

AIC Guide



The Storage, Handling
and Transportation of
Ammonium Nitrate-Based
Fertilisers 2015

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1 General information

1.1

Introduction

This Guide is concerned with the storage, handling and transportation of Ammonium Nitrate [AN] -based fertilisers and is intended for use by manufacturers, importers, merchants, storage companies and hauliers as a guide to good practice in the UK .

It replaces the previous code [Ref 1] that was published by the fertiliser industry's previous organisation, the Fertiliser Manufacturers' Association [FMA]. This revision considers recommendations contained in the "Guidance for the Storage, Handling and Transportation of Solid Mineral Fertilisers" [Ref 2] that was published in 2007 by European Fertiliser Manufacturers' Association [EFMA] which is now known as Fertilizers Europe.

It also considers information relevant to fertiliser grades of AN contained in the SAFEX Good Practice Guide [Ref 3] and takes account of the relevant European and UK legislation .

In creating this guide, the Agricultural Industries Confederation (AIC) has extensively consulted the UK Health and Safety Executive, and the advice given in UK Health and Safety Executive Guidance Note IND[G] 230L "Storage and Handling Ammonium Nitrate", Rev 11/2004. [Ref 4].

AIC considers that this Guide reflects current best industry practice, and that in following this guide management of risk to best practicable means should be ensured.

It should be noted however, that only a court of law can interpret legislation and it is with the court that any decision on compliance must ultimately be made. AIC accepts no responsibility

This document has been produced for the benefit of the members of AIC. The information and guidance provided in this document is given in good faith. AIC, its members, consultants and staff accept no liability for any loss or damage arising from the use of this guidance. As regulations are up-dated from time to time, readers are advised to consult the up-to-date information."

1.2

Scope

The Guide sets out requirements and recommendations for the handling, storage and transportation of straight nitrogen AN fertilisers and compound [NPK, NK or NP] fertilisers [as defined in Annex A] containing AN, based on their specific properties; these fertilisers hereinafter are called AN fertilisers, or AN-based fertilisers. [See examples 1-4 in appendix A]

The Guide provides advice on conditions in which AN-based fertilisers can be handled and stored safely in both bulk and packaged form.

The Guide does not apply to other forms of AN, e.g. porous prills/granules [also known as technical or industrial grade] or crystalline/technical grade. For the technical, industrial grade AN a Good Practice Guide has been published by SAFEX International [Ref 3].

The Guide applies to storage and handling at all manufacturers' premises, merchants' stores, distributors and ports. It does not to apply retrospectively. Separate guidance has also been published for farmers for the storage and handling of these fertilisers on farms [Ref 5].

1.3 Main Principles and Recommendations

AN fertiliser is safe when correctly handled and stored; it is not in itself combustible. As AN is an oxidising agent, it can assist other materials to burn, even if air is excluded.

AN will not explode due to the friction and impact found in normal handling, but it can be detonated under heat and confinement or by a severe shock. For example, in a fire, pools of molten AN may be formed and if the molten mass becomes confined [e.g. in drains, pipes, plant or machinery] it could explode, particularly if it becomes contaminated.

Safety control measures must be put in place to minimise the risks from these potential hazards to 'As Low As Reasonably Practicable' [ALARP]. Main principles and recommendations to achieve this are given below:

- Where possible, store away from centres of population.
- Where possible only store the minimum quantity of bulk AN necessary to operate the site.
- Control all potential ignition sources.
- Store away from explosives.
- Observe fire precautions.
- Buildings should be suitably constructed from non-combustible materials.
- Observe good housekeeping practices.
- Prevent contamination by foreign matter of any kind but particularly: combustible matter; farm chemicals such as weed killers; organic materials; oils and greases; acids and alkalis and incompatible or off specification materials or incompatible fertiliser such as urea.
- Avoid confinement in voids or hollow sections in the event of fire.
- Avoid moisture uptake.
- Secure stores and vehicles against unauthorised access.
- Implement Fertiliser Industry Assurance Scheme [FIAS] standards and obtain FIAS certification.
- Bulk heaps should be carefully managed as the risk of contamination is higher compared to packaged product.

2 Potential hazards

2.1 Potential Hazards of AN and AN-based Fertilisers

All AN-based fertilisers, under normal conditions, are stable materials. Under abnormal conditions they can give rise to certain hazards; the main being the enhancement of fire, thermal decomposition [with release of toxic fumes] and under extreme conditions, explosion. These potential hazards are discussed below.

2.2 Fire Hazard

AN based fertilisers themselves are not combustible; some of them are oxidizing in nature due to the presence of AN. Therefore, the risk of fire arises primarily from the presence of combustible materials such as stored fuels or packaging, parts of handling equipment [e.g. the fuels, lubricants and hydraulic fluids used therein] and combustible materials used in the construction of the store or bays.

Experience shows that fires start in combustible materials inappropriately stored near the fertiliser or in associated equipment such as mobile plant, fork lift trucks, loading shovels and vehicles or fixed plant e.g. belt conveyors. Other sources of ignition include electrical faults and hot work, e.g. welding or grinding. The capability to intensify fire depends not only on the AN content of the fertiliser but also on the nature of other components which may be present in the fertiliser and may have catalytic or thermal effect on the decomposition of AN.

2.3 Decomposition Hazard

Straight AN

AN decomposes by way of a number of reactions when heated to well above its melting point. These include [i] a number of exothermic and irreversible reactions releasing gases containing water vapour, oxides of nitrogen and/or nitrogen [ii] the endothermic and vapour-pressure-dependent, reversible, dissociation reaction into ammonia and nitric acid vapours.

The combined effect of these exothermic and endothermic reactions produces a self-limiting thermal effect up to a certain temperature, provided the gaseous products are able to freely escape. Under adiabatic conditions and free escape of gases the self-limiting temperature in pure AN has been found to be in the region of 290°C at atmospheric pressure [Ref 6].

It must be emphasised that any adverse condition such as the presence of reactive or catalytic substances and/or confinement of product gases will reduce this temperature, making AN thermally less stable. Under extreme conditions, if the gases are not able to escape, the endothermic effect can be almost totally suppressed, leading to a rapid exothermic effect and explosive behaviour. This is of particular significance for hot work on equipment which has been used for handling or processing AN and which may still contain deposits of AN due to inadequate cleaning and/or inspection.

Certain substances, notably chlorides, copper and zinc, enhance the rate of decomposition in AN. Acid conditions also have similar effects. AN reacts with many organic and combustible substances in exothermic ways, with the evolution of the above mentioned gases and fumes.

Gases evolved in the decomposition reactions include toxic components, including ammonia (NH₃) and nitrogen oxides (NO/NO₂).

AN-based Compound Fertilisers

AN-based fertilisers are thermally stable and are not prone to self-heat in normal conditions of storage. They require input of external heat to initiate decomposition.

Consideration of the potential decomposition hazard is important for AN-based compound fertilisers which contain chloride, e.g. in the form of potash; because chloride can enhance the rate of decomposition.

Normal [Thermal] Decomposition

With regard to the decomposition hazards the following points are noteworthy:

- During decomposition of AN-based compound fertilisers, copious amounts of fumes are given off which contain water vapour and various toxic gases such as nitrogen dioxide, hydrogen chloride, ammonia and chlorine depending on the composition of the fertiliser.
- The fumes may also contain ammonium chloride and AN, which along with the water vapour can markedly reduce visibility.
- The decomposition is also accompanied by release of heat with temperatures in the decomposing mass sometimes reaching 300-500°C.
- Decomposition can start even when the fertiliser is in the solid state.
- In fertilisers containing high levels of AN, melting may also occur.

In many cases the decomposition, initiated by an external heat source, will stop when the source is removed.

Self-sustaining Decomposition

In certain types of fertilisers the decomposition is able to continue and spread deep into the mass of material even when the heat source is removed [and even when air is excluded]. This is the phenomenon of self-sustaining decomposition, sometimes referred to as 'cigar burning' [Ref 7 and 8].

In the case of a self-sustaining decomposition its characteristics, e.g. speed of propagation, temperature in the decomposition zone and amount of gas produced, depend on the composition of the fertiliser and on the extent of melting at the decomposition temperature.

The presence of compounds of trace elements such as copper and impurities such as chromium can increase this decomposition rate. The speed of propagation can be measured by an official test, known as the Trough test [Ref 9] and tends to be in the region of 5-25 cm/h.

With this type of fertiliser the bulk form of handling presents a greater risk than does packaged and even minor heat sources such as a buried inspection lamp or self-heating resulting from contamination can be sufficient to initiate the decomposition.

Other Reactions

Ammonia gas, which is toxic, can be liberated from AN-based fertilisers [as from most ammonium salts] when they come into contact with alkaline materials such as lime.

2.3

Explosion Hazard

With solid AN-based products the following two types of events are mainly relevant when considering explosive effects:

Rapid Thermal decomposition causing release of gases and pressure build up in a container leading to its rupture [under conditions of full or semi-confinement]. When heated strongly under confined conditions, for example, during maintenance operations involving hot work on equipment in which fertiliser is confined [e.g. in a hollow metal structural section]. Contamination of the fertiliser with combustible and other reactive substances increases this risk.

Detonation: In this phenomenon the reaction rates are extremely fast; the reaction front travels at a supersonic speed with generation of a shock wave. In most commercial applications of explosives the release of explosive energy is by way of detonation, which produces a highly destructive blast wave.

Pure AN has explosive power equivalent to approximately 45% of TNT. Addition of fuel oil increases this significantly. Many organic substances can also act as fuels and thus produce a similar effect. In case of inorganic salts the effect depends on the nature of the substance and the composition.

Detonation sensitivity tends to decrease with increase in particle size, e.g. product of granules/prills [2-4 mm diameter] is less sensitive than fine crystalline AN.

Effect of Bulk Density on Detonation Resistance

AN-based fertiliser is difficult to detonate because it is produced in the form of dense prills or granules with a high degree of purity. Consequently, very energetic shocks are required to detonate it; neither flame, nor spark, nor friction can cause detonation.

High-Nitrogen content straight AN fertilisers have very low porosity [the oil absorption is typically <4%]; they have bulk densities in the approximate range of 850 to 1100 kg/m³. In contrast, the industrial grades of AN prills/granules produced for the explosives industry have significantly lower bulk densities [for example, 700-800 kg/m³]; they are deliberately produced to be much more porous. The presence of voids or air-pockets makes them much more sensitive to detonation and it facilitates the absorption of oil [required to produce ANFO explosive].

The Resistance to Detonation test was developed to help distinguish between these two main grades viz. agricultural and industrial. AN-based fertilisers, which pass the resistance to detonation test, have very high resistance to detonation. If not properly handled, a number of factors can decrease this resistance. These include contamination with incompatible substances, reduced particle size, increase in temperature and thermal cycling [which increases the porosity and causes breakdown of the prill or granule structure]. In practice, the products contain additives to give good anti-caking properties and thermal stability.

