HANDBOOK FOR THE SAFE STORAGE OF AMMONIUM NITRATE BASED FERTILIZERS

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HANDBOOK FOR THE SAFE STORAGE OF AMMONIUM NITRATE BASED FERTILIZERS

This booklet has been published under the joint auspices of the International Fertilizer Industry Association (IFA) and the European Fertilizer Manufacturers Association (EFMA) for the information of their constituent members.

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FOREWORD

Manufacturers have the responsibility of ensuring that all personnel under their control, engaged in handling and storage of ammonium nitrate based fertilizers have adequate knowledge of the potential hazards, means of prevention of the hazards and action to be taken in the event of an emergency. Manufacturers should take steps to ensure that this information is passed down the distribution chain to the final user so that all engaged in handling fertilizers are aware of the safe practices to be followed.

1. GENERAL INFORMATION

1.1 Introduction and Aims

1.1.1 The Handbook is intended for the use of manufacturers and suppliers. It sets out recommendations for the handling and storage of straight ammonium nitrate fertilizers and compound fertilizers containing ammonium nitrate hereinafter called **AMMONIUM NITRATE BASED FERTILIZERS.** The recommendations are based on the specific properties of the fertilizers. The Handbook provides advice on conditions in which ammonium nitrate based fertilizers can be handled and stored safely in both bulk and packaged form. It does not recommend one form of storage in preference to the other. The issuing fertilizer organisations believe that if users of this Handbook carefully follow' these recommendations the potential hazards of these fertilizers during storage and handling are minimised.

1.1.2 The laws relating to the storage of fertilizers vary from country to country with some accepting bulk and others not. In producing storage recommendations for both packages and bulk, IFA/EFMA have aimed to provide a comprehensive reference for all permitted circumstances. Furthermore the Handbook may serve as a reference for the preparation of rules and recommendations on safe handling and storage where no national regulations are available. It is strongly recommended that member companies within each country should, through their national associations, develop a code of practice for safe storage of these fertilizers using the guidance contained in this Handbook. This should incorporate some form of inspection procedure, by the manufacturer or supplier, to ensure that the premises used are suitable for the storage of fertilizer. Any code of practice based on this Handbook must recognise and conform to national rules.

1.1.3 This Handbook deals with the classification of ammonium nitrate based fertilizers and reviews their properties. It gives suggestions for good management and a list of basic good practices. It also includes recommendations for emergency action and first aid procedures in case of an accident.

1.2 Definitions

Ammonium Nitrate Based Fertilizers

Fertilizers which contain nitrogen in both ammonium and nitrate forms are, for the purpose of this guide, defined as **AMMONIUM NITRATE BASED FERTILISERS.** These fertilizers are generally supplied in prilled or granular form.

Straight Fertilizers

Fertilizers containing only one of the three plant nutrients N, P (P_20_5) K (K_2O).

Compound Fertilizers

Fertilizers containing two or more of the plant nutrients N, P ($P_2 0_5$) or K ($K_2 0$). This Handbook is concerned only with those fertilizers where the nitrogen content is derived totally or partially from ammonium nitrate.

Ammonium Nitrate Content, NH_4NO_3

For the purpose of the classification given later the content of ammonium nitrate in fertilizer is calculated according to the following rule:

All nitrate ions in a mixture for which a molecular equivalent of ammonium ions is present must be calculated as ammonium nitrate.

Example: *The ammonium nitrate Content of a fertilizer which contains 7% nitrate nitrogen and 12% ammoniacal nitrogen is calculated as follows:*
Nitrogen content derived from ammonium nitrate equals:
7% nitrate N and 7% ammoniacal N = 14% N
As pure ammonium nitrate contains 35% nitrogen, the ammonium nitrate content of this fertilizer is:
14/35 x 100 = 40%

Inert Materials

Inorganic filler materials which are inert, that is they do not affect the hazardous properties of ammonium nitrate.

Other Fillers

Some filler materials, such as calcium carbonate, dampen the detonation properties of ammonium nitrate. This effect is taken into account in the classification.

Total Combustible Material

The total amount of inorganic and organic combustible material present in the product. This is conventionally calculated as carbon.

1.3 Preservation of Quality

Fertilizers are normally manufactured as high quality materials in the form of prills or granules. It is in the interest of all concerned with the handling and storage of fertilizers to ensure that the quality is maintained right up to the point of usage: namely no moisture pick up or caking, free from contamination and of minimal dust content.

The general principles for the preservation of quality are:

- *Prevention of moisture pick up and caking.* This may require covering bulk material with plastic sheets during storage or transportation and

keeping storage buildings closed as much as possible to prevent ingress of moist air.

- *Prevention of contamination.* Storage areas should be cleaned before fertilizer is introduced. Access areas should be kept clean during storage. Spillage should be cleared up as soon as practicable.

- *Prevention of product breakdown.* Fertilizers, particularly of Type A (2.2) should not be stored in direct sunlight or in conditions where temperature cycling can occur, otherwise particles may breakdown (3.2.1.)

Many of the procedures necessary to maintain quality are the same as those required for the safe handling and storage of ammonium nitrate based fertilizers

Adherence to the principles outlined in the following sections of this Handbook will help to ensure the quality and safety of the material.

1,4 Objectives of the Recommendations and Principles for the Storage of Fertilizers

The objective of the recommendations is to specify good storage conditions for fertilizers to preserve quality and to ensure safety. In most cases requirements for quality and safety are similar. Warnings on how dangerous situations could arise and advice on how to avoid these are given in later sections.

In the selection of storage sites consideration should be given to the risk of water pollution. for example in waterways and canals, by fire-fighting water which may contain ammonium nitrate.

The essential principles which govern the preservation of quality and safe storage of ammonium nitrate based fertilizers are:

- Avoidance of moisture uptake.
- Prevention of contamination with foreign matter, whatever its composition, but particularly combustible matter, farm chemicals such as weedkillers, organic materials, oils and greases, acids and alkalis,
- Observance of good housekeeping principles.
- Avoidance of involvement of fertilizers in a fire.
- Storage away from sources of heat.
- Observance of fire precautions.
- Avoidance of serious confinement.
- Storage away from explosives.

2. CLASSIFICATION FOR STORAGE PURPOSES

2.1 General

The classifications below follow important national as well as international recommendations for transportation and storage. but do not include mixtures of ammonium nitrate with larger amounts of combustible material than specified below. In some cases this would change the classification of the product to that of an explosive or any product which is not defined within the detailed classification below. Fertilizers that are not covered by this detailed classification should be referred to the appropriate national authority,

Information on methods for testing the properties of ammonium nitrate based fertilizers is published by IFA/EFMA (Selected Tests Concerning the Safety Aspects of Fertilizers — I 992).

For the purposes of storage recommendations contained in this Handbook, ammonium nitrate based fertilizers have been classified into three Types. A, B and C, dependent on the ammonium nitrate content, the type and content of added matter and the reaction to heat.

The system is similar, but not identical, to the United Nations Classification (Transport of Dangerous Goods. United Nations. New York, 1991 — ST/SG/AC10/l/Rev, 7), In the system used in this Handbook, the definition of Type A fertilizers is the same as that used in Class 5.1 in the UN system. The definition of Type B fertilizers is similar to that used in UN Class 9. The Type C category used in this Handbook is not used in either the UN system or the IMDG Code. The classification used in this Handbook is intended only for storage purposes. For transport requirements reference must be made to the code appropriate to the mode of transport i.e. IMDC for sea, ADR for road. RID for rail, IATA/ICAO for air etc...

Manufacturers and/or suppliers should provide information on whether a particular fertilizer is Type A, Type B or Type C.

2.2 Ammonium Nitrate Based Fertilizers — Type A

These fertilizers listed below as A1 to A4 are classified as oxidising agents. They assist combustion of other materials and in a major fire can give rise to a hazardous situation.

A1 Mixtures of ammonium nitrate with added matter which is inorganic and chemically inert towards ammonium nitrate with:

- not less than 90% ammonium nitrate and not more than 0.2% of total combustible material (including organic material calculated as carbon), *or*

- more than ‘70% but less than 90% of ammonium nitrate and not more than 04% of total combustible material (Both are covered by UN Number 2067.)

A2. Mixtures of ammonium nitrate with calcium carbonate and/or dolomite with more than 80% but less than 90% ammonium nitrate and not more than 0,4% total combustible material (covered by UN Number 2068).

A3 Mixtures of ammonium nitrate/ammonium sulphate with more than 45% but not more than 70% of ammonium nitrate and not more than 0,4% of total combustible material (covered by UN Number 2069).

A4 Mixtures containing nitrogen/phosphate or nitrogen/potash or complete fertilizers containing nitrogen/phosphate/potash with more than 70% but less than 90% ammonium nitrate and not more than 04% of total combustible material (covered by UN Number 2070).

2.3 Ammonium Nitrate Based Fertilizers — Type B

The main hazardous property of this type of fertilizer is the ability to undergo self-sustaining decomposition (3.4.3). They are not regarded as oxidising agents.

Fertilizers in this category include non-segregating mixtures containing nitrogen (nitrate)/phosphate or nitrogen (nitrate)potash or complete fertilizers containing nitrogen (nitrate)/phosphate/potash with not more than 70% ammonium nitrate and not more than 0,4% of total added combustible material, or with not more than 45% of ammonium nitrate with unrestricted combustible material (covered by UN Number 2071).

Please Note:

- Fertilizers of the same composition and within the above limits which, as a result of testing in the “Trough Test” are found to be free from the risk of self-sustaining decomposition, are regarded as Type C fertilizers. (The “Trough Test” is detailed in the UN Transport Code Class 9.)

- By non-segregation is meant that the component parts of the mixture should not segregate during handling, to such an extent that a significant volume of the mixture no longer complies with the classification i.e. a significant portion of the mixture contains more than 70% ammonium nitrate.

