site and practice their duties under the fire plan. This will provide for flexibility in an emergency and will provide cover in case of absence or injury.

Activities covered should include:

- Initiating the alarm
- The correct use of fire extinguishers
- Site evacuation procedures
- Accounting for all personnel present.

	<p>WATER-BASED Direct stream at base of fire</p>
	<p>DRY POWDER Start at base of flame and move up where burning</p>
	<p>CO₂ Discharge as close to fire as possible from edge of flame forwards and upwards</p>
	<p>FOAM Do not direct stream onto the burning liquid. Allow foam to fall lightly on fire</p>

Different types of fires need the correct extinguishing techniques

Fire fighting actions

1. GENERAL

During a fire, noxious fumes will be emitted and all smoke, regardless of the type of material burning, **must** be treated as hazardous.

Firemen engaged in fighting the fire will require the protection of a self-contained breathing apparatus. However, an examination of recent incidents of major crop protection product fires has provided evidence that people working and living beyond the immediate site of the fire will not normally require evacuation. This is because the ascending force of the hot gases (thermal up-current) causes high dilution of the combustion gases and these can normally penetrate only slowly into 'closed' rooms. Thus, such people should simply be advised to stay indoors, close windows and doors and switch off any ventilation systems.

Unpleasant odours caused by minute, but non-toxic quantities of strongly smelling substances may be detected even at great distances from the fire and cause alarm though they are harmless.

2. WHAT TO DO WHEN A FIRE IS DISCOVERED

1. Sound the alarm locally or send a co-worker to do so.
2. Make sure the fire brigade is called quickly. In the meantime, try to limit the fire from spreading to other locations.
3. If you think you can deal with the small fire yourself, use the nearest available extinguisher.
4. If assistance is required, DO NOT DELAY. Clear the area of all personnel except those actually dealing with the fire and have them report to the assembly point.
5. The fire brigade should carry out the procedures agreed upon.
6. Only professional fire fighters equipped with self-contained breathing apparatus may enter the fire area.
7. Anyone exposed to fumes or smoke in a crop protection product store should be relieved of duty and checked for possible poisoning.

8. Fumes and smoke given off by the fire **must** be assumed to be toxic. Be ready to keep employees upwind. Prepare with the police on how to warn residents downwind of the fire to stay indoors and close all windows and doors and switch off any ventilation systems or to evacuate if necessary.
9. To collect run-off water from the fire, close sluices and drain plugs and, where necessary, construct a barrier of earth or sand bags to contain run-off or burning liquids.
10. Any incident inevitably attracts public media enquiries. Experience has shown that, if possible, only one responsible person from the warehouse with sufficient training should deal with such enquiries to avoid confusion and misinformation amongst the public.

Beware:

Conditions within a building on fire will quickly become untenable for personnel not equipped with self-contained breathing apparatus.

It is recommended that samples should be taken by a third party to evaluate the impact of a fire on the neighbourhood. This should be done in co-operation with the relevant authorities. Samples may include air from the smoke clouds, fire fighting water, water from neighbouring wells or surface water or plants or soil from the neighbourhood that may have been contaminated.

Hints on fire fighting

Fighting large out-of-control fires **must** be left to professional fire fighters. Try to extinguish small fires to prevent them spreading. However, never put yourself or others in danger.

Use water sparingly, preferably as a fine spray. It is suitable for fires of wood, paper, cardboard or for cooling nearby items. Dry powder or foam is preferred for burning liquids.



Use water sparingly



A spray is preferable to a jet

3. CLEAN-UP AFTER A FIRE

During clean-up operations great care **must** be taken to ensure adequate personal protection and to prevent environmental pollution. The following actions should be taken:

1. Post warning signs and rope off or close off the contaminated burned-out area and water 'run-off' area to prevent unauthorised entry. If possible, prevent further spread of contamination by rain, by bonding or covering the area with tarpaulins. Allow access only to personnel concerned with the clean-up. Maintain continuous supervision until clean-up is completed.
2. The person in charge of the clean-up operation **must** be familiar with crop protection products. Otherwise, expert help should be called upon.
3. Prepare a detailed plan, in co-operation with the local authorities. Include arrangements to ensure that only materials that are proven to be harmless are transferred to non-company-controlled operators, like scrap dealers. Disposal can be made easier where sorting of the waste is possible. Notify the local public health authorities of the plan. In many cases, their assistance and co-operation can be very helpful. In some instances, their involvement is mandatory.
4. Provide all personnel with protective clothing including rubber boots, solvent-proof gloves, goggles and, if necessary, a suitable respirator or mask.
5. Prohibit smoking, eating and drinking in the contaminated area.
6. Check if there is a risk of the building collapsing. Be careful not to carry chemicals out of the area on boots, wheels, etc., Arrange means of scrubbing wheels and boots at the gate.
7. Store contaminated fire fighting water until a decontamination process has been instigated or disposal in a treatment plant becomes possible.
8. Waste from the fire (e.g. ash, contaminated materials) should be covered until it can be safely removed. This is to avoid it contaminating surface water via rain water or being blown away by the wind.

7. CHECKLIST

Toxic liquids and residues should be absorbed in to sand, inert clay filler, pumice or other suitable absorbents.

Do not wash any material into surface water drains, waterways or sewerage systems.

Solid wastes and residues should be collected, packed in polythene bags and placed inside steel containers to await disposal. High temperature incineration is the recommended disposal route for these waste types.

9. Use mechanical loaders, dump trucks, etc. to minimise human contact with contaminated material. Avoid raising dust. If dust is a problem, moisten or cover the load with disposable covers. Transport debris to an approved dumping area in tight metal-bodied dump trucks or tight containers. Avoid overloading so that no spills will occur en route.
10. Obtain professional help to sample fields, banks and ditches for analysis, if contamination with water or atmospheric fallout has occurred. The results of the analysis will determine whether wells **must** be closed, cattle moved, etc.
11. Carefully decontaminate tools, vehicles and clothing after the clean-up.
12. Document the clean-up procedure used.

In the case of existing warehouses, an assessment **must** be made, based on the fulfilment of the recommendations of these guidelines. This will determine whether continued use of the warehouse can be justified.

In the case of the construction of a new warehouse, the rules as described in these guidelines should be applied.

The following checklist has been prepared in a way that makes it easy to complete. The answers will assist in the identification of what actions are needed.

Location and buildings

1. Does the warehouse satisfy the requirements relating to the location?
 Yes No
 - a. Away from bore holes & wells? Yes No
 - b. Away from open water sources? Yes No
 - c. Away from domestic areas? Yes No
 - d. Away from human activity? Yes No
 - e. Away from food or grain storage areas?
 Yes No
 - f. Away from community service areas?
 Yes No

If NO, in what respects does it fail?

.....
.....

2. Does the warehouse satisfy the stipulations for site access? Yes No
3. What is the nominal storage capacity of the warehouse? tonnes
4. Does the warehouse fulfil requirements regarding:
 - construction materials? Yes No
 - floor surface? Yes No
 - internal fire-break walls? Yes No
 - roof covering and ventilation? Yes No
 - heat and smoke release? Yes No
 - drainage? Yes No
 - local fire regulations? Yes No

If NO, in what respects does it fail?

.....
.....

5. Is the warehouse bunding at least 14 cm in height?
 Yes No

6. What additional system for containment of fire fighting water exists?
- none? Yes No
 - underground retention pit? Yes No
 - external containment wall? Yes No
 - other?

Describe.....