Mechanisms to Produce Detonation

The main mechanisms which, in theory, can cause a detonation in an AN fertiliser stack or bulk heap are impact of a powerful shock and development of rapid decomposition or burning [deflagration] into detonation [commonly described as Deflagration-to-Detonation Transition or DDT] [Ref 10]. A powerful shock can be generated by an adjacent high energy explosion.

Under normal conditions of production, storage and transport a high energy explosion adjacent to the fertiliser is extremely unlikely to occur in any credible industrial accident.

High velocity projectiles may be generated in a fire situation, e.g. when AN-based fertiliser is confined in hollow sections of equipment such as conveyor rollers and components of shovels. The rupture of welding equipment such as gas cylinders can also have a similar effect. These projectiles would not usually have sufficient energy to initiate a detonation in normal solid products but molten and/or contaminated fertilisers are more susceptible.

Various investigations [Ref 11 and 12] indicate that roof beams or building structures which may collapse in a severe fire are unlikely to have sufficient impact energy to initiate a detonation even in molten decomposing fertiliser.

AN + ammonium sulphate [AS] mixtures or Calcium Ammonium Nitrate [CAN] Fertilisers: Consideration of Explosive Energy

In compositions of AN+AS, the presence of AS is known to reduce the explosive power in mixtures containing less than 45% AN. On the other hand, in mixtures containing more than 70% AN the power is enhanced; it is more than that of pure AN. [The UN transport regulations limit the maximum AN content to 70% in such mixtures.]

In contrast to this effect, with CAN, carbonates of calcium and magnesium have been found to produce a substantial reduction in the explosive power of the mixture.

This reduction is caused by the endothermic decomposition of the Ca/Mg carbonates, absorbing some of the heat released during decomposition of AN. Calcium sulphate is also known to give a reduction in the explosive power of AN. Such mixtures containing no more than 80% AN are classified as non-hazardous in the UN transport regulations. However, when contaminated with organic or other incompatible materials their behaviour can change.

2.4

Self Heating

The presence of combustible material [as fertiliser component or contaminant] in AN fertilisers can, when the mixture is acidic, induce a slow spontaneous heating reaction. This results from the slow oxidation of the combustible materials. In the majority of cases this heating is only slight, but if the initial temperature of the fertiliser is abnormally high, the heating can lead to the thermal decomposition of the fertiliser and the evolution of toxic gases.

When a compound fertiliser is produced by granulation or prilling process, residual reactions between components of the fertiliser can occur during storage, this can also cause self-heating. The extent of such heating is low, seldom exceeding 10°C, and normally presents no hazard.

2.5

Dust

AN does not present a dust explosion hazard; because it is not combustible [Ref 13]. Accumulated deposits of contaminated dust, particularly with organic materials, can present decomposition and fire hazards.

2.6

Product Breakdown

Fertilisers containing AN 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 due to changes in volume when the temperature is cycled through 32°C [See Appendix J.1.2]. This is known as thermal cycling.

When stored in direct sunlight or under conditions where fluctuations between high and low temperatures can occur, these fertilisers may swell and physically break-down, particularly if they are inadequately stabilised or have picked up moisture. The effect is usually restricted to the surface layers of the product whether it is in bags or in bulk and results in material of unacceptable quality.

In some cases with packaged material it can also result in damage to the bags. In extreme cases of product breakdown, product safety may be affected, and result in a failure of a Detonation Resistance Test.

3 Methods of handling and storage

3.1 Introduction

AN-based fertilisers 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 below in this Chapter.

Nitrogen fertilisers containing >28% N derived from AN must be supplied to the final user in packaged form [Ref 14].

3.2 Packaged Fertiliser

Fertiliser packages can vary in size from 25 kg bags to Flexible Intermediate Bulk Containers [FIBCs]. In the UK grades of AN with an Nitrogen content of >28%, classified as hazardous are only allowed to be supplied to customers in packaging 500Kgs or greater.

Fertiliser bags should be moisture proof and should be sealed or adequately closed so as to prevent ingress of moisture. They should show adequate resistance to deterioration caused by the climatic conditions to which they may be exposed and conditions of handling, e.g. the frequency and method.

They should be resistant to contamination by water and oil. For this reason polythene and polypropylene bags are widely used.

Micro vents are generally provided in bags for stack stability. Groups of bags may be palletised for stacking by fork lift truck or other appropriate means. Precautions are needed in handling operations to avoid puncturing the bags.

The bags should be clearly labelled to indicate their contents and must comply with the relevant national and international regulations, if any, e.g. UN transport regulations [Ref 14], Fertiliser Regulations [Ref 15], CLP Regulation [Ref 16].

Characteristics and Safety Considerations

The package protects the product; consequently the risks of inadvertent contamination and moisture pick-up are substantially reduced for packaged products. The package labelling leads to easy identification of the product and, in some circumstances, it facilitates moving the material out of the danger area in the event of an emergency.

When the product is stored on pallets, air spaces within the pallet structure make the penetration of heat and flame into the stack more likely in the event of a fire and the collapse of the package under fire conditions can hinder fire-fighting. On the other hand gaps between the stacks provide access to the stored material for initial fire-fighting and create additional barriers to the propagation of detonation, thus reducing the risk of a major detonation. Generally speaking, with a packaged material there is a higher surface area exposed to fire or heat sources.

Construction of stable stacks is an important safety issue; this has been considered by the industry and guidance developed [See sections 4.9 and 4.12].

3.3 Bulk Loose Fertiliser

Fertiliser grades of AN may be induced to detonate under certain conditions. This is particularly the case in the event of molten AN foring in the vicinity of a bulk heap as a result of fire (and potentially initiated by an explosion or high-energy impact). Bulk heaps of AN are also susceptible to contamination. For the above reasons it is recommended that bulk heaps be carefully managed and the risk of fire and contamination

avoided. Wherever possible only store the minimum quantity of bulk AN necessary to operate the site. Fertiliser can be stored in bulk form in large unconfined heaps in buildings, in heaps in bays built into storage space, in open-top enclosed bays [i.e. bunkers], bins or hoppers. [Note: There may be regional variations in the names used.] These arrangements are described below.

- Storage building or warehouse – Fertiliser is stored in large heaps in buildings generally at manufacturing sites. Filling is by overhead in-feed system, shovels or tippers and recovery is by shovels or scraper re-claimer. Subway conveyors underneath the heaps are not recommended for fertilisers classified as hazardous.
- Open Bays – Fertiliser is contained in a bay with three sides, with access from one side for recovery and/or filling. Filling is by overhead feeding system, or tipper lorry. Recovery is by shovels or scraper re-claimer.
- Open-top Enclosed Bays – Fertiliser is contained within the bay with no access to product by vehicles. Filling is generally by overhead feeding system and a scraper re-claimer is used for recovery. Some designs have a removable front facilitating the full recovery of product and cleaning.
- Closed Bin, Hopper or Silo – Fertiliser contained within the bin is filled pneumatically or by other suitable means and is recovered from the bottom.

The above storage systems fall into two main types:

- In storage building/warehouses and open bays the bulk material is loose on the floor and not well contained, facilitating the exposure of product to vehicles and shovels, generating fines and also ingress of spillages of other substances if not properly managed.
- In enclosed bays, 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. In enclosed bays with fixed fronts emptying fully and cleaning can be difficult.

High speed thrower conveyors are not recommended for filling owing to difficulties in ensuring control.

In bulk storage there is a greater risk of contaminating the product during handling, transport and storage operations. Bulk heaps may require protection from the atmosphere to prevent moisture pick-up which can cause the formation of non-conforming materials.

Sudden collapse of parts of caked bulk heaps, typically the front leading edge [commonly known as cliff-facing] can present risk of injury [e.g. engulfment] to personnel and damage to vehicles in the vicinity.

The heaps cannot be easily moved in the event of an emergency when, in any event, appropriate handling equipment is required. For bulk storage there may be [depending on the location of a fire] a lower risk of the formation of molten material compared with bagged storage, because it is difficult for the fire and heat to penetrate the heap.

In a fire situation hollow sections in handling equipment such as poorly maintained conveyor rollers, components of shovels and hollow handrails can become a source of explosion and projectiles when contaminated by AN-based fertiliser. A detonation could involve a substantial proportion of the whole heap which can contain much larger quantities of the product than a typical stack.

The opportunity to find suitable bulk storage areas in users' premises is more than for packaged product. In the case of UN 2071 [fertilisers capable of self-sustaining decomposition] fertilisers stored in bulk, decomposition can be more readily initiated by small heat sources e.g. light bulb.

4 Recommendations and requirements for storage of all fertilisers containing AN

4.1

Location of Stores

Planning Authorities must be consulted before considering the building of new stores or changing use of existing ones, where storage quantities of AN above 1250 tonnes are involved. In most cases Planning [Hazardous Substances] and COMAH Regulations are likely to apply [See Appendix C] and the UK Health & Safety Executive will need to be consulted. Bear in mind that special conditions will apply to stores covered by the COMAH Regulations [See also 4.8].

Stores [whether involving new construction or change of use] should not be located near potential sources of major fire or explosion and in their selection consideration should be given to the potential risk of affecting them from the hazards of the materials stored.

As part of any initial planning process a risk assessment must be undertaken to determine the risk to third party premises, especially domestic residences and high risk facilities that are difficult to evacuate such as hospitals, and schools.

In the UK, HSE suggest the use of an appropriate model for the purposes of consequence modelling of AN storage using an overall yield based on a TNT equivalence of 13.75%. One such model that could be used for this purpose is the ESTC Indoor blast model [Ref 17]. Other equivalency figures may apply however, according to the circumstances that are being modelled. For further information on this aspect please contact AIC Head Office or a specialist consultant.

4.2

Notification and Marking of Sites

If you propose to store or are storing 25 tonnes or more of 'dangerous substances' you must:

- Notify your local Fire and Rescue Service.
- Mark the entrance of the site with the designated warning sign.
- Notify the Enforcing Authority [HSE].

If you propose to store or are storing more than 150 tonnes or more of 'relevant AN mixtures', defined as a mixture containing AN where the nitrogen content exceeds 15.75% of the mixture by weight, you must notify your local Fire and Rescue Service.

Where dangerous substances are stored on site, the site should be clearly labelled as required by the Dangerous Substances [Notification and Marking of Sites] Regulations normally with an "exclamation mark" sign at the entrance and an "oxidising" sign on relevant storage areas.

4.3

Construction and Design of Storage Buildings

The buildings should be in good order and capable of shielding the products from the weather and preventing access by unauthorised persons and stray animals.

The design of the building should be such as to provide good access both to the building and within the store. The design should also facilitate safe access to emergency and fire-fighting equipment even in a fire. Seek advice from the local fire authorities as necessary.