2.4 Ammonium Nitrate Based Fertilizers — Type C

Fertilizers in this category are not capable of self-sustaining decomposition and in International Transport Codes are considered non-hazardous with the exception of transport by air when this type of fertilizer remains classified as UN Number 2071 (Type B in this Handbook).

Specifically this classification refers to fertilizer under the following compositions:

- Mixtures of ammonium nitrate with calcium carbonate and/or dolomite containing not more than 80% of ammonium nitrate and not more than 0,4% total combustible material.

- Mixtures of ammonium nitrate/ammonium sulphate containing not more than 45% ammonium nitrate and not more than 0.4% of total combustible material.

- Fertilizers conforming to the Type B composition and which do not exhibit the property of self-sustaining decomposition (covered by UN Number 2071).

3. PROPERTIES AND POTENTIAL HAZARDS OF AMMONIUM NITRATE BASED FERTILIZERS

3.1 General

All ammonium nitrate based fertilizers are, under normal conditions stable materials which in themselves present no risk. Most fertilizer grades of ammonium nitrate are manufactured in such a way that the resistance of the product to detonation is high. They are not combustible. However, they can decompose under fire conditions and may enhance the severity of the fire and give off toxic fumes and gases. With fertilizers containing a high concentration of ammonium nitrate, melting may also occur.

Under extreme fire conditions, particularly if the fertilizer is contaminated with combustible material and confined in an enclosed space, there is the possibility of an explosion. The risk is minimised if the recommendations in this Handbook are followed.

Ammonia gas can be liberated from ammonium nitrate based fertilizers (as from all ammonium salts) when they come into contact with alkaline materials such as lime. Ammonia is a toxic gas: it is colourless but its presence can be detected because of its characteristic strong smell.

Mixtures of ammonium nitrate dust and air do not present an explosion hazard.

3.2 Properties of Type A Fertilizers

3.2.1 Types A1, A2 and A3 Fertilizers

Fertilizers containing ammonium nitrate are generally manufactured in a prilled or granular form which enhances their quality and safety. In some formulations inclusion of materials such as dolomite or calcium carbonate suppresses acidity. In many cases additives are incorporated to prevent the disintegration of the product that could otherwise occur when the temperature is cycled through 32°C. This disintegration is caused by the significant increase in volume of the particles associated with the crystal structure change that occurs at about 32°C in products without such additives,

These manufacturing procedures result in a limitation in the ammonium nitrate content. giving a practical maximum of 34,5% nitrogen in the product.

(Pure ammonium nitrate contains 35*% nitrogen.)*

Highly concentrated ammonium nitrate fertilizers are specifically made

in the form of high density prills or granules of low porosity and high purity to minimise any detonation risk. These materials are very resistant to detonation.

These concentrated ammonium nitrate fertilizers are oxidising agents and in fire conditions can assist the combustion of other materials. They may melt at temperatures somewhat lower than the melting point of pure ammonium nitrate (169^0C). When heated sufficiently, for example in fire conditions, they can decompose giving off gases containing toxic oxides of nitrogen.

In unfavourable storage and handling conditions these fertilizers may absorb water from the atmosphere. In addition, when stored in direct sunlight, or in conditions such as in transport where fluctuations between high and low temperatures can occur the surface layers of the product may swell and disintegrate particularly if water has been absorbed, The effect is usually restricted to the surface layers of the product whether the material is in bags or in bulk, This results in material of unacceptable quality. In some cases with packaged material it can also result in damage to the bags, Precautions that can be taken to avoid the problem are outlined in Section 7.8.2.

3.2.2 Type A4 Fertilizers

These fertilizers contain other plant nutrients in addition to nitrogen, They have the properties of Types A1, A2 and A3 above and exceptionally, in addition, may exhibit some of the properties described under Type B below,

3.3 Properties of Type B Fertilizers

3.3.1 General

In these fertilizers the ammonium nitrate content is lower than in Type A4 (that is, they contain less than 70% ammonium nitrate),

Type B covers only those fertilizers in which thermal decomposition continues even when the external initiating heat source is removed. This distinguishes them from fertilizers covered under Type C (3.5). They may also suffer product disintegration when cycled through a temperature of $32°^0$C.

An understanding of the particular properties of Type B fertilizers, namely thermal decomposition, self-sustaining decomposition and self-heating is essential when considering safe storage and handling practices and these properties are discussed in more detail in Section 3.4.3,

3.4 Potential Hazards of Type A and Type B Fertilizers

3.4.1 General

These types of fertilizers are potentially more hazardous than Type C in nature for the reasons given in Section 2. A brief description of their likely behaviour in hazardous conditions is given here to illustrate the reasons for the recommendations in Section 7 and 8.

3.4.2 Fire Hazard

Fertilizers are not combustible hence the risk of fire is dependent on other combustible materials which may be present, such as parts of equipment. fuels/fluids used in the handling equipment and combustible materials stored or used in the construction of the store or bays. Experience has shown that if fires occur in fertilizer stores they are usually initiated in combustible materials present outside the fertilizer stacks or heaps. The size and intensity of fire is significantly dependent on the nature and quantity of these combustible materials,

When bagged material is involved in a fire the packaging material may melt and break, releasing the product. Polythene and similar packaging materials do not generally propagate burning through the stack. Hot or molten fertilizer can, however, oxidise the packaging material, but the amount of the packaging material is too small to make a significant effect on the fire. The hot spilled fertilizer may cause burning and continued smouldering of wooden pallets, if present, generally in the area of contact. In addition. pallets can allow heat and flame to penetrate into the interior of the stack,

In the case of bulk material there are no packaging materials and wooden pallets involved, hence fire cannot penetrate into the heap. Involvement of the fertilizer depends. as with bagged material, on the severity of the fire and on other materials present.

3.4.3 Thermal and Self-Sustaining Decompositions

Both Types A and B will decompose, if involved in a fire; fumes containing toxic components will be evolved.

Type B will undergo self-sustaining decomposition when exposed to an external heat source. Sources can be relatively minor such as buried inspection lamps or hot metal from welding operations.

The properties of Type B fertilizers, namely thermal decomposition, self-sustaining decomposition and self-heating are as follows:

- *Thermal.and SeIf-Sustaining Decompositions.* When these fertilizers are acidic (that is with a pH of a 10% solution/suspension of fertilizer

in water lower than pH 4.2) and/or contain materials which have a catalytic effect, such as chlorides and/or copper, thermal decomposition can take a different course to that of the straight ammonium nitrate fertilizers considered above. Decomposition can start when the fertilizers are in the solid state; toxic oxides of nitrogen together with hydrochloric acid vapour and chlorine gas can be evolved, Chloride contents as low as 0.5% (expressed as chlorine) in a mixture containing ammonium nitrate can be sufficient to have a significant effect on the decomposition.

In many cases the decomposition, initiated by an external heat source, will stop when the heat source is removed (Type C). With some fertilizers (Type B) however, the decomposition will continue and spread deep into the mass of material even when the heat source is removed. This is the phenomenon of self-sustaining decomposition sometimes referred to as cigar burning where the decomposition propagates through the mass of the material.

The characteristics of the self-sustaining decomposition phenomenon, (speed of propagation, temperature in the decomposition zone, amount of gas produced), depend on the composition of the fertilizer and on the extent of melting at the decomposition temperature. The presence of trace elements such as copper compounds and impurities such as chromium compounds exert an influence.

The volume of the gases, which include steam, nitrogen oxides and chlorides, can reach 400 times the volume of the mixture; the temperature in the decomposition zone is usually in the range 300-500°C.

- *Self-heating during storage.* The presence of combustible materials in ammonium nitrate fertilizers can, when the mixture is acidic, induce a spontaneous heating reaction, This results from the slow oxidation of the combustible materials. In the majority of cases this heating is of very modest proportions. In an extreme case. However, particularly if the initial temperature of the fertilizer is high, the heating can lead to the thermal decomposition of the fertilizer with the evolution of gases which contain toxic compounds.

  Reactions between components of the fertilizer during storage can also be a cause of self-heating. The extent of such heating is low, seldom exceeding 10^0C, and normally presents no hazard,

3.4.4 Detonation Hazard

This applies to Type A fertilizers only.

Ammonium nitrate based fertilizer in the form of high density prills or

granules of low porosity is very resistant to detonation. The resistance is decreased by a number of factors, e.g. contamination with combustible and/or incompatible substances, as listed in Section 7.2.2, reduction in size and increase in porosity.

The two main mechanisms which in theory can cause a detonation in an ammonium nitrate fertilizer stack or bulk heap are:

- the development of rapid decomposition (deflagration) in a fire and transition to detonation

- shock initiation by an adjacent explosion or projectile impact.

Transition of any rapid decomposition (deflagration) to detonation in a stack or bulk heap involved in a fire is very unlikely because the very severe conditions of enhanced pressure which are necessary are not met in practice.

The theoretical possibilities are that the fertilizer may detonate when:

- Subjected to an external shock wave: that is an adjacent detonation of a high explosive.

  NOTE: high density fertilizers such as those conforming to EC Directive 80/876 are very resistant in this respect and therefore are unlikely to detonate.

- Heated and severely confined for example when molten ammonium nitrate runs into drains.

  NOTE: in some cases the confining tube will rupture before the material reaches pressures necessary for detonation. Pressure burst of tubes in these circumstances can occur with Type B and C fertilizer as well as with Type A.

- Struck by high velocity projectiles : projectiles can be generated when ammonium nitrate based fertilizer, confined in hollow sections of equipment such as conveyor rollers and components of shovels, is involved in a fire. The rupture of welding equipment such as gas cylinders can have a similar effect. Falling objects, such as roof beams or building structures, which may be produced in a severe fire do not have sufficient impact energy to initiate a detonation even in molten decomposing fertilizer.

The sensitivity to detonation by these three possibilities is increased with temperature of the fertilizer and contamination. Contamination of material by fuel and/or hydraulic oil is more likely with bulk material, and care must be exercised to avoid this.