7. What is the overall capacity of containment?
 m³

Is this sufficient to contain the expected volume of fire fighting water? Yes No

8. Is the warehouse well ventilated? Yes No

9. Are all vents above bunding height? Yes No

10. If the warehouse is heated:
- Is the heating source located away from the storage area? Yes No
 - Is direct heating of products avoided? Yes No

11. Is there sufficient light? Yes No

Is it properly positioned? Yes No

12. Is the warehouse fitted with a lightning conductor? Yes No

13. Are sufficient emergency exits provided? Yes No

Do they conform to local safety requirements? Yes No

14. If any office or amenity accommodation exists in the warehouse structure:

• Is it adequately segregated from the store? Yes No

• Has it an exit other than through the warehouse? Yes No

Fire and environmental protection

15. Is the prohibition of smoking rigidly enforced in the warehouse? Yes No

16. Are the forklift trucks operating in warehouses with flammable goods properly protected from generating sparks? Yes No

17. Is product stored at a safe distance from light fittings, electrical equipment and ancillary operations such as shrink wrapping? Yes No

18. Does the number and type of fire extinguishers, hydrants and hose-lines satisfy requirements? Yes No

19. Does the warehouse have automatic protection such as sprinklers or smoke detectors? Yes No

Are maintenance and tests carried out periodically for fire detection and fire fighting equipment? (This includes the respective documentation.)

- Extinguishers (yearly)? Yes No

- Alarm systems (bi-monthly)? Yes No

- Sprinklers (yearly)? Yes No

- Fire fighting pump(s)? Yes No

20. Are fire alarms automatically linked to the fire brigade? Yes No

What is their response time? mins

Warehouse management

21. Is there a defined management structure with clear areas of responsibility? Yes No

22. Do these responsibilities include:

• Receipt and dispatch of goods? Yes No

• Occupational health and safety? Yes No

• Industrial hygiene and safety? Yes No

• Maintaining suitable storage conditions? Yes No

• Security? Yes No

• Protection of the environment? Yes No

• Emergency procedure plans? Yes No

23. Does the warehouse have adequate precautions against arson and burglary? Yes No

24. Do these precautions include:

• Alarm systems? Yes No

• Burglar-proof gates and windows? Yes No

• Fenced-in premises? Yes No

• 24-hour guard service? Yes No

• Perimeter lighting? Yes No

25. Are all staff adequately trained concerning:

• Occupational Health and Safety? Yes No

• General company requirements?

- safety procedures? Yes No

- FAO International Code of Conduct on the Distribution and Use of Pesticides? Yes No

- location & use of Material Data Safety Sheets (MSDS)? Yes No

• Knowledge of product hazards? Yes No

- Safe operating procedures? Yes No
 - Emergency response procedures?
 - Spill response training? Yes No
 - Fire extinguisher training? Yes No
 - Respiratory protection training (and test fitting)? Yes No
 - Powered industrial truck training (forklift trucks etc)? Yes No
26. Is a supervisor present during receipt and dispatch of all goods to check documents, package integrity, etc.? Yes No
27. Are current Material Safety Data Sheets (MSDS) available for all products? Yes No
28. Is an outline of the materials storage plan in each warehouse kept up to date? Yes No
29. If any product is stored outside the warehouse are conditions satisfactory regarding
- Security? Yes No
 - Weather protection? Yes No
 - Access for fire fighting? Yes No
30. Is the warehouse divided into distinct and separate storage bays? Yes No
31. Are passageways clearly marked and accessible? Yes No
32. Does the arrangement for block storage comply with recommendations? Yes No
33. Are the racks used in the warehouse non-combustible? Yes No
34. Are stock records kept up to date? Yes No
35. Do the stock records guarantee knowledge of the quantity and location of the goods at any time? Yes No
36. Does product segregation or separation within the premises satisfy requirements? Yes No
37. If ancillary operations like shrink wrapping, refilling or repacking are carried out, are these done in a segregated room? Yes No
38. Are all non-routine maintenance or construction activities authorised in writing? Yes No
39. Are the requirements on use and charging of forklift trucks met? Yes No

Hygiene and personal safety

40. Are standards of hygiene and housekeeping adequate? Yes No
41. Are personnel issued with work clothes and protective gloves? Yes No
Are these routinely worn when handling products? Yes No
42. Does protective equipment exist on the premises for handling spills? Yes No
43. Are adequate first aid materials and facilities provided? Yes No
Is the staff familiar with their use? Yes No

Spillages

44. Is there an agreed procedure for dealing with spillages? Yes No
45. Are spilled dry products removed by vacuum cleaner? Yes No
46. Is there a full set of spill equipment? Yes No
47. Is absorbent material available? Yes No