A suitable and sufficient 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 are provided to deal with outbreaks of fire on equipment.

Chemical extinguishers are not effective against fires or decomposition involving nitrate-based fertiliser; water is most effective.

All bulk products should be stored on a single floor which should be without basement or cellar [except for channels required for product movement]. Similarly, stacks of bagged material should also be stored on a single floor without basement.

Where there is more than one floor, due consideration should be given to the nature of materials stored on the various floors, their susceptibility to fire and their interaction with the fertilisers stored elsewhere in the building, e.g. due to melting and the ease of access in emergency.

Construct the buildings from not-readily combustible materials such as brick, concrete or steel, suitably protected where necessary against corrosion [See 4.3.10]. Wood or other combustible materials should not be used.

Laminated or similar fire resistant wood may be used in the construction of beams provided they do not come in direct contact with the product and a fire risk assessment confirms their safe use. Advice should be sought from national regulations or relevant regulatory bodies.

Floors should be maintained in good condition to prevent significant cracks and pot holes developing that may become filled with compacted AN. For hazardous fertilisers i.e. those grades containing more than 28% Nitrogen, floors should be of non-readily combustible material such as concrete [preferably without bitumen joints or coating] or highly filled asphalt containing less than 9% bitumen. For relaying damaged existing surfaces, target 6% bitumen content in asphalt.

Galvanised items such as sheeting, vents and girders should be avoided as far as possible in the construction because of the zinc content which is known to react with AN. A number of protective paint systems or coatings are available [Ref 18].

Buildings should not have internal drains, pits or channels so as to avoid trapping and confining fertiliser. However, if this is not practical, seal them securely, so that molten fertiliser cannot run into them in a fire. Also consider in-filling drains and channels with incombustible and fertiliser-compatible material.

Care should be taken during construction to avoid areas where fertiliser could accumulate or be trapped in hollow sections.

All buildings should have adequate provisions for ventilation to help dissipate heat and discharge fumes in the event of a fire or decomposition.

Provide protection against lightning to BS EN 62305.

Consider the provision of an adequate and reliable fire detection system based on a risk assessment taking account of factors such as the nature and quantities of the materials stored, the construction of the building and its location, subject to local or national requirements and advice/approval by the local fire services as appropriate.

Examples of fire detection systems include smoke/heat / flame detection, temperature measurement, and gas [e.g. N₂O, NO_x and/or NH₃] detection.

Based on a risk assessment the above provision may not be necessary on manufacturing sites where activities are continuous on a 24-hour basis and therefore human presence on a regular and frequent basis is generally available.

Permanent installations for space heating and provision of electrical energy should be positioned in such a way that the fertiliser cannot come into contact with or be affected by them, even when the store is full. This applies to steam, hot water pipes and radiators as well as to other heat sources [whether or not insulation is provided], to runs of electric cables [which dissipate heat] and to the location of lamps.

Do not use electrical heaters based on a radiant exposed coil in the storage area. Install the main electrical switch where it cannot come into contact with fertiliser and is easy to find, preferably outside the store.

The top of the stacks or heaps should be at least 1 metre below eaves, beams, the overhead conveyor [or its platform] and light fittings whichever is the lowest point. This is to avoid affecting the fertilisers with, for example, input of heat [from friction or other sources] and contamination. Bulkhead fittings used to protect lamps from mechanical damage offer no barrier to fertiliser which may come into their proximity.

Fluorescent or LED lamps are preferred for roof lighting because they are cooler than filament lamps. The light assembly should be resistant to corrosion. Lamps should be securely mounted and should not be in contact with bulk fertiliser. Take care to minimise dust accumulation when positioning and protecting lamps.

4.4

Equipment and Vehicles in Storage Buildings

Where conveyor belts are used, consideration should be given to the provision of overload trip controls and or the use of fire resistant belts.

Avoid wherever possible, hollow shafts and sections on equipment used for these fertilisers. Where they are used wash them out regularly to prevent the build-up of fertiliser.

Where plastic materials are used for pipes, ducts, silos etc. it should be recognized that static electricity can be generated and appropriate care should be taken for personal safety.

Protect those parts of the equipment that contain reactive materials such as copper and/or zinc to prevent the corrosive effects of stored product on the equipment.

Electric installations must conform to national regulations including those for damp places and must be inspected regularly as to their condition of fitness. Necessary repairs should be carried out promptly.

Electric motors, transformers and other electrical equipment inside or associated with the storage building must be protected against overload and constructed in accordance with an approved national specification.

The main electrical switches, fuses, transformers and controllers should be located outside the storage area. The local switches and electrical cables within the storage area should be in a place where there is no possibility of contact with the stored product. Avoid the accumulation of dust on electrical equipment, including cables since all electrical equipment generates heat.

Copper may also react adversely with AN dust and form explosive compounds.

As such take particular note of the following points in the design and specification of the electrical equipment, for example, motors, switches etc.

- Protect electrical equipment from corrosion by keeping it separate from fertiliser as far as possible.
- All electrical equipment in AN stores must be to a minimum IP 54 rating, but that consideration should be given to increasing this to IP 64 (dusty areas) or 65 (dusty and /or wet areas)
- Avoid all exposed brass and copper by using, for example, weatherproof / nylon cable glands.
- Minimise the use of metal parts, for example, by using polycarbonate for junction boxes, enclosures, indicator stations etc., because of the hygroscopic and corrosive nature of fertiliser materials.
- Use fully enclosed plastic fittings for lighting, particularly.

Restrict the use of cable hand lamps. All portable lamps should be protected by a protective cover and a wire cage and they should not be covered by the product. Lamps preferably should have a pushbutton contact, switching off the lamp automatically. Hand lamps with dry batteries are preferred.

Inspect all electrical installations regularly minimum every five years or more frequently bearing in mind the corrosive nature of fertiliser and raw materials. Carry out any repairs immediately.

Vehicles generally carry fuel such as diesel; they too need to be controlled so as not to present a fire or contamination risk to fertiliser.

Vehicles, fork-lift trucks and mechanical shovels should be equipped with a fire extinguisher suitable for tackling fires on the vehicle. They should only be parked in designated safe areas, preferably outside the store where practical and kept in a clean condition and free from oil leaks. Where it is absolutely necessary to park in the storage building, it should be in a segregated area where a fire involving the vehicle will not affect the AN.

To limit the danger from fire transport loading and unloading operations should where possible be carried out side away from fertiliser storage areas.

4.5**Maintenance of Plant Equipment and Vehicles [PEV]**

Scheduled routine planned preventative maintenance of PEV should be in place.

A robust pre use checking procedure should be in place for all vehicles to ensure that any vehicle used in the vicinity of fertiliser is in a safe condition.

Equipment, particularly its moving parts, should be regularly cleaned and kept in good condition. Care should be taken to avoid oil leaks, particularly where this could contaminate the fertiliser. Any leaks or spills must be cleaned up immediately.

Maintenance and refuelling of vehicles and the greasing and oiling of vehicles and mobile equipment should be done well away from the fertiliser storage area. No oil or grease should be kept in those parts of the building where it could become mixed with AN-based fertilisers or accumulated fertiliser dust and residues.

Maintenance work in the storage area should be carried out only with specific authorisation and exclude operations using heat, such as welding and brazing, unless under strict control [e.g. hot work permit or equivalent].

Hot Work

- Maintenance or repairs on equipment handling fertiliser should exclude, as far as possible, operations using heat, such as welding and brazing, unless under strict control. AIC recommend a permit to work system is used.
- These operations should only be carried out after proper cleaning and inspection of hoppers or equipment [in particular, hollow sections] and a strict procedure must be in place to ensure proper cleaning.
- This storage and handling equipment may contain, or may be coated with, fertiliser residues which can be easily overlooked. On heating, the fertiliser residues produce gaseous products some of which are toxic.
- Fertilisers trapped in confined spaces and heated can undergo a decomposition leading to pressure build-up and possibly an explosion. This is particularly the case with respect to nitrate and urea-based fertilisers. Cold cutting methods can help to avoid application of heat.
- In exceptional [emergency] circumstances it may be possible to effect hot work if the product can be properly protected (e.g. covered with fire blanket) and monitored for damage during and after the hot work is complete.
- Particular care must be taken when performing such hot work over or in the vicinity of moving parts such as belts which could convey hot metal parts into a fertiliser storage area. All such hot work should be covered by a permit system. Any insulation removed to carry out work should be replaced promptly on its completion.

Electrical installations should be inspected regularly, taking into consideration the corrosive nature of fertilisers the inspection may be at shorter interval than the minimum specified by regulations.

Where there is a danger of sparking or heat affecting fertiliser, the equipment should be immediately electrically isolated and a repair programme initiated.

All work should be inspected on completion and a record should be kept of all inspection and repairs.

4.6

Store Management Principles

The essentials of good store management are: to manage to the lowest possible risk:

- Any opportunity for a fire,
- Any opportunity to mix incompatible substances,
- Any presence of off specification AN,
- And by ensuring that all relevant materials meet the Detonation Resistance Test [DRT] requirement.

Access to all storage areas, whether indoors or out, should be permitted to authorised persons only.

Consideration should also be given to securing the site from theft or misuse.

Stores should be kept securely locked when not in use.

An up to date inventory of stored products should be kept, covering the type of fertiliser, quantity and location. This information should be readily available in any event, as it may be required by the emergency services, e.g. in case of a fire.

Fertilisers should be moved out of the store in the order in which they were received, i.e. following the principle of "first in first out", as far as this is practicable.

The store should be inspected regularly, e.g. at the end of the normal working day or shift, particularly when maintenance has been carried out.

Procedures should be in place to promptly identify and handle non-conforming materials safely where appropriate; guidance has been published by AIC [See section 5].

Products should not be transferred to the store at abnormally high temperatures; practical limits should be set depending on the type of fertiliser in order to avoid caking and other quality problems [Ref 19].

It is important in harbour areas for loading and unloading facilities from ship to shore to be designed to avoid contamination. Loading and unloading during adverse weather such as rain, snow or hails are not advisable because of the risk of caking and water ingress.

To minimise the risk of fire and contamination:

- Forbid smoking, open fires, electrical heaters with exposed radiant coils/filaments and naked flames [except when authorised for maintenance]. Display NO SMOKING signs prominently, where appropriate.
- Do not store fertilisers where they may be affected by any source of heat or stored combustible materials. In particular pallets or packaging must not be stored against the walls of the fertiliser store or close enough to the bagging line or any stored fertiliser where it might cause any increased fire risk.
- Minimise the quantity of combustible packaging materials close to handling and storage areas.
- It is recognised that fertiliser bagging and blending facilities will require a small inventory of packaging and pallets close to blending plant or a packing line. Other general fertiliser stores may also have small quantities of these materials, e.g. for re-bagging damaged bags.
- Plastic packaging is generally considered a greater hazard than wooden pallets as it can melt

during a fire leading to movement of molten and potentially burning plastic within the store, thereby spreading the fire. The risk will also depend on quantities of such materials involved in a fire.