3.5 Properties and Potential Hazards of Type C Fertilizers

3.5.1 General

These fertilizers can contain the same components as Type A and Type B above but have a lower ammonium nitrate content than the corresponding group in Type A and a higher content of inert material. There is no risk of detonation under conceivable storage conditions, nor do they exhibit the property of self-sustaining decomposition. They may, however, exhibit the other thermal decomposition characteristics described in 3.4.3 above. In a fire therefore they could decompose liberating substantial quantities of fume. They may also suffer product disintegration when cycled through a temperature of 32^0C.

3.5.2 Potential Hazards of Type C Fertilizers

Type C fertilizers do not have the same potential hazards as the Type A and Type B materials. They do not present an explosion risk in normal storage and handling operations. However heating and confinement should be avoided. Many will decompose, evolving toxic fumes, if involved in a fire but they will not undergo the self-sustaining decomposition phenomenon. This means that the decomposition of the fertilizer will stop once the fire initiating it has been extinguished.

4.. CHARACTERISTICS OF HANDLING AND STORAGE MODES

..

4.1 General

Type A and Type B fertilizers are potentially more hazardous than Type C. Consequently storage conditions and recommendations for Type A and Type B are more stringent than those for Type C.

Ammonium nitrate based fertilizers can be stored handled and transported in packaged form or in bulk. There are advantages, disadvantages and potential hazards associated with each mode. These are described later. Sections 7-9 give detailed recommendations for each storage mode according to the classification of the fertilizer Type A, B or C.

Strict adherence to the recommendations contained in this Handbook will minimise the risk of an accident and enable the fertilizers to be stored safely. Continued vigilance is necessary to ensure that the recommendations are followed at all times.

4.2 Packages

4.2.1. Requirements and Types

Packages can vary in size from the normal 50kg bags to Intermediate Bulk Containers (IBC's or "Big Bags") with capacities commonly up to 1 tonne. Groups of bags may be palletised for stacking by fork lift truck or other appropriate means.

The bags used for packaging ammonium nitrate based fertilizers should be moisture proof and should be sealed or adequately closed so as to prevent ingress of moisture. They should comply with the relevant national/international packaging regulations and should show adequate resistance to deterioration caused by the climatic conditions to which they may be exposed.

The type of bags used, their size and construction will depend on the frequency and method of handling climatic conditions and market requirements. They should be resistant to contamination by water and oil. Polythene bags are widely used for this reason. In handling operations, precautions are needed to avoid puncturing of the bags and hooks should not be used,

The bags should be clearly labelled to indicate their contents. National and international regulations should also be complied with and where no regulations exist, it is recommended that the yellow "Oxidising Agent" label should be on bags of Type A fertilizers.

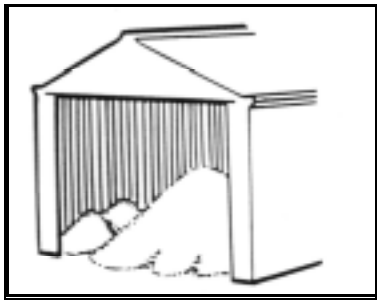
4.2.2. Characteristics and Safety Considerations

With packaged materials inadvertent contamination is avoided and the package protects the product from moisture pick-up. Labelling of the package leads to easy identification of the product and, in some circumstances, it may be possible to move the material out of the danger area in the event of an emergency. However, particularly when the product is palletised, gaps between the bags and pallets make penetration of heat and flame into the stack easier in the event of fire and the collapse of the package under fire conditions can hinder fire fighting. Generally speaking, with packaged material there is a higher surface area exposed to fire or heat sources.

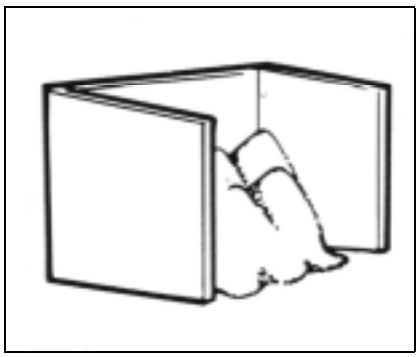
4.3 Bulk Material

4.3.1 Requirements and Types

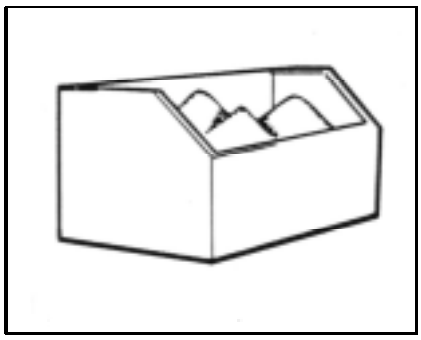
Fertilizer can be stored in bulk form in large unconfined heaps in buildings, in heaps, in bays built into storage space, in bunkers, bins or hoppers. (Note: There may be regional variations in the names used.) These arrangements are shown below with typical filling and recovery (i.e. reclaiming) methods currently in use.



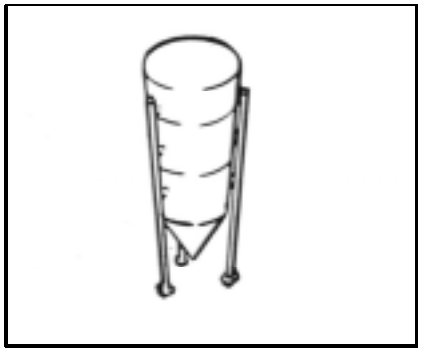
Shed — Fertilizer is stored in large heaps in dedicated sheds (generally at manufacturing sires). Filling is by overhead in-feed system. vehicles or tippers and recovery is by shovels or scraper reclaimer. Subway conveyors are not recommended for Type A or Type B fertilizers.



Open Bays — Fertilizer is contained in a bay on three sides, with access from one side for recover and/or filling. Filling is by overhead infeed system, vehicle or tippers. Recovery is by shovels or scraper reclaimer.



Bunker — Fertilizer is contained within the bunker with no access to product by vehicles. Filling is generally by over-head infeed system and for recovery scraper reclaimer is used.



Closed Bin, Hopper or Silo — Fertilizer contained within the bin is filled pneumatically or by other suitable means and is recovered from the bottom. (The capacity is commonly up to 30t.)

The storage systems fall into two main types. In the case of sheds and open bays the bulk material is loose on the floor and not well contained. facilitating exposure of product to vehicles and shovels and ingress of spillages of other substances.

In the case of bunkers, closed bins, hoppers and silos, the product is well contained, minimising exposure to foreign materials. The use of purpose built feeding and reclaim systems further reduces the contamination risk. Bunkers are particularly suitable for relatively large-scale operations.

4.3.2 Characteristics and Safety Considerations

For bulk storage it is difficult for fire and heat to penetrate into the interior of the heap from the surface and there is a lower risk of the formation of molten material in the case of Type A fertilizers, However, there is a greater risk of inadvertent contamination during handling, transport and storage operations. Bulk heaps require protection from the atmosphere to

prevent moisture pick-up. The heaps cannot be easily moved in the event of an emergency when, in any event, appropriate handling equipment is required. In a fire situation hollow sections in handling equipment such as conveyor rollers, components of shovels and hand rails can become a source of explosion and projectiles when contaminated by ammonium nitrate. The opportunity to find suitable bulk storage areas in users premises is more limited. In the case of Type B fertilizers in bulk, decomposition can be more readily initiated by small heat sources.

5. TRANSPORT OF FERTILIZER

"Ammonium nitrate based fertilizers" are referred to as "ammonium nitrate fertilizers" in transport rules, codes and recommendations.

It is not the purpose of this Handbook to cover the transport of fertilizers. It can be noted, however that it is the manufacturers and suppliers responsibility to ensure that the transport used - road, rail, inland waterway sea - is suitable for the carriage of ammonium nitrate based fertilizers which are referred to as ammonium nitrate fertilizers in transport rules. The transport equipment should be inspected for cleanliness and thoroughly cleaned as appropriate before the fertilizer is loaded. Appropriate information should be given to the person responsible such as ship/barge master or lorry driver.

For transport of bulk product (Types A and B) dedicated container type vehicles offer the best option from a safety view-point.

Transport vehicles, where not dedicated should be thoroughly cleaned before and after carriage of fertilizer to prevent cross contamination.

Compliance with National Regulations and/or International Transport Codes such as IMO-Sea, ADR-Road, RID-Rail or ICAO- Air is essential.

6.. EMERGENCY ACTIONS AND PROCEDURES

6.1 Identification of the Hazard by Fertilizer Type

6.1.1 Type A Fertilizers

Type A fertilizers are not in themselves combustible but they are oxidising agents and will intensify fire in any combustible material present. If involved in a fire toxic fumes and gases may be evolved. The first priority there fore, is to extinguish the fire using copious quantities of water, It is also important to prevent melting of the product and to this end water should be directed onto stacks or heaps of Type A fertilizers in close proximity to the fire,

61.2 Type B Fertilizers

Type B fertilizers are capable of self-sustaining decomposition. that is decomposition will continue once initiated even if the heat source is removed. During the decomposition large volumes of toxic fumes and gases will be evolved. In the case of a fire adjacent to the fertilizer the first priority is to extinguish that fire. In the case of decomposition of the fertilizer the first priority is to locate, and if possible expose. the seat of the decomposition and to direct large quantities of water onto that area to bring the decomposition under control.

6.1.3 Type C Fertilizers

Type C fertilizers are neither classified in a hazard category according to international regulations nor are they capable of self-sustaining decomposition. Under fire conditions, however, they may decompose when sufficiently heated with the resultant emission of toxic fumes and gases. The priority in the case of a fire involving Type C fertilizers is to extinguish the fire using copious quantities of water.

6.2 Action in Emergency

If in a store containing ammonium nitrate based fertilizers smoke or fumes are observed, and if conditions permit, a check should be made to see if flames can be detected.