Waste disposal

48. Are wastes disposed of in a safe manner? Yes No
49. Have the methods of disposal been approved by the authorities? Yes No
50. Is the re-use of emptied containers satisfactorily prevented? Yes No

Emergency management

51. Is there a plan to deal with emergencies? Yes No
52. Has this been agreed with the local fire brigade? Yes No
53. Is there a fire plan showing positions of all fire fighting equipment? Yes No
54. Are personnel trained in fire fighting? Yes No
55. Is a fire drill regularly practised in co-operation with the local fire brigade? Yes No
56. Can the emergency agencies be contacted immediately? Yes No

8. APPENDIX: STORAGE GUIDE




Product classification - Hazard Classes and Hazards Symbols following the UN Classification for Dangerous Goods

The Classification based on the UN Globally Harmonised System of Classification and Labelling of Chemicals is included for information and comparison as this system may be used and accepted in future.





The classifications of the different systems are not identical, so the comparison does not fit absolutely. We have endeavoured to compare as well as possible how they match.

Segregation means storing separately in different rooms with a fire wall as a barrier




Separation means storing separately in different parts of the same room

United Nations Classes of Hazard Label*	Dangerous Goods Hazard Class	Method of Storage / Special Recommendations	GHS Classification
	2. (in)flammable** gas	segregate; explosion-proof equipment or open-air storage needed	Flammable aerosols
	3. - (in)flammable** liquids Flashpoint 61° or below - Combustible liquids Flashpoint above 61°	not to exceed 250 tonnes, unless fire-protected recommended not to exceed 250 tonnes	Flammable liquids (category 1 – 3) Flammable liquids (category 4)
	4. (in)flammable** solids	recommended not to exceed 250 tonnes	Flammable solids

*Note: hand drawn signs must not be used.
Size and quality of signs are defined by regulations
**Note: Inflammable and flammable have the same meaning (British vs. American usage)

United Nations Classes of Hazard Label*	Dangerous Goods Hazard Class	Method of Storage / Special Recommendations	GHS Classification
	4.2. Spontaneously combustible	segregate; open-air storage recommended	Pyrophoric liquids, pyrophoric solids, self-heating substances
	4.3. Dangerous when wet	segregate; no sprinkler! protect from rain	Substances, that, in contact with water, emit flammable gases
	5. Oxidizing substances	separate from flammables or combustibles	Organic peroxides
	6. toxic substances	legal requirements may demand segregation if highly toxic (LD50 oral <25mg/kg)	Toxic substances

*Note: hand drawn signs must not be used.
Size and quality of signs are defined by regulations

United Nations Classes of Hazard Label*	Dangerous Goods Hazard Class	Method of Storage / Special Recommendations	GHS Classification
	6. & 3. Toxic flammable	treat as flammable or combustible as mentioned above (max. 250 tonnes)	
	8. Corrosives	separate from crop protection product packed in metal	Corrosive substances
	9. Various dangerous substances	no limit: if non-combustible use as a barrier for separation; Consideration of combustible solids is recommended	Hazardous to the aquatic environment

*Note: hand drawn signs must not be used.
Size and quality of signs are defined by regulations

9. USEFUL REFERENCES

CropLife International publications

Guidelines for the safe and effective use of crop protection products (Guideline 1)

Guidelines for personal protection when using crop protection products in hot climates (Guideline 2)

Guidelines for the safe transport of crop protection products (Guideline 4)

Guidelines for the avoidance, limitation and disposal of crop protection product waste on the farm (Guideline 5)

Guidelines for the safe formulation and packaging of crop protection products (Guideline 6)

Guidelines for emergency measures in cases of crop protection product poisoning (Guideline 7)

Also visit the Croplife International website for latest information and publications.

www.croplife.org

Other publications

IVA-Leitlinie "Sichere Lagerung von Pflanzenschutz- und Schädlingsbekämpfungsmitteln", Industrieverband Agrar, Frankfurt am Main, Germany (in German)