- Avoid transporting flammable or combustible substances through the storage area.
- Avoid activities within the storage area, such as vehicle maintenance and equipment repair not directly linked to the storage.

Arrangements for Small Packing Operations

To minimise the potential for packaging or pallet fires affecting fertiliser, the inventory of packaging and pallets in the vicinity of the packing line[s] should be limited to that necessary for half a day's operations. Waste pallets and packaging should be removed to their designated waste storage areas on a regular basis and always at the end of the working day.

Arrangements for Larger Quantities of Packaging and Pallets

To minimise the potential for packaging or pallet fires affecting fertiliser, the principle is to keep such materials well-separated from fertiliser storage. This can be accomplished in a number of ways, but in order of preference these are:

Store the materials

- in a separate building or outdoor location away from the fertiliser store.
- in an open-sided shed [e.g. lean-to] adjacent to the store, separated by the external wall of the store.
- in a partitioned area [walled enclosure] within the store. Where any fire involving the materials will not affect the AN
- within the store, but separated by a safe distance from fertiliser as determined by risk assessment, where any fire involving the materials will not affect the AN.

With regards to the above the following aspects must be considered:

- Plastic packaging has the potential to melt in a fire situation, potentially allowing burning material to move within the store and affect fertiliser and other combustible materials.
- The arrangements for storage must consider how this may be prevented by either total separation [e.g. not in the same building] or by ensuring the material cannot flow to the stored fertiliser or combustible materials [by using bunds, walls or ramps].
- Both plastic and pallet fires emit substantial hot gases, and the store should be designed to allow these gasses to escape and not affect the AN.
- Options include large wall openings [open vehicle access points] or venting via the roof space [e.g. louvered roof or polycarbonate-type panels which readily fail if heated – as an approximate guide, 10% of roof area].
- Where internal partition walls are used, they shall provide an adequate barrier to fire spread – for example, non-combustible materials such as brick, concrete or rock-wool sandwich panels [typically 4" thick] and a ramp in the opening provided for access.

Good housekeeping is essential to avoid any possible hazard arising from contamination. In particular:

- Clean the storage area before putting fertilisers into the store and when switching from one product to another.
- Keep equipment, walls and floors [including all passageways and open spaces] clean and free from contaminants at all times.
- Take care of contaminated materials promptly and safely.
- Clean up and dispose of rubbish promptly and safely.
- Avoid contaminating pallets, ropes, covers and other equipment with fertilisers.
- Do not use organic substances such as sawdust as an aid to cleaning floors but use inorganic absorbents or sweeping aids [e.g. 'Sorboil' – a proprietary product], limestone, sand, dolomite, lava stone and gypsum.

4.7

Storage with Other Products

Do not store flammable or readily combustible materials such as packaging materials, pallets, gasoline, oil, sulphur, hay, straw, organic substances, and reactive chemicals such as acids, or oxidizing agents where they can contaminate or affect the fertiliser in the event of a fire.

In normal storage conditions the products should be stored so as not to contaminate each other.

Agricultural products whose reaction with fertilisers may be unknown, for example pesticides, disinfectants or weed-killers, should be treated in a similar manner. The advice of the local fire authorities should be sought and a reference should be made to any national standards or regulations.

Do not store fertilisers in the vicinity of explosives. Where explosives are stored at the same site they must be stored strictly in accordance with national explosives legislation.

Take precautions to avoid the inadvertent mixing of different fertiliser products even though they may be of the non-classified type. Such inadvertent mixing may generate non-conforming [including classified] materials with unpredictable properties. For example, mixing two non-classified AN-based NPKs may result in a classified NPK of the SSD type. For further information see Fertilizers Europe guidance [Ref 20 & 21] and/or seek expert advice.

If urea or urea-based fertiliser is stored at the same site as AN-based fertilisers, take a hierarchical approach to minimise the risk of their interaction.

Avoid storage in the same building if, e.g. there is another storage building available on site.

- If urea or urea-based fertiliser needs to be stored in the same building as AN-based fertilisers, do not store them in adjacent bays and arrange the storage so that they cannot contaminate or affect each other in the event of a fire.
- In case of blending and/or packaging plants: As far as possible, use dedicated equipment for each material. Where this is not possible or practical, blending, packaging and handling equipment should be thoroughly decontaminated and inspected before being switched from material to another.

4.8

AN Fertilisers classified as Hazardous [5.1 Oxidisers]

Extreme care should be taken with the storage of non-fertiliser products, in particular combustible and reactive chemicals, in the same storage area as classified AN-based fertilisers. Non-fertiliser products should be separated by means of a suitable fire-break which has been assessed according to the expected amount and nature of the other products to be stored.

Types of materials which are considered to be potentially hazardous are:

- Combustible materials giving rise to a fire hazard and thermal radiation.
- Materials which are chemically unstable in themselves or which can give reactive mixtures when in contact with AN.
- Materials and articles capable of giving rise to a release of energy in an explosive way.
- Materials capable of releasing toxic fumes when involved in a fire or in a reaction with AN.

For these reasons, as a basic principle the following materials should not be stored in the same storage building as classified fertilisers as they may contaminate or affect each other in the event of a fire or accident.

- Solid or liquid materials sensitive to explosive decomposition [e.g. organic peroxides].
- Flammable liquids such as gasoline, lubricating fluid, coating oil and fuel oils.
- Gas cylinders including those for welding operations.
- Oil-based pesticides.
- Corrosive liquids, acids and other reactive substances such as chlorates, hypochlorites, chlorinated organic compounds, bleaching powder, chromates, nitrites, copper and zinc salts, permanganates.
- Readily combustible solid or liquid products such as sulphur, powdered metals and organic substances such as hay, straw, grain and animal feedstuffs.
- Products such as quick-lime and calcium cyanamide which generate heat in the presence of moisture.
- Products such as cement, lime, basic slag and other alkaline substances which will liberate ammonia gas from the AN-based fertilisers.
- Other agricultural products whose behaviour towards AN may be uncertain, for example branded pesticides, disinfectants or weed killers.
- In exceptional circumstances it may be permissible to store small quantities if they are so arranged as to offer no risk of contamination or adverse effect in the event of a fire or accident.

Materials which are thermally stable and known to be compatible may be stored in the same storage area as AN; provided that precautions to ensure no contamination of products in bulk shall occur.

Fertilisers belonging to class 5.1, UN 2067 [oxidizers] shall not be stored in the same stack, heap or bay as those belonging to class 9, UN 2071 [SSD type] which could act as a heat source in case of a decomposition.

4.9

UN 2071 Fertilisers: [i.e. those capable of self-sustaining decomposition, also known as 'cigar-burners'].

When handling in bulk, consider the following precautions:-

- Provide 24 hour surveillance in bulk stores for example by automatic heat or gas detectors.
- Equip the store with special fire-fighting devices such as Victor Lances for dealing with fertiliser decomposition and fires. [See Appendix D].
- Limit any single bulk heap size to a maximum of 2000 tonnes.
- Separate each heap of UN 2071 with walls or a minimum of a 2 metre air gap
- Separate UN 2067 fertilisers from UN 2071 fertilisers by an air gap of at least 5 m or a barrier of inert material at least one pallet [1.5 m] wide

4.10

Storage in Packaged Form

All the requirements and recommendations of Sections 3.2 and 4.1 to 4.8 apply.

The height of stacks of bagged product should be such that they are at least 1 metre below eaves, beams and light fittings.

The maximum size of the stacks will depend on the management of the store, but they should be arranged and sized to allow ready access. It is recommended that individual stacks should be limited to a maximum of 300 tonnes. Where it is not practicable to limit stacks to 300 tonnes, the individual stack size should be supported by a suitable and sufficient risk assessment to show that appropriate controls are in place.

It is recommended to construct stacks under 300 tonnes with a passageway at least 1 metre wide around each stack and with one passageway wide enough to allow vehicles access for easy dismantling in an emergency.

Pallets made of wood, metal or plastic are suitable, provided they are of sufficient strength for the intended use. Empty wooden pallets and plastic bags should be stored in a suitable area separate from the fertiliser such that in the event of a fire the fertiliser cannot become affected. They should not be stacked against the storage building wall.

Damaged pallets should not be used. Used/returned pallets should be checked for contamination and, where appropriate, should be cleaned prior to re-use.

Different types of fertilisers should not be stored in the same stack. Any non-fertiliser products should not be stored with fertilisers in the same stack.

IBCs of whatever size should be stored in stable stacks.

- When stacking, the height of door beams and electrical fittings should be checked in relation to that of the lifting equipment.
- When stacking in layers of 2 or more, consideration must be given to the pattern of stacking for achieving good stability [e.g. by staggering in one or both directions].
- To safely deal with the potential instability problem due to a damaged bag in a stack, procedures should be in place based on a risk assessment to safely remove it and stabilise the stack.

Note: A guidance document on stacking is available from AIC [Ref 22].

When storing different fertiliser products and non-fertiliser materials in adjacent stacks proper consideration should be given to their possible interaction in the event of a fire.

It is important to avoid damaging the bags during handling, e.g. by provision of adequate separation distances between stacks or by preventing forks of the lifting equipment contacting [and thereby damaging] the next row of bags. This can be achieved by various methods such as shorter forks, provision of buffers on forks or wider spacing between the adjacent rows of bags. Bags can also be damaged by the mishandling of pallets. Good training is, therefore, important in this respect.

- Do not use hooks to move bags, unless specifically designed for the task.
- Do not drop bags of fertiliser from excessive heights.
- Do not allow rough handling of bags.
- Avoid loops of the bags sliding on the tines of the lifting equipment.
- Avoid sharp edges on lifting equipment.

Small quantities of spilled or contaminated fertiliser should be collected, kept separate from non-contaminated material and appropriately marked. These materials should not be washed into water-courses or drains.

4.11

Storage in Bulk

Bulk fertilisers may be stored in heaps, in open or enclosed bays, in dedicated buildings or in silos. All the foregoing requirements and recommendations of Sections 3.3 and 4.1 to 4.8 apply.

AN fertilisers classified as Hazardous [5.1 Oxidisers] in Bulk Heaps

In order to minimise the risk, the following risk reduction processes are recommended:

- Only store the minimum quantity of bulk AN necessary to operate the site.
- Where appropriate, further separate bulk AN into smaller heaps to minimise the impact arising from any accidental detonation.
- For non-COMAH sites, it is recommended that storage quantities of AN in individual bulk heaps are kept as low as practicable, a suitable and sufficient risk assessment must be carried out to show that necessary controls are in place in accordance with the Management of Health and Safety at Work Regulations 1999- [See Appendix C]
- For COMAH sites, a suitable and sufficient risk assessment must be carried out to show that appropriate controls are in place in accordance with the Management of Health and Safety at Work Regulations 1999- [See Appendix C].
- For Upper tier sites, additional risk assessment work may be required by HSE as part of the mandatory safety report. It is recommended that specialist advice is obtained for the large scale bulk storage of AN fertilisers.