If flames are present then a fire involving combustible material or the building is likely. If no flame is present then a self-sustaining decomposition involving Type B fertilizers is probably taking place.

In the event of a fire and/or decomposition involving ammonium nitrate based fertilizer the following action should be taken.

6.2.1. Inform the local Fire Service immediately telling them what materials are, or may be involved.

6.2.2 Avoid breathing the fumes from a fire involving ammonium nitrate fertilizers: they are toxic and their full effect may be delayed by as much as 48 hours.

6.2.3 Evacuate, and keep away. all personnel not involved in fire fighting from the scene of the fire, and in particular keep people away from the fumes.

6.2.4 Ensure maximum ventilation as quickly as practicable. Open all doors. windows and roof openings if possible.

6.2.5 In the case of major decomposition tackle with copious quantities at water; preferably with high pressure water jets or lances to the seat of the decomposition. This is particularly important in the case of Type B fertilizers

6.2.6 In the case of minor decomposition. endeavour to remove the decomposing material from the main heap and in any event use copious quantities of water directed to the seat of the decomposition.

6.2.7 Under severe fire conditions the application of water to hot ammonium nitrate may cause eruptions of steam. Fire fighting personnel should take all necessary precautions whilst continuing to apply water to the seat of the fire.

6.2.8 Do not use chemical extinguishers, foam or sand. Attempts to smother a fire in which ammonium nitrate based fertilizers are involved are useless and potentially hazardous. In particular never try to smother the fire with steam. *Note: outbreaks of fire on equipment where the fertilizer itself is not directly involved may be extinguished by these means.*

6.2.9 Keep adjacent fertilizer cool by spraying with water,

6.2.10 Drains must be protected by incombustible materials such as bags of sand to prevent the ingress of molten ammonium nitrate.

6.2.11 Avoid breathing the fumes. Fight the fire from up-wind and from outside of buildings if possible. Use self-contained breathing apparatus if fumes are entered.

6.2.12 Supervision by fire-fighting personnel should continue until there is no further risk of decomposition or reoccurrence of the fire,

6.2.13 After the fire the area must be cleaned up efficiently' under the supervision of a competent person. Damaged or contaminated fertilizer should be disposed of in a safe manner (7.6.10).

6.2.14 Where necessary advise the relevant local authority if as a result of the fire-fighting action, water contaminated with ammonium nitrate has entered water courses etc...

6.3 Emergency Procedure

For every storage location there should be a written procedure to be followed in the event of an emergency. All personnel should be instructed in these procedures. Regular practice of the emergency procedures should be carried out.

6.4 Training

Personnel involved in the handling and storage of ammonium nitrate based fertilizers should be adequately instructed as to the potential hazards of the fertilizers stored. They should also be trained in the

- correct storage and handling procedures
- emergency procedures
- correct use of emergency equipment.

6.5 Safety Equipment

All storage locations should be adequately equipped with fire-fighting equipment suitable to tackle the initial outbreaks of fire. This should include:

- chemical extinguishers for use on fires on equipment,
- water supplies and hoses capable of reaching all parts of the stores.

In the case of bulk storage of large quantities of Type B fertilizers fire fighting equipment such as the Victor-lance[1] should be available.

Consideration should be given to the provision of specialist personal protective equipment such as self-contained breathing apparatus in large stores, for example manufacturers premises where adequate technical back up facilities are available.

6.6 First Aid

Thermal decomposition of ammonium nitrate based fertilizers can produce a gas mixture of the following volumetric composition:

Nitrous Oxide	7 - 20%
Nitrogen	19 - 26%
Water Vapour	45…-… 65%
Ammonium Chloride	0…..-… 7%
Hydrogen Chloride	0.5 - 10%
Chlorine	0…..-……2%
NO-NO_2 (NO_x)	0…..-……9%

The above composition should be regarded as indicative only and will vary depending on the fertilizer composition.

Nitrous fumes are particularly toxic and the effects of their inhalation may be delayed and lead to lung oedema. Any person who has definitely inhaled nitrous fumes must be made to lie down in shade and be kept warm and rest even though no symptoms may be evident. Give oxygen, especially if the person is blue in the face. Artificial respiration should only be applied if breathing fails. Immediate medical help should be sought and the affected person kept under medical supervision for at least 48 hours, Hospitalisation is preferred.

(1) Victor-lance described in Proceedings No. 137 of the Fertiliser Society (London).November 1973, page 19.

7. RECOMMENDATIONS FOR THE STORAGE OF AMMONIUM NITRATE BASED FERTILIZERS TYPE A

For detailed classification see Section 2.2.

7.1 General

7.1 1 These fertilizers should not be stored in the close proximity of a hospital or institution which cannot readily be evacuated in the event of a fire, Advice should be sought from the relevant authority as to the location of the store.

7 1.2 These fertilizers should not be stored near possible sources of major fire or explosion such as oil storage, or gas lines where such sources can affect the stored fertilizer.

7.1.3. These fertilizers should be stored in such a way that they cannot be affected by any source of heat or contaminated by combustible materials. Storage near combustibles such as hay or straw should be avoided. Precautions should be taken to minimise the risk of fire.

7.1.4. Storage areas should be protected from access by unauthorised persons. Entry only for Authorised Persons notices should be displayed.

7.1.*5* Ensure the storage area is clean before ammonium nitrate based fertilizers are put into the store. Organic materials such as sawdust should not be used for cleaning or drying.

7.1.6 As basic good housekeeping practice it is recommended that stored ammonium nitrate based fertilizers are moved out of the store. as far as is practicable, in the order in which they were received into it.

7.1.7 Smoking, fire and open lights should be forbidden, and this prohibition should always be observed. Notices with the instruction **"Smoking Prohibited"** should be fixed in places throughout the storage area where they are clearly visible.

7.1.8 Moving parts of mechanical conveying equipment should be regularly cleaned and kept in good condition. Care should be exercised to avoid oil leaks, particularly where this could contaminate the fertilizer.

7.1,9 As far as possible, the greasing and oiling of store equipment should be done outside the building. No oil or grease should be kept in those parts of the building where it could become mixed with ammonium nitrate based fertilizers or accumulated fertilizer dust and residues.

7.1.10 Maintenance work in the storage area should be carried out only with specific authorisation, Any operation which requires the use of heat such as welding, brazing, flamecutting, should be performed under supervision.

Precautions should be taken to prevent the initiation of fire, for example through the falling of hot particles or sparks from welding.

7.1.11 Vehicles and fork lift trucks should be equipped with a fire extinguisher suitable for tackling fires on the vehicle They should be kept in a clean condition and be regularly checked for oil or fluid leaks. They should not be used if leaks are found until necessary repair has been carried out. When not in use for loading or unloading they should be parked in an approved part of the store building which is segregated from the fertilizer and preferably outside the storage area. The exhaust from internal combustion engines used in the building should not be allowed to impinge on the stored product and other than for the purpose of loading and unloading, the engines should not be left running unnecessarily.

7.1.12 Flammable or combustible substances should not be carried through the storage area.

7.1.13 Personnel involved in the storage and handling of fertilizers should be instructed in the safe handling of the product. The personnel should also be instructed on the action to take in the event of an emergency. They should also be trained in correct fire-fighting procedure (6.2).

7.1.14 All passageways and open spaces in the storage area must at all times be kept clean and free from spilled materials, waste, stored products and equipment.

7.1.15 The store-keeper should keep an inventory of stored products. This should be readily available in the event of fire.

7.1.16 The store should be inspected regularly, particularly when maintenance has been carried out. A routine check should take place at the end of the normal working day or shift.

7.1.17 Manufacturers and suppliers should ensure that their customers are aware of storage requirements and the reasons for them. Visits to customers premises should be made to ensure sensible storage practices are being followed.

7.2 Storage with Non-Fertilizer Products

7.2.1 Extreme care should be taken with the storage of non-fertilizer products in the same storage area as ammonium nitrate based fertilizers of Type A. Separation of non-fertilizer products should be effected by means of a fire-fighting barrier, the resistance of this barrier to be assessed according to the expected amount and nature of the other products to be stored. The advice of the local fire authorities should be sought. In some cases a completely empty space may be adequate with the general principle that under fire conditions the products should not affect each other. In normal storage conditions the products should be so stored as not to contaminate each other.

7.2.2 The following products are considered to be potentially hazardous when stored in the vicinity of the ammonium nitrate based fertilizers. It is essential that neither should affect the other at any time, including under fire conditions.

(a) Solid or liquid materials sensitive to explosive decomposition.

(b) Flammable liquids such as gasoline, lubricating and fuel oils.

(c) Gas cylinders.

(d) Oil based pesticides.

(e) Corrosive liquids, acids, and other reactive substances such as chlorates, hypochlorites, bleaching powder, chromates, nitrites. copper salts, permanganates.

(f) Readily combustible solid or liquid products such as sulphur, powdered metals, and organic substances such as hay, straw. grain and animal feedstuffs.

(g) Products which generate heat in the presence of moisture, such as quick-lime and calcium cyanamide

(h) Products which will liberate ammonia gas from the ammonium nitrate based fertilizers such as cement, lime, basic slag and other alkaline substances.

(i) Other agricultural products whose behaviour towards ammonium nitrate may be uncertain, for example branded pesticides. disinfectants or weedkillers.

NOTE: Where explosives are stored at the same site as ammonium nitrate based fertilizers they must be stored strictly in accordance with national explosives legislation.

7.2.3. Inert and unreactive products may be stored in the same storage area as the fertilizer but for quality reasons contamination of products in bulk must be avoided.

7.3 Storage Buildings

7.3.1. The principles which determine the suitability of a building for storage of the fertilizer are set out below'. They are directed primarily against the fire hazard but are also pre-requisites of good housekeeping, management, and the preservation of the physical properties and quality of the fertilizer.