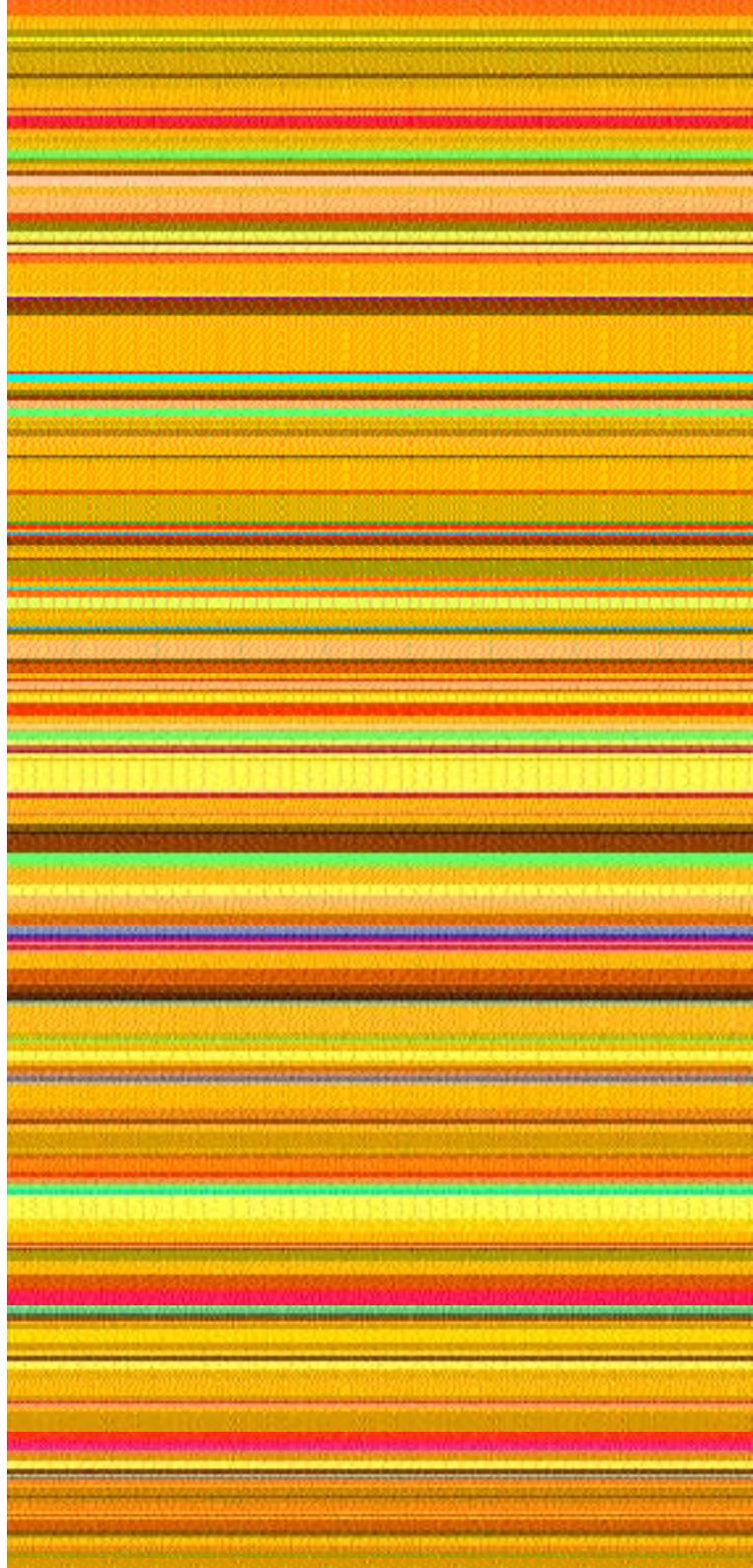
Food and Agriculture Organization of the United Nations (FAO) Pesticide Storage Manual (publication V8966). www.fao.org/ag/AGP/agpp/Pesticid/r.htm

Booklets from the British Crop Protection Council, BCPC Publications, 7 Omni Business Centre, Omega Park, Alton Hampshire, GU34 2QD, U.K.

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