The storage space may be sub-divided into a number of bays of convenient shape and dimensions. Clearly label the areas to indicate their contents.

Most fertilisers are hygroscopic and therefore when stored in bulk may absorb moisture from humid air. Appropriate precautions should, therefore, be taken to protect them from absorbing moisture. This can be achieved by, for example, keeping storage time to a minimum, covering the

heaps with water-impermeable sheeting or by the provision of air conditioning in stores. Keep the doors of the building closed as much as possible.

Take care to avoid contamination of the fertiliser in bulk heaps, e.g. by ensuring that handling equipment is suitably clean and by clearing up spillages promptly.

The use of explosives to break up fertiliser, or adjacent heaps, that have caked in storage is EXPRESSLY FORBIDDEN. Caked product can be broken up by mechanical means following suitable risk assessment. When in doubt seek advice from the manufacturers.

Sweep up fertilisers spilled during handling operations and dispose of them in a safe manner [See Chapter 5]. It is important that gangways or aisles adjacent to bulk heaps are kept clean. Do not allow fertiliser to become compacted into the floor of the passage or bays where it can become contaminated with spilled oil, etc.

Fertilisers from production units are normally put into stores at temperatures of about 30°C to 50°C; in no event should a temperature of 55°C be exceeded.

When storing different fertiliser products and non-fertiliser materials in the same building they should be well separated to prevent cross-contamination and proper consideration should be given to their compatibility including in the case of a fire.

Areas used for loose bulk storage, bays and bunkers must be kept clean and free from contamination and inspected for cleanliness immediately before the fertiliser is put into them.

Whenever possible, only use the buildings for AN-based fertilisers and ingredients used in AN-based fertiliser blends. When the buildings are not being used for the above materials, e.g. due to seasonal demands thoroughly clean them before any other product is introduced.

4.12

Closed Bin [also known as Hopper or Silo]

Bins shall be made of non-combustible, non-reactive materials, e.g. stainless steel or similar suitable material. They should be of adequate strength to hold the stored tonnage safely. They should be installed on a concrete base on level well-drained ground, with adequate access for loading, unloading and emergency response.

Bins should be capable of being thoroughly cleaned before the fertiliser is introduced and so constructed that moisture absorption and product contamination are avoided during storage.

Bins should preferably be installed outdoors, at a safe distance from any combustible material, e.g. fuel tanks, such that a fire involving the combustible material would not affect the AN in the bin.

Bins must be provided with a venting device, to prevent vacuum collapse during unloading [tapping], to enable the discharge of pneumatic air during filling operations and to enable the discharge of gases generated in the event of a fire. Normally one of the filling or de-aeration pipes can be used for this purpose, however, the venting requirement in the event of a fire should be assessed.

Only one fertiliser product should be stored in each bin at a given time. The silo may be used for other products only after thorough cleaning.

When using pneumatic air for conveying purposes take care to prevent contamination [e.g. oil and dust].

When using plastic pipes, take care against the build-up of static electricity during loading and unloading.

4.13

Outside Storage [packaged form only]

The storage is regarded as outside when the storage area is not protected by walls and a roof. Outside storage is generally suitable for packaged products. Bulk fertilisers should only be stored outside in closed bins, hoppers or silos.

The recommendations made concerning co-storage with other products for inside storage [See Section 4.7] equally apply for outside storage.

Special care should be taken to avoid the storage in close proximity to combustible materials such as wooden pallets, gasoline etc. even when separated by a boundary fence. Vehicles should be parked in a designated area at a safe distance from the stored products when not in use.

The design should ensure that good and safe access to the storage area and to the product stored within is available to emergency and fire-fighting equipment even in the event of a fire/decomposition.

Exchange information with the local fire authorities where appropriate.

Consideration should also be given to the provision of adequate lighting.

Storage areas should:

- Be on level well-drained ground without projections or snags which could puncture or tear the packages.
- Have suitable road access.
- Be checked frequently when located near to population centres particularly where there is a risk of vandalism.
- Be protected against unauthorised access, eg by means of a fence. Warnings against unauthorised entry should be posted.

Repeated temperature cycles may cause physical deterioration of some products. This physical deterioration may result in the breakdown of the fertiliser particles and damage to packages. The product should be protected from direct sunlight, eg by plastic sheeting. This can be achieved for example by resting the sheet on a single layer of pallets above the stack. The layer of pallets provides a thermal insulating effect.

It is good practice:

- To store the first layer of packages on pallets to prevent damage from ground projections and to minimise water ingress from surface water.
- To protect the stacks with plastic sheeting against rain and dirt/dust. The sheeting should be adequately secured against adverse weather conditions by, for example, ropes and/or weights. Care should be taken to avoid water accumulation on the sheets on top of the stack.

Stack sizes: The maximum height of the stack should take into account stack stability, bag strength and safe handling when loading, unloading and sheeting. For straight AN this should be limited to 300 tonnes See also 4.9.3 Note: A guidance document on stacking is available from AIC [Ref 22].

5 Management of non-conforming/off-spec products, DRT-failed product and pallets

5.1 Detonation test

All those who manufacture, import, supply or keep high-N [$>28\%$ N derived from AN which is equivalent to 80% AN] products must keep copies of DRT certificates as required by the AN Materials [High Nitrogen Content] Safety Regulations 2003 [SI 1082 /2003].

5.2 Guidance for Off-spec and Reject Materials

The following descriptions and definitions have been taken from the guidance developed by Fertilizers Europe [EFMA guidance documents, Ref 20 for producers and Ref 21 for distributors].

Non-conforming materials

Are those materials which do not meet the characteristics of the intended products at the time of production or storage [as relevant] or when marketing. They include both off-spec and reject materials, [which are defined below]. Essentially, they include everything other than marketable specified product.

Off-spec products:

A number of chemical and/or physical characteristics are specified for fertilisers for purposes of production and/or marketing, which generally relate to quality and/or safety. For example, they include nutrient contents; moisture level; particle size; pH stabilizer content; presence of proscriptive concentrations of heavy metals, chloride and carbon; bulk density; oil retention [porosity]; colour; caking tendency; besides detonability and capability in terms of self-sustaining decomposition.

These include, for example:

- off-spec products from production processes
- off-spec products returned from customers
- products deteriorated in storage and handling due to, for example, physical breakdown, caking and contamination.
- spillages: clean or contaminated.
- various accumulations in and around equipment [e.g. deposits of mixtures of product and coating agents in coating drums, contaminated accumulations underneath conveyor belts].

Most of such deviations or changes have no significant impact on the potential hazards of the products; they tend to give rise to quality issues. In this guidance, these materials are described as off-spec products. The designation 'off-spec' does not mean that the product is unsafe or non-saleable. It may be acceptable to sell it as a fertiliser under a new specification or for a different application, or it may be possible to recycle or rework it within the process.

Reject materials

This description is used for products which are out of specification, or have deteriorated during storage and/or handling in such a way that they can be considered potentially hazardous. They cannot be sold as fertiliser products and may require treatment to render safe.

Examples include; those which contain more than the maximum permitted level of combustible material; those which have physically degraded into fines and could fail the Detonation Resistance Test, where applicable, and products grossly contaminated with reactive substances.

5.3

Guidance for Utilisation and Treatment

Various methods are possible for the safe utilisation of the non-conforming materials, depending on the extent and nature of the deviation or degradation. [Ref 22]

Suitability of possible options for a specific non-conforming material depend on a number of factors: e.g. the availability of suitable manufacturing processes on the site with a potential for recycle; the availability of other manufacturing processes, which can use them as process materials; and marketing as saleable products.

Importers, producers, distributors and merchants should also evaluate their particular situation and select the most suitable solution after carrying out a risk assessment.

Treat any stock of AN-based fertiliser which becomes contaminated as suspect and dispose of it in an appropriate manner depending on the nature of the contamination, and taking every care to avoid environmental damage. The following recommendations have been drawn up on this basis.

- Collect spillage and contaminated product into a designated area or in a skip/bin marked for this purpose. Avoid mixing rejects of AN-based products with urea-based products.
- Reject AN-based fertilisers with a High-N content shall be promptly rendered safe by either being diluted in 1:1 ratio with limestone or dolomite or dissolved in water (e.g. for liquid fertilisers).
- Dispose of small quantities of spillage and contaminated product by spreading thinly on open ground, but take care to avoid contamination of any water course, exceeding nitrogen spreading rates and or impact in any Nitrate Vulnerable Zones.
- Large quantities of contaminated fertiliser (diluted where necessary) which cannot practicably be spread on open ground, should be disposed by selling to a FIAS certified or company-audited customer provided the material and the sale comply with Fertiliser Regulations 2003/2003 or in accordance with the advice given by the local waste disposal authority to ensure compliance with current legislation.
- Do not dispose of AN-based fertilisers by washing into water courses or drains or attempting to burn.

5.4 **DRT-failed Material**

Material which fails or considered likely to fail the DRT requires special care due to its potential explosion risk.

AIC has developed a guidance note on contingency plan for handling and treating such materials [Ref 22]; reference must be made to that document.

5.5 **Ancillary Materials: Pallets, Packages and Other Materials**

These include, for example, contaminated or broken pallets, ropes or covers, damaged or discarded fertiliser bags and other packaging materials. Put damaged bags into over-packs, i.e. a secondary bag of sound construction that will prevent further spillage. Used packages, ropes, covers and other materials should be recycled, if possible, or disposed of safely by other means in conformity with any relevant legislation.

6 Fire prevention and emergency response

6.1 Safety and Fire Risk Assessment

Based on a fire risk assessment, consideration should be given to the provision of a suitable fire detection system in stores or sites storing fertilisers and located in the vicinity of centres of population. Examples of fire detection systems include smoke/heat / flame detection, temperature measurement, and gas [e.g. N₂O, NO_x and/or NH₃] detection.

6.2 Safety and Fire-fighting Equipment

All stores, outdoors or indoors, should have a reliable means of alerting the emergency services, e.g. by a reliable telephone system.