7.3.2 Fire prevention by excluding unnecessary services and practices from the storage area and limiting the entry of unauthorised persons is recommended. However, in the event of fire it is important that facilities

are such that speedy control is possible. In this respect, good access both to and within the store is important. Precautions that minimise the effect of

a fire should be considered, Storage structures should provide good natural or mechanical ventilation in the event of fire.

7.3.3 When new buildings are constructed for use as fertilizer stores they should be single storey and without basement or cellar. However, if there is a second storey and this is intended to be used for fertilizer or other materials, due consideration should be given to the types of these other materials in the storage area and their susceptibility to fire or their interaction with the products stored. Care should be taken during the construction to avoid areas where fertilizer could be trapped in hollow sections or could accumulate.

7.3.4 The floor of buildings should be constructed of not-readily combustible material such as concrete, preferably without bitumen joints or renderings, or highly filled asphalt covering. Internal pits. drains and gutters should be excluded,

7.3.5 The building should be in good order and capable of shielding the products from the weather and from access by unauthorised persons.

7.3.6 The buildings should be constructed of not-readily combustible material such as concrete or steel, where necessary suitably protected against corrosion. The roof should be of light construction. Wood or other combustible materials should not be used.

7.3.7 Due to the corrosive nature of ammonium nitrate the use of galvanised metal for construction should be avoided,

7.3.8 Protection against lightning should be provided.

7.3.9 Buildings should not have inside drains. However, if this is not practical, they must be securely sealed with an incombustible material, so that in the event of fire molten ammonium nitrate cannot run into them with consequent risk of explosion.

7.3.10 Permanent installations for space heating or providing electrical energy should be very carefully considered and positioned in such a way that the fertilizer cannot come into contact with them. *(Account should he taken of the effect on their location when the store is fully stocked.* This applies to steam, water pipes or radiators as well as other heat sources, whether or not insulation is provided. It also applies to runs of electric cables (which dissipate heat) and to the siting of lamps. Direct electrical heaters should not be used. The main electrical switch should be situated so that it is easy to find and no contact with fertilizer is possible, preferably by siting it outside the storage area.

7.3.11 It is recommended that the height of the stacks or heaps should be such that they are at least 1 metre below eaves, beams and light fittings.

Bulkhead fittings used to protect lamps from mechanical damage offer no protection to fertilizer which may come into their proximity. Fluorescent lamps are preferred for roof lighting because they run at lower temperatures than filament lamps. All parts of the fluorescent light assembly should be constructed of not-readily combustible materials. Care should be taken in the siting and protection of lamps to minimise dust accumulation.

7.3.12 The capacity of stores and the size of heaps, bays, and other areas should conform to national regulations.

7.4 Equipment Used in Storage Buildings

7.4.1 Conveyor belts and other equipment used for handling ammonium nitrate based fertilizers, particularly in fixed installation, should not have any parts fabricated from readily combustible material. Due regard should be paid to the provision of fire resistant conveyor belts, overload trip controls and idler stop alarms.

7.4.2 Wherever possible, hollow shafts should not be used on equipment in service with ammonium nitrate based fertilizers.

7.4.3 If any part of the equipment contains copper it should be adequately protected from contact with the stored product.

The corrosive effect of ammonium nitrate on zinc (as galvanised or otherwise) should be noted.

7.4.4 Electric motors and transformers inside or associated with the storage building must be constructed in accordance with an approved national specification, and protected against overload. The main electrical switches, fuses, transformers, motors and controllers should be located outside the storage area. The local switches within the storage area should be in a place where there is no possibility of contact with the stored product.

7.4.5 Electric installations must conform with national regulations for damp places and must be inspected regularly as to their condition of fitness. e.g. at least once per year. Any repairs necessary should be carried out immediately A permanent record should be kept of inspection and repairs.

7.4.6 A supply of water adequate to deal with an outbreak of fire should be available in the vicinity' of the building. This should be discussed with the local fire service. In addition it is recommended that fire extinguishers be provided to deal with outbreaks of fire on equipment.

NOTE: chemical extinguishers are riot effective against decomposing fertilizer.

7.5 Maintenance Procedure in Storage Area

7.5.1 Maintenance to be carried out in the store area should exclude operations using heat, such as welding and brazing, unless under strict control. If the requirement for welding is unavoidable and it is carried out in such a position that dross or heated metal could fall amongst the products, the latter must first be covered (with for example damp sacking) and kept under observation for several hours after the work is finished.

7.5.2 Welding operations should not be carried out without proper cleaning and inspection of hoppers or equipment. These may contain, or be coated with, ammonium nitrate based fertilizer residues which can be easily over-looked. The fumes from these decomposing fertilizers are toxic. Fertilizers trapped in confined spaces, such as hollow box construction members. can result, sometimes after a delay. in the development of dangerously high pressure, leading to explosion and even detonation, when heated, because of gases evolved during decomposition of the fertilizer.

7,6 Storage in Packaged Form

7.6.1 All foregoing requirements of Section 7 apply.

7.6.2 The height of stacks of bagged product should be such that they are at least 1 metre below eaves, beams and light fittings. The size of the stacks will depend on the management of the store, but they should be constructed with a passageway at least 1 metre wide around each stack with one passageway wide enough to provide vehicular access to facilitate dismantling in the event of an emergency.

7.6.3 Stacks should be arranged and sized to allow' ready access.

7.6.4 These fertilizers should not be stored with any non-fertilizer products in the same stack.

7.6.5 IBC's of whatever size should be stored in stable stacks. When stacking the height of doors. beams and electrical fitments should be checked in relation to that of the lifting equipment.

7.6.6 Ammonium nitrate based fertilizer of Type A should not be stored adjacent to fertilizers which may be capable of self-sustaining decomposition (Type B, Section 2.3) and hence act as a heat source, or in such a position that they could contact each other in a fire.

7.6.7 Stacks of ammonium nitrate based fertilizer Type A may be stored adjacent to stacks of stable materials such as limestone or calcium ammonium nitrate.

7.6.8 Pallets made of wood, metal or plastic are suitable, provided the are of sufficient strength for the intended duty. Empty wooden pallets should be stored in a suitable area separate from the fertilizer. They' should not be

stacked outside against the building. Damaged pallets should not be used,

7.6.9. When urea is stored in the same building care should be exercised to ensure that the material cannot come into contact with the fertilizer at any time including in a fire,

7.6.10 Bags broken in storage should be removed from the stack. Any bagged product damaged on receipt at store should be re-packed before stacking. Any spilled or contaminated ammonium nitrate based fertilizer must be cleaned up and disposed of in a suitable manner. Small quantities of spilled or contaminated fertilizer should be collected into a container suitably marked and kept for the purpose. This material can be disposed of by spreading on open land (with the land owners permission). Larger quantities, say 250kg or more, should be disposed of after consultation with the manufacturer, supplier or local waste disposal authority. Ammonium nitrate based fertilizers must not be washed into water-courses or drains,

7.7 Storage in Bulk

7.7.1 Selection of Method

7.7.1.1 *Manufacturers premises*
Storage in bulk in sheds, bays. bunkers or separate silos is acceptable.

7.7.1.2 *Intermediate Store, Harbour Facility' or Farm*
Storage in silos or closed bins (4.3.1) is the preferred and recommended procedure. Other procedures can be used under the strict guidance of the manufacturer.

7,7.2 Sheds, Open Bays and Bunkers

7.7.2.1 The requirements in Section 7.1 to 7.5 apply.

7.7.2.2 Bulk ammonium nitrate based fertilizer Type A may be stored in heaps and bays built into the storage space or stored in bins (4.3.1). Bays and bins alike must be kept clean and free from contamination. They should be inspected for cleanliness immediately before the fertilizer is put into them, They should be clearly labelled to indicate the nature of their contents.

7,7.2.3 Wood or other readily combustible materials should not be used in the construction of new bays.

7.7.2.4 The storage space may be sub-divided into any number of bays of convenient shape and dimensions. The size of the heap should conform to national regulations.

7.7.2.5 Bins where used should be constructed of non-combustible materials and their capacity should be according to national regulations. It is preferable that the side of the bin adjacent to the gangway should be slatted, especially at ground level.

7.7.2.6. Type A ammonium nitrate based fertilizers are hygroscopic and in bulk may absorb moisture from humid air. Appropriate precautions should therefore be taken to protect them from moisture uptake. This can be achieved by air conditioning in stores, by storage in enclosed plastic silos, or by covering the heaps with not-readily combustible plastic sheeting.

7.7.2.7 Care should be taken to avoid contamination of the fertilizer in bulk heaps, e.g. by cleaning handling equipment after use, and by clearing up spillage promptly (7.7.2.11).

7.7.2.8 The use of cable handlamps should be restricted. All portable lamps should be protected by a glass cover and a wire cage and they should not be covered by the product. Lamps should have a pushbutton contact. switching off the lamp automatically. Handlamps with dry batteries are preferred.

7,7.2.9 The use of explosives to break up ammonium nitrate.based fertilizer, or adjacent heaps, that have caked in storage must be EXPRESSLY FORBIDDEN. Caked product can be broken up by mechanical means or by the use of compressed carbon dioxide devices.

7.7.2.10 The height of bulk heaps is generally restricted by minimum distance from roof beams, lights etc. (7.3.11) and by available discharge equipment.

7.7.2.11 Fertilizers spilled during handling operations should be swept up at once, and disposed of in a safe manner. It is important that gangways or aisles adjacent to bulk heaps of Type A products are cleaned regularly (daily) to avoid the unacceptable condition of ammonium nitrate compacted onto the floor.

7.7.2.12 Mechanical shovels or other mobile handling equipment should be stored outside the storage building or in such a position that fertilizer in the heaps or spilled onto the floor cannot be affected by a fire involving the vehicle.