Where significant quantity of fertiliser is stored the local fire brigade should be consulted in the provision of fire-fighting equipment. Stores should be adequately equipped with fire-fighting equipment which should include:

- A fire water supply via a typical water hydrant[s] from a piped supply or a reservoir. Factors such as accessibility and protection against adverse weather conditions, e.g. frost and snow, should be considered. The local fire service should be made aware of the water supply facilities and should approve static water tanks or fire hydrants.
- A standard water supply capable of reaching all parts of the storage area, or an adequate supply of water extinguishers for fighting initial outbreaks of fire.
- Appropriate chemical extinguishers for fires on equipment where fertilisers are not directly involved.
- Specialist personal protective equipment such as self-contained breathing apparatus should be provided in accordance with local/national requirements and in large stores, e.g. manufacturers' premises, where adequate technical back up facilities are available. These shall be of an approved type properly maintained and regularly inspected. [Where such equipment is not provided, see Sections 6.4.2 and 6.4.3 for safe escape from toxic fumes].
- Records of all maintenance and inspection of all safety equipment shall be kept.

Due consideration should be given to the likelihood of a fire as a result of vehicle malfunction especially one involving a loading shovel or delivery vehicle in the AN store. Emergency plans should be robust enough to cover these eventualities, and be capable of tackling the vehicle fire and any product decomposition which occurs.

6.3 Main Potential Hazards of Fertilisers

The four main potential hazards to consider for fertilisers in terms of damage to people, property and environment are

- intensification of a fire
- release of toxic fumes
- explosion
- environmental contamination

6.4 FIRE – [or Fertiliser Decomposition] Emergency Action to be Followed

If smoke or fumes are observed in a fertiliser store and if it is safe to do so [i.e. not being affected by the flames, fumes or smoke], check to see if flames can be detected. If flames are seen, then a fire involving combustible material or the building itself is likely. If no flame can be seen, then fertiliser decomposition is probably taking place.

- Raise the alarm and evacuate the storage area.
- Call the Fire Services and advise them that fertilisers are involved.

In the case of a fire with visible flames: Provided it does not compromise your safety and route of escape, locate the source of the fire and extinguish it by the most appropriate method available. This may apply to situations where ancillary material may be involved [e.g. rags, pallets, rubbish and oil/lubrication in a mechanical shovel], which is not in direct contact with the fertiliser.

In the case of fertiliser involvement or decomposition [with or without combustible material burning and affecting the fertiliser]. This may apply, for example, to situations where pallets in stacks may be on fire or fertiliser may be undergoing thermal decomposition.

- Avoid breathing the fumes; they can be toxic.
- Keep all personnel not involved in fire-fighting away from the scene of the fire and in particular, keep people away from the fumes.
- Check what types of fertilisers are stored.
- Provided it does not compromise your safety and route of escape, ensure maximum ventilation as quickly as practicable by opening all doors, windows and roof vents [provided it does not accelerate the burning of combustible materials]; otherwise, leave this to the emergency services. As far as possible, this should be done from outside the building.
- If AN-based fertilisers are involved, do not use chemical extinguishers, foam or sand; attempts to smother a fire are useless and potentially hazardous. In particular, never try to smother the fire with steam. Note: Outbreaks of fire on equipment where the fertiliser itself is not directly involved may be extinguished by these means.
- Advise the Fire Services on their arrival of the types of fertilisers that are involved [particularly point out if AN-based fertilisers are present] and that self-contained breathing apparatus may be required. Safety Data Sheets of the products involved should be given to them.
- Protect drains by suitable materials such as bags of sand to prevent the ingress of molten AN and avoid any decomposition of AN taking place in confinement.
- Fight the fire from upwind and from outside the buildings, if possible. Use self-contained breathing apparatus if entering fumes.
- Where combustible material is the source of the fire extinguish this source as a matter of priority.
- Tackle a major decomposition of fertiliser with the effective application of water, preferably with high pressure water jets directed at the seat of the decomposition. This is particularly important in the case of fertilisers of the SSD type, UN 2071, for which special lances such as Victor lances are recommended. See Appendix I. [N.B. Victor lances can also be used for any bulk fertiliser type].
- In a minor decomposition try to remove the decomposing material from the main heap and direct copious quantities of water on the seat of the decomposition.

- If necessary, keep adjacent fertiliser cool by spraying with water. In this respect particular care is needed in the case of fertilisers capable of SSD, i.e. those belonging to UN 2071.
- Under severe fire conditions the application of water to hot AN may cause eruptions of steam and splashing of the melt. Fire-fighting personnel should take all necessary precautions for their safety whilst continuing to apply water to the seat of the fire.
- Depending on the risk assessment there are two main options: 1) evacuation of the area, or 2) continue normal firefighting. The following factors contribute to a 'high risk scenario': high concentration of AN in the fertilizers, a classification for transport or storage of the concerned fertilizers, a high level of contamination with incompatible and/or combustible materials. A possible confinement of the fertilizer, e.g. in a solid bulk tanker, could be a contributory factor for a high risk scenario. Factors pointing to a 'low risk scenario' are low concentration of AN in the fertilizers, no classified fertilizers, presence of NPK fertilizers only, a low level of contamination with incompatible and/or combustible materials. In the case of a high risk scenario, evacuation should be considered. In case of a low risk scenario firefighting is the first priority.
- If the initial assessment indicates the possible risk of an explosion, consider evacuation of all personnel. Set up a remote unmanned water deluge, where possible and if safe to do so.
- In a serious emergency situation if supply of fresh water is not available sea water can be used to extinguish a fire.
- After the fire, clean up the area effectively under the supervision of a competent person. Dispose of damaged or contaminated fertiliser in a safe manner.
- Where necessary advise the relevant local and/or water authority if water contaminated with AN has entered watercourses etc. Further advice on control of fire-water run-off is given in EH 70 [Ref 23].
- Continue supervision until there is no further risk of decomposition or recurrence of the fire.

6.5

Toxic Gases Hazard

Most fertiliser materials thermally break down, when heated, releasing gases some of which may be toxic or harmful. Fertilisers based on ammonia tend to be more prone than others in this regard and they include, for example, AN and AN-based fertilisers, MAP, DAP and urea or urea-based fertiliser. They give off ammonia gas when decomposing. Those containing AN also release oxides of nitrogen. NPK fertilisers can give off a number of gases [e.g. ammonia, oxides of nitrogen and hydrogen chloride] depending on the source materials used.

For the preparation of Safety Reports and emergency plans under COMAH regulations it may become necessary to do consequence analysis for certain accident scenarios such as a major fire with the evolution of toxic fumes. Such consequence analysis will involve the prediction of the concentration of toxic gases at various distances as the fumes disperse downwind in the atmosphere.

Dispersion models are available from a number of organisations. Such models will require the 'source' term as an input, which is the rates of release of the toxic components.

For straight AN the relevant information is available from a number of fire tests carried out by the UK's Health & Safety Executive [Ref 24].

6.6 First Aid Procedures

Any person who has definitely inhaled oxides of nitrogen or ammonia gas must be removed from the fumes, made to lie down in shade, kept warm and made to rest even though no symptoms may be evident.

- Give oxygen, especially if the person is blue in the face.
- Apply artificial respiration only if breathing fails.
- Seek immediate medical help and keep the affected person under medical supervision for at least 48 hours. Hospital treatment is recommended.

6.7 Explosion Hazard

Most fertilisers are free from explosion hazards. Those fertilisers which can present explosion hazards are required to pass the Resistance to Detonation test to prove they have high resistance to detonation and, therefore, the risk of a major explosion involving detonation of a significant amount of the stored fertiliser is extremely small. However, if a consequence analysis of a scenario involving a detonation in a stack or heap is required, the main point of consideration would be overpressures generated by the blast wave. Such overpressures can be derived from an estimation of the TNT equivalent and the efficiency of explosion. Guidance on these aspects is available from AIC Head Office.

6.8 Environmental Considerations

AN has low aquatic toxicity and does not present a major hazard to the environment if spilled on land. It is widely used as a fertiliser as it supplies nitrogen for plants. It is readily soluble in water and biodegradable; it is not persistent and does not bio-accumulate.

The potential harm to the aquatic environment can be from:

- toxicity of free [non-ionised] ammonia
- oxygen depletion due to nitrification of ammonia/AN
- eutrophication due to nitrate

AN can create toxic effects when dissolved in water through the production of free [or non-ionised] ammonia. The extent of this reaction is very low below a pH of 7 and thus for most fertiliser products the toxic risk to the aquatic environment is negligible in practice.

Nitrification of ammonia/ammonium to nitrate by bacterial action is a relatively slow process and therefore discharge into a running stream or tidal estuary waters is unlikely to result in harm. However, a high AN concentration in confined surface waters may induce the proliferation of algae [eutrophication] or, eventually, contamination of ground water by nitrates.

7 Security

7.1

Security Risk Assessment

Provision of security arrangements should be based on a risk assessment, taking into consideration such issues as entry into site via access gate/door[s] by unauthorised persons, entry through any fence and protection of the product.

A procedure should be in place to control persons who can enter the site or store. Entry of unauthorised persons to storage premises shall be prevented.

Effective and secure fencing should be provided, where appropriate. In some situations, such as large outdoor storage in vulnerable areas, provision of camera-linked TV monitoring or infra-red alarm systems should be seriously considered. Advice in this regard may be sought from Your local Counter Terrorism Security Advisor [CTSA].

Avoid storing fertiliser adjacent to public highways or where there is uncontrolled public access.

7.2

Explosive Precursors and Counter Terrorism

Whilst sold for legitimate uses, products containing AN including fertilisers can also be misused for criminal purposes. Terrorists, for example, use them to manufacture homemade explosives. The vigilance of sellers has played a key role in enabling the authorities to detect and disrupt such activities.

Suspicious transactions and significant disappearances and thefts of products containing AN must be reported to the Contact Point (see below) in accordance to EU-Regulation 98/2013 [UK Explosive Precursors Act 2014]

How to Recognise Suspicious Transactions

A suspicious transaction is any transaction or attempted transaction where there are reasonable grounds for suspecting that the product is intended for malicious purposes. Whether behaviour is suspicious has to be judged on a case-by-case basis. Indicators of suspicious behaviour may include when a customer:

- Appears nervous, avoids communication, or is not a regular type of customer
- Attempts to purchase an unusual amount of a product or unusual combinations of products
- Is not familiar with the regular use(s) of the product(s), nor with the handling instructions
- Is not willing to share what he/she plans to use the product(s) for
- Refuses alternative products or products with a lower (but for the proposed use sufficient) concentration
- Insists on paying cash, especially large amounts
- Is unwilling to provide identity or home address details if requested
- Requests packaging or delivery methods that deviate from what would be ordinary, advised, or expected.

If you are suspicious of a transaction or attempted transaction, or discover a theft or disappearance that cannot easily be explained, you must report it to the UK Contact Point on 0800 789321 or email Chemical.Reporting@Met.Police.UK.