7.7.2.13 Type A fertilizers are normally put into stores at temperatures of about 30 to 50; in no event should a temperature of 55^0C be exceeded,

7.7.2.14 A and Type B fertilizers should not be stored in the same building.

7.7.2.15 Other fertilizers may be stored in adjacent bays but the building should not be used at any time for the storage of any non-fertilizer material, including packaging materials and pallets unless these are separated from the fertilizer by a suitable fire break. A fire in these packaging materials should not be able to affect the fertilizer.

7.7.2.16 Urea should preferably not be stored in the same building as Type A fertilizers. If this is unavoidable conditions should be such that neither fertilizer can affect each other in any circumstances, in particular in the case of fire.

7.7.3 Closed Bin, Hopper or Silo

7.7.3.1 Type A ammonium nitrate based fertilizers may be stored in vertical steel or plastic silos, bins or hoppers (4.3.1), provided they are used only to hold fertilizer. The silo should be capable of being thoroughly cleaned before the fertilizer is introduced and so constructed that moisture absorption and product contamination are avoided during storage. Provision should be made for ventilation in the event of fire.

7.7.3.2 Silos should be made of plastic or steel and be of adequate strength to safely hold the tonnage stored. They should preferably be installed on a concrete base, giving good access to trucks for loading and unloading.

7.7.3.3 Silos should preferably be installed outdoors, at a safe distance from any combustible matter.

7.7.3.4 Silos must be provided with a venting device, in order to prevent a vacuum being created during tapping operations. Normally one of the filling or deaeration pipes can be used:these are usually protected from moisture uptake by closing the pipes with a piece of plastic and adhesive tape.

7.7.3.5 Only one fertilizer product should be stored in each silo. Only after thorough cleaning may this silo be used for other fertilizer products.

7.7.3.6 Any vehicle used to transport Type A ammonium nitrate based fertilizer alternately with other products, e.g. animal feeding stuffs, should be thoroughly cleaned between each operation to avoid cross contamination.

7.7.3.7 For normal security reasons, the silos should be fenced against unauthorised access, but giving access to the spreading device, which can be filled under the silo.

7.7.3.8 A supply of water adequate to deal with an outbreak of fire should be available in the vicinity of the building. This should be discussed with the local fire service. In addition it is recommended that fire extinguishers be provided to deal with outbreaks of fire on equipment.

NOTE: chemical extinguishers are not effective against decomposing fertilizer.

7.8 Outside Storage of Type A Fertilizers

7.8.1 Many of the general principles for the storage of ammonium nitrate based fertilizers apply just as much to that stored in the open as that stored in a building. It is generally recommended that ammonium nitrate fertilizers should not be stored in bulk outdoors.

7.8.2 It should be noted that repeated temperature cycles may cause physical deterioration of some products (3,2.1). Physical deterioration may result in the breakdown of the fertilizer particles and damage to packages. The product should be protected from direct sunlight.

7.8.3 Due note should be taken of ground conditions when storing outdoors to avoid damage to the product.

7.8.4 Outdoor storage areas should be protected against unauthorised access. e.g. by means of a fence. Warnings against unauthorised entry should be posted.

8. RECOMMENDATIONS FOR THE STORAGE OF AMMONIUM NITRATE BASED FERTILIZERS TYPE B

For detailed classification, see Section 2.3

8.1 General

8.1.1 These fertilizers should not be stored in the close proximity of a hospital or institution which cannot readily be evacuated in the event of a fire. Advice should be sought from the relevant authority as to the location of the store.

8.1.2 These fertilizers should not be stored near possible sources of major fire such as oil storage or gas lines or where such sources can affect the stored fertilizer.

8.1 .3 These fertilizers should be stored in such a way that they cannot be affected by any source of heat or contaminated by combustible materials. Storage near combustibles such as hay or straw should be avoided. Precautions should be taken to minimise the risk of fire.

8.1.4 Storage areas should be protected from access by unauthorised persons. “Entry only for Authorised Persons” notices should be displayed.

8.1.5 Ensure the storage area is clean before ammonium nitrate based fertilizers are put into the store. Organic materials such as sawdust should not be used for cleaning or drying.

8.1.6 As basic good housekeeping practice it is recommended that stored ammonium nitrate based fertilizers are moved out of the store, as far as is practicable, in the order in which they were received into it.

8.1.7. Smoking, fire and open lights should be forbidden, and this prohibition should always be observed. Notices with the instruction “**Smoking Prohibited”** should be fixed in places throughout the storage area where they are clearly visible,

8.1.8 Moving parts of mechanical conveying equipment should be regularly cleaned and kept in good condition. Care should be exercised to avoid oil leaks, particularly where this could contaminate the fertilizer.

8.1,9 As far as possible, the greasing and oiling of store equipment should be done outside the building. No oil or grease should be kept in those parts of the building where it could become mixed with ammonium nitrate based fertilizers or accumulated fertilizer dust and residues.

8.1.10 Maintenance work in the storage area should be carried out only with specific authorisation. Any operation which requires the use of heat such as welding, brazing, flamecutting, should be performed under supervision. Precautions should be taken to prevent the initiation of fire, for example through the falling of hot particles or sparks from welding.

8 1 11 Vehicles and fork lift trucks should be equipped with a fire extinguisher suitable for tackling fires on the vehicle. They should be kept in a clean condition and be regularly checked for oil or fluid leaks. They should not be used if leaks are found until necessary repair has been carried out. When not in use for loading or unloading they should be parked in an approved part of the store building which is segregated from the fertilizer and preferably outside the storage area. The exhaust from internal combustion engines used in the building should not be allowed to impinge on the stored product and other than for the purpose of loading.and unloading, the engines should not be left running unnecessarily,

8.1.12 Flammable or combustible substances should not be carried through the storage area.

8.1.13 Personnel involved in the storage and handling of fertilizers should be instructed in the safe handling of the product. The personnel should also be instructed on the action to take in the event of an emergency. They should also be trained in correct fire-fighting procedure (6.2).

8.1.14 All passageways and open spaces in the storage area must at all times be kept clean and free from spilled materials, waste, stored products and equipment.

8.1.15 The store-keeper should keep an inventory of stored products. This should be readily available in the event of fire.

8.1.16 The store should be inspected regularly, particularly when maintenance has been carried out. .A routine check should take place at the end of the normal working day or shift.

8.1.17 Manufacturers/suppliers should ensure that their customers are aware of storage requirements and the reasons for them. Visits to customers premises are recommended to ensure that sensible storage practices are being followed.

8.2 Storage with Non-Fertilizer Products

8.2.1 Extreme care should be taken with the storage of non-fertilizer products in the same storage area as ammonium nitrate based fertilizers of Type B. Separation of non-fertilizer products should be effected by means of a fire-resisting barrier, the resistance of this barrier to be assessed according a to the expected amount and nature of the other products to be stored. The advice of the local fire authorities should be sought. In some cases a completely empty space may be adequate with the general principle that under fire conditions the products should not affect each other. In normal storage conditions the products should be so stored as not to contaminate each other.

8.2.2 The following products are considered to be potentially hazardous when stored in the vicinity of these ammonium nitrate based fertilizers. It is essential that neither should affect the other at any time, including under fire conditions.

(a) Solid or liquid materials sensitive to explosive decomposition.
(b) Flammable liquids such as gasoline, lubricating and fuel oils.
(c) Gas cylinders.
(d) Oil based pesticides.
(e) Corrosive liquids, acids, and other reactive substances such as chlorates, hypochlorites. bleaching powder, chromates, nitrites, copper salts, permanganates.
(f) Readily combustible solid or liquid products such as sulphur, powdered metals, and organic substances such as hay, straw grain and animal feedstuffs.
(g) Products which generate heat in the presence of moisture, such as quick-lime and calcium cyanamide.
(h) Products which will liberate ammonia gas from the ammonium nitrate based fertilizers such as cement, lime, basic slag and other alkaline substances.
(i) Other agricultural products whose behaviour towards ammonium nitrate may be uncertain, for example branded pesticides, disinfectants or weedkillers.

NOTE: *Where explosives are stored* at *the same site as ammonium nitrate based fertilizers they must be stored strictly in accordance* with *national explosives legislation.*

8.2.3 Inert and unreactive products may be stored in the same storage area as the fertilizer but for quality reasons contamination of products in bulk must be avoided.

8.3 Storage Buildings.

8.3.1 The principles which determine the suitability of a building for storage of the fertilizer are set out below. They are directed primarily against the fire hazard but are also pre-requisites of good housekeeping, management, and the preservation of the physical properties and quality of the fertilizer.

8.3.2 Fire prevention by excluding unnecessary services and practices from the storage area and limiting the entry of unauthorised persons is recommended. However, in the event of fire it is important that facilities are such that speedy control is possible. In this respect, good access both to and within the store is important. Precautions that minimise the effect of

a fire should be considered. Storage structures should provide good natural or mechanical ventilation in the event of a fire.

8.3.3 When new buildings are constructed for use as fertilizer stores they should be single storey, and without basement or cellar. However if there is a second storey and this is intended to be used for fertilizer or other materials, due consideration should be given to the types of these other materials in the storage area and their susceptibility to fire or their interaction with the products stored. Care should be taken during the construction to avoid areas where fertilizer could be trapped in hollow sections or could accumulate.

8.3.4 The floor of buildings should be constructed of not-readily combustible material such as concrete, preferably without bitumen joints or renderings, or highly filled asphalt covering. Internal pits, drains and gutters should be excluded. Where buildings used for storing these fertilizers have wooden floors, they should be upgraded to the above standard as soon as practicable. In the meantime, the floor should be permanently covered by heavy duty not-readily combustible sheeting.

8.3.5 The building should be in good order and capable of shielding the products from the weather and from access by unauthorised persons.

8.3.6 The buildings should be constructed of not-readily combustible material such as concrete or steel, where necessary suitably protected against corrosion. The roof should be of light construction. Wood or other combustible materials should not be used in places where, through prolonged contact with the fertilizers they could become impregnated with ammonium nitrate. Existing wood surfaces so exposed should be protected against impregnation by the product, for example by covering permanently with tough impervious plastic sheeting or plaster. Damage to these linings should be repaired immediately.

8.3.7 Due to the corrosive nature of ammonium nitrate the use of galvanised metal for construction should be avoided.

8.3.8 Protection against lightning should be provided.

8.3.9 Permanent installations for space heating or providing electrical energy should be very carefully considered and positioned in such a way that the fertilizer cannot come into contact with them. *Account should be taken of the effect on their location when the store is fully stocked.* This applies to steam, water pipes or radiators as well as other heat sources, whether or not insulation is provided. It also applies to runs of electric cables (which dissipate heat) and to the siting of lamps. Direct electrical heaters should not be used. The main electrical switch should be situated so that it is easy to find and no contact with fertilizer is possible. preferably by siting it outside the storage area.

8.3.10 It is recommended that the height of the stacks or heaps should be such that they are at least 1 metre below eaves, beams and light fittings. Bulkhead fittings used to protect lamps from mechanical damage offer no protection to fertilizer which may come into their proximity. Fluorescent lamps are preferred for roof lighting because they run at lower temperatures than filament lamps. All parts of the fluorescent light assembly should be constructed of not-readily combustible materials. Care should be taken in the siting and protection of lamps to minimise dust accumulation.

8.3.11 The capacity of stores and the size of heaps, bays, and other areas should conform to national regulations.

8.4 Equipment Used in Storage Buildings

8.4.1 Conveyor belts and other equipment used for handling ammonium nitrate based fertilizers, particularly in fixed installations, should not have any parts fabricated from readily combustible material. Due regard should be paid to the provision of fire resistant conveyor belts, overload trip controls and idler stop alarms.

8.4.2 Wherever possible, hollow' shafts should not be used on equipment in service with ammonium nitrate based fertilizer.

8.4.3 If any part of the equipment contains copper it should be adequately protected from contact with the stored product.

The corrosive effect of ammonium nitrate on zinc (as galvanised or otherwise) should be noted.

8.4.4 Electric motors and transformers inside or associated with the storage building must be constructed in accordance with an approved national specification, and protected against overload. The main electrical switches, fuses, transformers, motors and controllers should be located outside the storage area. The local switches within the storage area should be in a place where there is no possibility of contact with the stored product.

8.4.5 Electric installations must conform with national regulations for damp places and must be inspected regularly as to their condition of fitness, e.g. at least once per year. Any repairs necessary should be carried out immediately. A permanent record should be kept of inspection and repairs.

8.4.6 supply of water adequate to deal with an outbreak of fire should be available in the vicinity of the building. This should be discussed with the local fire service. In addition it is recommended that fire extinguishers be provided to deal with outbreaks of fire on equipment.

NOTE: chemical extinguishers are not effective against decomposing fertilizer.

8.5. Maintenance Procedure in Storage Area

8.5.1 Maintenance to be carried out in the store area should exclude operations using heat, such as welding and brazing, unless under strict control. If the requirement for welding is unavoidable and it is carried out in such a position that dross or heated metal could fall amongst the products, the latter must first be covered (with for example damp sacking) and kept under observation for several hours after the work is finished,

8.5.2 Welding operations should not be carried out without proper cleaning and inspection of hoppers or equipment. These may contain, or be coated with, ammonium nitrate based fertilizer residues which can be easily overlooked. The fumes from these decomposing fertilizers are toxic. Fertilizers trapped in confined spaces, such as hollow box construction members. can result, sometimes after a delay, in the development of dangerously' high pressure, leading to explosion and even detonation, when heated. because of gases evolved during decomposition of the fertilizer.

8.6 Storage in Packaged Form

8.6.1 All foregoing requirements of Section 8 apply.

8.6.2 The height of stacks of bagged product should be such that they are at least 1 metre below eaves, beams and light fittings. The size of the stacks will depend on the management of the store, but they should be constructed with a passageway at least 1 metre wide around each stack with one passageway wide enough to provide vehicular access to facilitate dismantling in the event of an emergency.

8.6.3 Stacks should be arranged and sized to allow ready access.

8.6.4 These fertilizers should not be stored with any non-fertilizer products in the same stack,

8.6.5 IBC's of whatever size should be stored in stable stacks. When stacking the height of doors, beams and electrical fitments should be checked in relation to that of the lifting equipment.

8.6.6 Stacks of ammonium nitrate based fertilizer Type B may be stored adjacent to stacks of stable materials such as superphosphates, ammonium phosphate, calcium ammonium nitrate or limestone.

8.6.7 Pallets made of wood, metal or plastic are suitable, provided they are of sufficient strength for the intended duty. Empty wooden pallets should be stored in a suitable area separate from the fertilizer. They should not be stacked outside against the building. Damaged pallets should not be used.

8.6.8 When urea is stored in the same building care should be exercised to ensure that the material cannot come into contact with the fertilizer at any time including in a fire.

8.6.9 Bags broken in storage should be removed from the stack. Any bagged product damaged on receipt at store should be re-packed before stacking. Any spilled or contaminated ammonium nitrate based fertilizer must be cleaned up and disposed of in a suitable manner. Small quantities of spilled or contaminated fertilizer should be collected into a container suitably marked and kept for the purpose. This material can be disposed of by spreading on open land (with the land owners permission). Larger quantities, say 250kg or more, should be disposed of after consultation with the manufacturer, supplier or local waste disposal authority. Ammonium nitrate based fertilizers must not be washed into water-courses or drains.

8.7 Storage in Bulk

8.7.1 Selection of Method

8.7 1 .1 *Manufacturers premises*
Storage in bulk in sheds, bays, bunkers or separate silos is acceptable.

8.7.1.2 *Intermediate Store, Harbour Facility or Farm*
Storage in silos or closed bins (4.3.1) is the preferred and recommended procedure. Other procedures can be used under the strict guidance of the manufacturer.

8.7.2 Sheds, Open Bays and Bunkers

8.7.2.1 The requirements in Section 8.1 to 8.5 apply.

8.7.2.2 Bulk ammonium nitrate based fertilizer Type B may be stored in heaps and bay's built into the storage space or stored in bins (4.3.1). Bays and bins alike must be kept clean and free from contamination. They should be inspected for cleanliness immediately before the fertilizer is put into them. They should be clearly labelled to indicate the nature of their contents.

8.7.2.3 Wood or other readily combustible materials should not be used in the construction of new bays. Where existing wood structures are used the exposed parts should be protected, for example by covering them permanently with tough resilient plastic sheeting.

8.7.2.4 The storage space may be sub-divided into any number of bays of convenient shape and dimensions, The size of the heap should conform to national regulations.

8.7.2.5 Bins where used should be constructed of non-combustible materials and their capacity should be according to national regulations.

8.7.2.6 Type B ammonium nitrate based fertilizers are hygroscopic and in bulk may absorb moisture from humid air. Appropriate

precautions should therefore be taken to protect them from moisture uptake. This can be achieved by air conditioning in stores, by storage in enclosed plastic silos, or by covering the heaps with not-readily combustible plastic sheeting.

8.7.2.6 Care should be taken to avoid contamination of the fertilizer in bulk heaps, e.g. by cleaning handling equipment after use, and by clearing up spillage promptly (8.7.2.11).

8.7.2.8 The use of cable handlamps should be restricted. All portable lamps should be protected by a glass cover and a wire cage and they should not be covered by the product. Lamps should have a pushbutton contact, switching off the lamp automatically. Handlamps with dry batteries are preferred.

8.7.2.9 The use. of explosives to break up ammonium nitrate based fertilizer, or adjacent heaps, that have caked in storage must be EXPRESSLY FORBIDDEN. Caked product can be broken up by mechanical means or by the use of compressed carbon dioxide devices.

8.7.2.10 The height of bulk heaps is generally restricted by minimum distance from roof beams, lights etc. (83.10) and by available discharge equipment.

8.7.2.11 Fertilizers spilled during handling operations should be swept up and disposed of in a safe manner.

8.7.2.12 Mechanical shovels or other mobile handling equipment should be stored outside the storage building or in such a position that fertilizer in the heaps or spilled onto the floor cannot be affected by a fire involving the vehicle.

8.7.2.13 Type B fertilizers are normally put into stores at temperatures of about 30 to 50^0C; in no event should a temperature of 55^0C be exceeded.

8.7.2.14 Other fertilizers may be stored in adjacent bays but the building should not be used at am' time for the storage of any non-fertilizer material, including packaging materials and pallets unless these are separated from the fertilizer by a suitable fire break. A fire in these packaging materials should not be able to affect the fertilizer.

8.7.3 Closed Bin, Hopper or Silo

8.7.3.1 Type B ammonium nitrate based fertilizers may be stored in vertical steel or plastic silos, bins or hoppers (4.3.1). at the

merchants as well as on the farm, providing these silos/bins are used only to hold fertilizer.

The silo should be thoroughly cleaned before the fertilizer is introduced.
Silos should be so constructed that moisture absorption and product contamination are avoided during storage. Provision should be made, however, for ventilation in the event of fire.

8.7,3.2 Silos should be made of plastic or steel and be of adequate strength to safely hold the tonnage stored. They should preferably be installed on a concrete base, giving good access to trucks for loading and unloading.

8.7.3.3 Silos should preferably be installed outdoors, at a safe distance from any combustible matter.

8.7.3.4 Silos must be provided with a venting device, in order to prevent a vacuum being created during tapping operations. Normally one of the filling or deaeration pipes can be used; these are usually protected from moisture uptake by closing the pipes with a piece of plastic and adhesive tape.

8.7.3.5 Only one fertilizer product should be stored in each silo. Only after thorough cleaning may this silo be used for other fertilizer products.

8.7.3.6 Any vehicle used to transport Type B ammonium nitrate based fertilizer alternately with other products, e.g. animal feeding stuffs, should be thoroughly cleaned between each operation to avoid cross contamination.