Detailed advice is available for businesses on security from National Counter Terrorism Security Office [NaCTS0] <https://www.gov.uk/government/publications/secure-your-fertiliser>

7.3



Fertiliser Industry Assurance Scheme (FIAS)

FIAS is the industry scheme sponsored by government to assure fertiliser security and traceability in the industry supply chain. The UK government encouraged and supported this industry initiative as an alternative to further legislation. AIC manages the development and implementation of the scheme under the supervision of the FIAS Steering Group, which has representatives from government and industry stakeholders.

FIAS covers the assurance of all fertilisers intended for agriculture, horticulture, forestry, amenity and any other such commercial use. It does not apply to fertilisers packaged for home garden use. The issues and the risks vary according to the type of fertiliser and it is for this reason that the entire scheme has adopted a "Risk assessment" approach to achieving the necessary level of assurance. www.aictradeassurance.org.uk/fias Details of all of FIAS accredited companies are available for inspection on the website

8 Training

All site personnel and visitors should be made aware of the emergency procedures and safety information. Personnel involved in the handling and storage of fertilisers should be adequately instructed as to the potential hazards of the raw materials and fertilisers stored and the precautions to take.

In addition to the above, train personnel [including contractors] in:

- correct storage and handling procedures for all materials, including non-conforming products
- correct use of safety equipment.
- emergency procedures.
- fire-fighting procedures.
- procedures relating to work permits.

Keep records of all training.

9 Transport

9.1

Introduction

The main principles and recommendations described in Section 4. for storage apply equally to transport; namely avoidance of contamination, prevention of a fire, care during repair and maintenance of transport units, provision of appropriate hazard information and product security.

Transport regulations mainly apply to classified products such as oxidizers of class 5.1, UN 2067. These regulations specify various requirements such as type and strength of packaging, labelling, transport documentation, safety aspects of vehicle and training of drivers.

Companies involved in the transport of fertiliser materials classified as dangerous goods must appoint a Dangerous Goods Safety Advisor [DGSA] [See Appendix C]

There are no specific requirements in road and rail transport regulations for compound fertilisers belonging to UN 2071. For air transport, fertiliser falling within the composition specified in UN 2071 remains classified as UN 2071 irrespective of the result of the trough test.

Requirements relating to the security of dangerous goods in transport are incorporated in these regulations. They specify a number of general provisions relating to the security of all classified dangerous goods when transported. Some selected dangerous goods are listed as High Consequence Dangerous Goods.

AN and AN-based fertilisers of Class 5.1 [oxidizers] when transported in bulk [i.e. unpackaged form] come within the scope of the rules for High Consequence Dangerous Goods. These require additional safeguards such as the provision of security plans.

The European Chemical Industry Council [CEFIC] has published an industry guidance relating to security provisions for transport by road as specified in ADR [Ref 25].

A European regulation is also in place to enhance security in ship and port facilities. Its main objective is to introduce and implement Community measures aimed at enhancing the security of ships used in international trade and domestic shipping and associated port facilities in the face of threats of intentional unlawful acts [Ref 25].

Manufacturers and/or suppliers should ensure that those persons responsible for transporting their fertiliser are aware of this Guide and its relevant provisions.

9.2

General Provisions for All Transport Modes

The following provisions are recommended for all modes of transport as appropriate:

- Take care to prevent spillages. This is valid for all loading/unloading areas with particular attention to be paid to multipurpose equipment such as weighbridges and transportable cranes.
- Avoid contamination of the product, especially by non-compatible materials.
- Fire extinguishers are provided on transport units [e.g. vehicle cabs and ship bridges] primarily for fighting local fires; they are not intended for the fertiliser load. However, if fertilisers are involved in a fire and are decomposing, only water must be applied.
- Ban smoking in all loading and unloading areas.
- Do not load damaged bags. Unload any that are discovered and clean up any spillage.
- Ensure that the decks of transport units are dry, clean, free from incompatible materials and free from snags which could cause damage to bags before the loading of the product.

Additional recommendations for each mode of transport are given overleaf.

9.3

Road Transport

The provisions of 9.1 and 9.2 apply.

Take care when loading/unloading vehicles to avoid any part of the load or spillage from the load coming into contact with the exhaust pipes. Care should also be taken to prevent the load being thermally affected by the exhaust pipes and catalytic converters.

Hauliers should instruct their drivers to keep loads within their control throughout the journey and to take care when the vehicle is parked, bearing in mind the security aspects.

Ban all non-essential vehicles from stores. Do not allow any vehicle to enter stores unless free from oil or fuel leaks.

For classified materials the provisions of ADR apply. Special attention should be given to:

- Vehicle equipment, marking and labelling
- Provision of Instructions in Writing by the carrier to the vehicle crew
- Training
- Security provisions.

Vehicles should not be parked in the fertiliser storage areas unless being loaded or unloaded.

Vehicles should not be left with the engine running unless under supervision.

All vehicles should be diesel powered.

For packaged product the following apply:

- Distribute loads evenly over the deck of the vehicle as far as is reasonably practicable in order to maintain stability.
- Vehicles carrying fertiliser should not carry incompatible materials as part loads. AN-based fertilisers should not be carried together with combustible materials, acids or other incompatible materials particularly in the case of classified fertilisers.
- Sheet and securely fasten bagged material in a safe manner after loading. A safe system for the sheeting of the load on flat-bed lorries or taut liners should be provided.

For bulk products the following apply:

- Ensure that the vehicle is clean and dry and is inspected prior to loading. This is important both from safety and quality points of view.
- Any vehicle used to transport fertiliser alternately with other products, e.g. animal feedingstuffs, should be adequately cleaned between each operation to avoid cross contamination.
- The load-carrying compartment should be constructed of impervious, not readily combustible materials.
- An undamaged sheet should be used to cover the whole of the cargo carrying compartment adequately. The sheet should be of a suitable material [e.g. coated synthetic fibre].
- Sealed rigid containers shall not be used.

Where vehicles incorporate a load heating facility it should be switched off and isolated when fertilisers are being transported.

9.4

Rail Transport

The provisions of 9.1 and 9.2 apply.

Apply the national rail transport regulations.

The transport must be carried out in accordance with the RID regulations when transporting any classified material.

Distribute bags evenly in the wagon and in such a way that any movement of the load does not prevent the opening of the doors.

Care is needed with bulk loads to ensure the closure is effective to prevent moisture ingress and product leakage.

9.5

Sea Transport

The provisions of 9.1 and 9.2 apply

Sea transport deserves a high degree of attention and careful management as this involves relatively large quantities of materials, long travel distances and often international shipments. A number of requirements have been specified for the safe transportation for AN based fertilisers in sea transport regulations, e.g.

- IMDG Code for the transport of packaged goods by sea [Ref 26]
- IMSBC Code for the transport of bulk material by sea [Ref 27]

These regulations specify certain safety related requirements for the products, e.g. resistance to detonation, which must be complied with.

Fertilizers Europe has published a guidance document for the sea transport of AN-based fertilisers [Ref 28] and, therefore, only an overview is given below.

Restrictions concerning the stowage of other goods must be adhered to as specified in the sea transport regulations.

The holds of ships should be checked to ensure:

- Cleanliness [including on top of the beams]
- No moisture
- No impurities
- No electrical cables or lamps in contact with the cargo
- No soft wood in contact with the cargo
- No hot pipes and other potential sources of heat in contact with the cargo

Vessels should be of sound construction with holds constructed of impervious not-readily combustible materials. Ensure that various detailed requirements described in the relevant regulations/codes for the vessels are met. Only a minimum of dry dunnage should be used.

Hatches should be designed, constructed and maintained so as to prevent the ingress of water. They should be fully closed once loaded to keep the cargo dry.

The design of electrical installations and fittings in holds should be such as to minimise the risk of mechanical or chemical damage.

When the vessel is in the harbour, hot work can only be performed with the permission of the representative from the harbour terminal and must follow the same authorisation procedures as those required for work in the local harbour area.

For bulk product the following apply:

- Inspect all fertiliser before and during loading and, if contaminated, halt the loading operation.
- If fertiliser is found to be contaminated on unloading, the contaminated portion should be stored separately. Identify the contaminant and take appropriate action based on expert advice.
- Do not load or unload when it is raining, snowing or hailing and make every reasonable effort to ensure that product does not become damp. Batten down hatches immediately after loading has been completed and cover with tarpaulins where appropriate.
- Consider the angle of repose, as material with a low angle can shift during rough seas [Ref 39].

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11 Appendices

Appendix A

Definitions and Explanation of Terms Used

Additives

Chemical substances, which are added to fertilisers in small quantities, e.g. to facilitate manufacturing processes and/or to improve their agronomic values and/or quality parameters [e.g. caking tendencies, thermal stability]. Examples of additives include ammonium sulphate, magnesium nitrate, aluminium sulphate, and a variety of proprietary products.

Ammonium Nitrate [AN]-based fertiliser

AN based fertilisers are those which contain nitrogen in both ammonium [NH₄⁺] and nitrate [NO₃⁻] forms, irrespective of their source; e.g. AN or KNO₃ and MAP see examples below.

AN [AN] Content

This is calculated on the basis of nitrate ions for which a molecular equivalent of ammonium ions is present.

Example 1:

The AN [AN] content of a fertiliser which contains 7% nitrate nitrogen and 12% ammoniacal nitrogen is calculated as follows:-

Nitrate nitrogen content derived from AN = 7%.

AN contains equal amount of nitrate N and ammoniacal N

Therefore, ammoniacal N content = 7%

Therefore, total N content derived from AN = 14%.

As pure AN [formula NH₄NO₃] contains 35% total nitrogen, the AN content of this fertiliser is:

$$[14 \times 100] / 35 = 40\%$$

The following table gives the total nitrogen content in fertilisers derived from AN:

| | | | | | | | |
|------|-----|------|----|------|----|-------|------|
| AN % | 100 | 90 | 80 | 70 | 60 | 45 | 30 |
| N % | 35 | 31.5 | 28 | 24.5 | 21 | 15.75 | 10.5 |

Example 2:

Where a fertiliser does not contain ammonium nitrate, but sources of ammonium and nitrate ions are available from other ingredients; the AN [AN] content of that fertiliser is considered to be as if these ions are provided by AN.

For example: A fertiliser which is made of 60% potassium nitrate and 40% MAP can be calculated as follows:

Potassium nitrate contains no ammoniacal N and 13.86% nitrate N.

MAP contains, typically, 11% ammoniacal N and no nitrate N. Therefore, the mixture contains:

$$\text{nitrate-N from potassium nitrate } 60 \times 13.86/100 = 8.3\%$$

$$\text{ammoniacal-N from MAP } 40 \times 11/100 = 4.4\%$$

The ammoniacal N is the limiting number because it is less than the nitrate N value.

Therefore total N as derived from AN = $2 \times 4.4 = 8.8\%$.

Therefore, calculated equivalent AN content in the fertiliser = $[8.8 \times 100] / 35 = 25.14\%$.