8.7.3.7 For normal security reasons, the silos should be fenced against unauthorised access, but giving access to the spreading device, which can be filled under the silo.

8.7.3.8 .A supply of water adequate to deal with an outbreak of fire should be available in the vicinity of the building. This should be discussed with the local fire service. In addition it is recommended that fire extinguishers be provided to deal with outbreaks of fire on equipment.

NOTE: chemical extinguishers are not effective against decomposing fertilizer.

8.8 Outside Storage of Type B Fertilizers

8.8.1 Many of the general principles for the storage of ammonium nitrate based fertilizers apply lust as much to that stored in the open as that stored in a building. It is generally recommended that ammonium nitrate based fertilizers should not be stored in bulk outdoors.

8.8.2 It should be noted that repeated temperature cycles may cause physical deterioration of some products (3.2.1). Physical deterioration may result

in the breakdown of the fertilizer particles and damage to packages. The product should be protected from direct sunlight.

8.8.3 Due note should be taken of ground conditions when storing outdoors to avoid damage to the product.

8.8.4 Outdoor storage areas should be protected against unauthorised access. e.g. by means of a fence. Warnings against unauthorised entry' should be posted.

9. RECOMMENDATIONS FOR THE STORAGE OF AMMONIUM NITRATE BASED FERTILIZERS TYPE C

Type C fertilizers can contain the same components as those of Type A and Type B but they have a lower ammonium nitrate content than Type A and they do not exhibit the property of self-sustaining decomposition as those of Type B. Any decomposition caused by an external heat source will cease once that source is removed. In a fire situation however toxic gases and fumes containing chlorine and oxides of nitrogen may be released.

In the storage of Type C fertilizers the basic principles of good housekeeping as with all products should be maintained in order to preserve the quality of the material through the avoidance of contamination and moisture pick up. In addition storage near sources of heat should be avoided.

However, in practice, Type C fertilizers will often be stored in the same building used for Type A and/or Type B. In these cases it is important to note that the storage and handling requirements for the Type A and/or Type B fertilizers should take precedence.

The following recommendations take into account the basic principles of good housekeeping and general safety requirements for Type C fertilizers where only Type C is stored.

9.1 General

9. 1 .1 These fertilizers should not be stored near possible sources of major fire such as oil storage or gas lines where such sources can affect the stored fertilizer.

9. 1 2 These fertilizers should be stored in such a way that they cannot be affected by any source of heat or contaminated by combustible materials. Storage near combustibles such as hay or straw should be avoided.

9.1.3 Ensure the storage area is clean before ammonium nitrate based fertilizers are put into the store and that all passageways and open spaces in the storage area are kept clean and free from spilled material, waste, stored products and equipment. Organic materials such as sawdust should not be used for cleaning or drying.

9.1 .4 Precautions should be taken to minimise the risk of fire. Smoking and fire should be forbidden.

9.1.5 Moving parts of mechanical conveying equipment should be regularly cleaned and kept in good conditions.

9. 1 .6 Maintenance work in the storage area should be carried out only with specific authorisation. Any operation which requires the use of heat such as welding, brazing or flamecutting, should be performed under

supervision. Precautions should be taken to prevent the initiation of fire, for example, through the falling of hot particles or sparks from welding.

9.1.7 Vehicles and fork lift trucks should be equipped with a fire extinguisher suitable for tackling fires on the vehicle. They should be kept in a clean condition, and free from oil leaks and parked only in designated safe areas.

9.1.8 Personnel involved in the storage and handling of fertilizers should be instructed in the safe handling of the product, emergency and fire fighting procedures (6.2).

9.1.9 The store-keeper should keep an inventory of stored products. This should be readily available in the event of fire.

9.1.10 The store should be inspected regularly, particularly when maintenance has been carried out.

9.1..11 Manufacturers or suppliers should ensure that their customers are aware of and comply with storage requirements and the reasons for them. Visits to customers premises are advisable.

9.2 Storage with Non-Fertilizer Products

9.2.1 Inflammable or readily combustible materials such as gasoline, oil, sulphur or organic substances, and reactive chemicals such as acids, oxidising or reducing agents, should not be stored in or carried through the storage building.

9.2.2 Contamination of the fertilizer by inflammable or reactive materials, or by substances which would be dangerous in a fire situation, must be avoided.

9.2.3 Explosives must not be stored in the vicinity of the fertilizer, nor used to loosen caked material.

9.3 Storage Buildings

9.3.1 When new buildings are constructed for use as stores for Type C ammonium nitrate based fertilizers they should preferably be single store.

9.3.2 The buildings should be constructed of not-readily combustible material such as concrete or steel, where necessary suitably protected against corrosion. The roof should be of light construction. Wood or other combustible materials should not be used in places where through prolonged contact with the fertilizers they could become impregnated with ammonium nitrate. Existing wood surfaces so exposed should be protected against impregnation by the product, for example by covering permanently with tough impervious plastic sheeting or plaster. Damage to these linings should be repaired immediately.

9.3.3 Buildings should have good access for fire fighting purposes and should be provided with adequate natural or mechanical ventilation to cope with fumes from a fire situation. In normal circumstances, however, ventilation should be restricted to avoid moisture uptake.

9.3.4 In areas where lightning is prevalent adequate protection should be provided.

9.3.5 Permanent installations for space heating or providing electrical energy should be very carefully considered and positioned in such a way that no contact with or heat transfer to the fertilizer is possible. The main isolating switch should be easily accessible in emergency situations.

9.3.6 It is recommended that the height of the stacks or heaps should be such that they are at least 1 metre below eaves, beams and light fittings. Fluorescent lamps are preferred for roof lighting because they run at lower temperatures than filament lamps.

9.4 Equipment Used in Storage Building

9.4.1 Wherever possible, hollow shafts should not be used on equipment in service with ammonium nitrate based fertilizer.

9.4,2 If any part of the equipment contains copper it should be adequately protected from contact with the stored product.

9.4.3 Electric installations must conform to national regulations for damp places and must be inspected regularly as to their condition of fitness, e.g. at least once per year.

9.4.4 A supply of water adequate to deal with an outbreak of fire should be available in the vicinity of the building. This should be discussed with the local fire service. In addition it is recommended that fire extinguishers be provided to deal with outbreaks of fire on equipment.

NOTE: chemical extinguishers are not effective against decomposing fertilizer.

9.5 Maintenance Procedure in Storage Area

9.5.1 Maintenance to be carried out in the store area should exclude operations using heat, such as welding or brazing, unless under strict control. If the requirement for welding is unavoidable and it is carried out in such a position that dross or heated metal could fall amongst the products, the latter must first be covered (with for example damp sacking) and kept under observation for several hours after the work is finished.

9.5.2 Welding operations should not be carried out without proper cleaning and inspection of hoppers or equipment. These may contain, or be coated with, ammonium nitrate based fertilizer residues which can be easily

overlooked. The fumes from these decomposing fertilizers are toxic.
Fertilizers

trapped in confined spaces (e.g. hollow box construction members) can result, sometimes after a delay, in the development of dangerously high pressure, leading to explosion and even detonation, when heated, because of gases evolved during decomposition of the fertilizer.

9.6 Storage in Packaged Form

9.6.1 All foregoing requirements of Section 9 apply.

9.6.2 The height of stacks of bagged product should be such that they are at least 1 metre below eaves, beams and light fittings. The size of the stacks will depend on the management of the store, but they should be constructed with a passageway at least 1 metre wide around each stack with one passageway wide enough to provide vehicular access to facilitate dismantling in the event of an emergency.

9.6.3 Type C fertilizers should not be stored with any non-fertilizer products in the same stack but may be stored adjacent to stacks of stable materials such as for example superphosphate, ammonium phosphate calcium ammonium nitrate and limestone.

9.6.4 Empty wooden pallets should be stored in a suitable area separate from the fertilizer and preferably away from the storage building.

9.6.5 Broken bags should be repacked before stacking. Spilled or contaminated ammonium nitrate based fertilizer should be disposed of in a suitable manner.

9.7 Storage in Bulk

9.7.1 The requirements in Section 9.1 to 9.5 apply.

9.7.2 In principle all methods of storage are acceptable for Type C ammonium nitrate based fertilizers, except at intermediate stores, harbours or farms where silos or bins are preferred.

9.7.3 Bulk ammonium nitrate based fertilizer Type C may be stored in heaps and bays built into the storage space or stored in bins (4.3.1.). They should be clearly labelled to indicate the nature of their contents.

9.7.4 Wood or other readily combustible materials should not be used in the construction of new bays or bins. Where existing wood structures are used the exposed parts should be protected, for example by covering them permanently with tough resilient plastic sheeting.

9.7.5 Appropriate precautions should be taken to protect the product from moisture pick up, for example by air conditioning or covering with plastic sheeting.

9.7.6 The use of explosives to break up ammonium nitrate based fertilizer,

or adjacent heaps, that have caked in storage must be EXPRESSELY FORBIDDEN..

Caked product can be broken up by mechanical means or by the use of compressed carbon dioxide devices.

9.7.7 Where Type C ammonium nitrate based fertilizers are stored in closed bin, hopper or silo:

- The silo should be thoroughly cleaned before the fertilizer is introduced, and only one product contained at any given time,
- Silos should be constructed of plastic or steel such that moisture absorption and product contamination are avoided during storage.
- Provision should be made, however, for ventilation in the event of fire.
- They should preferably be installed on a concrete base, giving good access to trucks for loading and unloading.
- Silos must be provided with a venting device in order to prevent a vacuum being created during tapping operations.

9.8 Outside Storage of Type C Ammonium Nitrate Based Fertilizers

9.8.1 Many of the general principles for the storage of Type C ammonium nitrate based fertilizer apply just as much to that stored in the open as that stored in a building. It is generally recommended that these products should not be stored outdoors in bulk without weatherproof protection,

9.8.2 Due note should be taken of ground conditions when storing outdoors to avoid damage to the product.