Example 3:

The composition of a CAN and AS-based blend formulation: 26:0:0:8 [SO₃] can be calculated as follows.

Taking % SO₃ of AS = 60, AS content of the formulation = $[8 \times 100] / 60 = 13.3\%$

Taking % N of AS = 21, N from this amount of AS = $[21 \times 13.3] / 100 = 2.8$ units

Remaining N = $26 - 2.8$ i.e. 23.2 units, which must come from CAN.

Assuming N content of CAN = 27%,

CAN content of the formulation = $[23.2 \times 100] / 27$ i.e. 86%

Thus, the overall composition: CAN 86.0%

AS 13.3%

Filler [by difference] 0.7%

AN content of the fertiliser = $[23.2 \times 100] / 35$ i.e. 66.3%, the product [being a mixture of AN and AS] is classified as an oxidizer.

Example 4:

The composition of a blend based on AN, potash and AS: 24:0:14:7.5 [SO₃] can be calculated as follows.

Taking basic data as %N in AN source

= 34.5, %K₂O in potash = 60, % SO₃ of AS = 60 and %N of AS = 21.

Potash content = $[14 \times 100] / 60$ i.e. 23.3%

AS content = $[7.5 \times 100] / 60$ i.e. 12.5%

%N from AS = $[12.5 \times 21] / 100$ i.e. 2.63

Therefore, remaining N from AN source = $24 - 2.63$ i.e. 21.37

Therefore, AN source content = $[21.37 \times 100] / 34.5$ or 61.07%

Overall composition:

| | |
|------------------------|--------|
| AN source material | 61.07% |
| Potash | 23.3% |
| AS | 12.5% |
| Filler [by difference] | 3.13% |

This is an NPK fertiliser with <70% AN, hence not classified as an oxidizer. If found not to be capable of a self-sustaining decomposition in the Trough test, it will not fall in Class 9. It will be not be classified as a dangerous substance.

If the above fertiliser was reformulated to contain >70%AN, e.g. by reducing the potash level, it would be classified as an oxidizer.

Blended fertiliser

A fertiliser obtained by dry mixing of more than one fertiliser, with no chemical reaction.

Classified

The term 'classified' is used in this guidance to describe fertiliser products and related substances, which are classified under the UN scheme for transport regulations as dangerous [Ref 13] or under the Classification, Labelling and Packaging Regulations as hazardous [Ref 15]. Examples of typical Classes include explosives, flammables, oxidisers and corrosive.

Coating agents/materials

These are additives applied to the surface of fertiliser particles in order to improve the quality parameters, such as moisture pick-up, caking tendency, dust formation and flow ability.

Combustible material

The terms "combustible material" and "total combustible material" when used in legislation, both refer to the total amount of organic and inorganic combustible material [e.g. elemental sulphur] present in the product, expressed as carbon. All other references to combustible material used in this guidance apply to common materials such as petrol, diesel fuel, kerosene, paint, wood, organic waste, straw, grain, etc.

Complex fertiliser

A compound fertiliser, obtained by chemical reaction, by solution, or in its solid state by granulation, having a declarable content of at least two of the primary nutrients. In its solid state each granule contains all the nutrients in their declared composition

Compound fertiliser

A fertiliser having a declarable content of at least two of the primary nutrients and obtained chemically or by blending or by combination of both.

Critical Relative Humidity [CRH]

It is the value of the relative humidity of the surrounding air, above which the material absorbs moisture and below which it does not.

Density [units kg/m³]

It is expressed and measured in a number of different ways; the main types are given below:

- Material density:
Mass per unit volume of the material included within the surface of the particles
[EN 12944-2] [Ref 8].
- Bulk density [loose]:

Mass per unit volume of a material after it has been tipped freely into a container under clearly specified conditions [EN 12944-2].

- Bulk density [tapped]:
Mass per unit volume of a material tipped into a container and compacted under clearly specified conditions [EN 12944-2].
- Packing [also called loading] density:
Mass per unit volume of a material after a tube has been filled with this material involving intermittent tapping of the tube to compact the material, e.g. in the EU resistance to detonation test [Ref 14].

DRT

Detonation Resistance Certificate, which is specified in The AN Materials [High Nitrogen Content] Safety Regulations 2003, Statutory Instrument 2003 No. 1082

Fillers

Materials, which have no primary nutrient value and are added mainly to adjust the final nutrient content of fertilisers to the required levels, are considered as fillers. These include calcium carbonate, dolomite and calcium sulphate [gypsum, anhydrite]. Some of these may contain secondary nutrients [e.g. S, Mg, Ca] and/or have beneficial effects, e.g. on soil pH or on the thermal stability and detonation properties of AN.

Fire break and Fire barrier

Fire break is typically an empty space, gap or separation the purpose of which is to prevent spread of fire. Fire barrier is a physical wall or partition constructed for the same purpose.

Granulation /prilling processes

These industrial processes are used to produce solid granules or prills. For granules rotating drum or paddle mixers are used, whereas vertical tall towers are used for making prills.

Inert materials

Fillers or additives which do not affect the chemical properties of AN [such as. clay and sand].

Non-conforming fertiliser materials

Non-conforming materials are those materials which do not meet the characteristics of the intended products at the time of production or storage [as relevant] or when marketing. They include both off-spec and reject materials, which are defined below. Essentially, they include everything other than marketable specified product.

A number of chemical and/or physical characteristics are specified for fertilisers for purposes of production and/or marketing, which generally relate to quality and/or safety. For example, they include nutrient contents; moisture level; particle size; pH stabilizer content; presence of proscriptive concentrations of heavy metals, chloride and carbon; bulk density; oil retention [porosity]; colour; caking tendency; besides detonability and capability in terms of self-sustaining decomposition.

Nutrient content

The most common practice for expressing the primary nutrient contents is in the form of nitrogen as % N, phosphorus as % P₂O₅ [or in some countries as % P] and potassium as % K₂O [or in some countries as % K].

$$P_2O_5 \times 0.44 = P$$

$$K_2O \times 0.83 = K$$

$$SO_3 \times 0.40 = S$$

Off-spec products

During production, deviations in process controls can lead to products that do not meet one or more of these specifications. Changes can also occur during storage and subsequent handling, taking the product out of specification. These changes include, for example, moisture pick-up, physical breakdown, caking and contamination. Most of such deviations or changes have no significant impact on the potential hazards of the products; they tend to give rise to quality issues. In this guidance, these materials are described as off-spec products. Thus, it does not mean that the product is unsafe or non-saleable. It may be acceptable to sell it as a fertiliser under a new specification or for a different application, or it may be possible to recycle or rework it within the process.

Reject materials

Reject materials are described as products which are out of specification, or have deteriorated during storage and/or handling in such a way that they can be considered potentially hazardous. They cannot be sold as fertiliser products unless treated to render safe. Examples include; those which contain more than the maximum permitted level of combustible material; those which have physically degraded into fines and could fail the Detonation Resistance Test, where applicable, and products grossly contaminated with reactive substances.

Stabilisers

These are a particular group of additives which can be added to AN-based fertilisers in order to improve their [thermal] stability against deterioration due to fluctuations in temperature during storage and transport.

Storage area

A designated area within a building or outdoor on-site which is used for storage of product, raw material or equipment.

Storage building

Any building which is used for the storage of fertilisers and is so designated. It may also be used for other approved activities such as blending, bagging, maintenance, storage of raw materials and packaging. Where any of these activities are undertaken; they must be properly segregated so that no risk of fire or contamination to fertilisers might occur.

Store or warehouse

Storage building, area or place used for storage of fertiliser indoors or outdoors.

Straight fertiliser

A nitrogenous, phosphoric or potassic fertiliser having a declarable content of only one of the primary nutrients. In the UN transport regulations 'Nitrogen type' description has been used for the 'straight'. The single nutrient can come from different source materials, e.g. a mixture of AN and ammonium sulphate is a straight Nitrogen fertiliser.

Types A, B and C fertilisers

These descriptions were used in the past, several years ago, based on the classification of the fertilisers in the UN transport regulations. Type A referred to oxidisers [Class 5.1], Type B was used for those capable of self-sustaining decomposition [Class 9] and Type C for those not classified as dangerous. These descriptions are not used in this guidance and the main categories are based on the current UN classification system [See Chapters 4 and 11].

Appendix B

Properties of AN

1 General

Its chemical formula is NH_4NO_3 and molecular weight 80, with total N content of 35%.

Its CAS number is 6484-52-2 and EINECS number 299-347-8.

Pure AN is a white crystalline solid with a melting point of 169.6°C. There is no true “boiling point” because decomposition begins to take place before the boiling condition is reached.

2 Crystalline forms

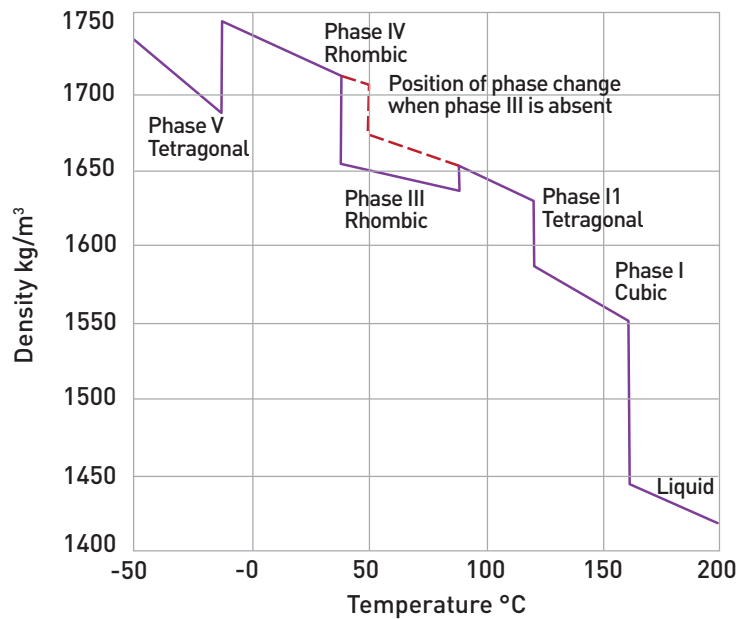
Solid AN occurs in five different stable crystalline forms or phases; the relevant details are given in Table 2 [Ref 10]. The transitions from one form to another are accompanied by volume changes as shown in Figure 1. The transition at 32.3°C is of particular interest to the fertiliser industry as it is accompanied by a substantial volume increase [approximately 3.6%] when the temperature is raised. Unless stabilised, the AN product going through cycles of temperature changes across 32°C can break down into fines due to the resulting density changes. To prevent this, certain stabilisers can be added, e.g. magnesium nitrate, aluminium sulphate which shifts the transition to a higher temperature involving a smaller volume change, as can be seen in figure 1. This is referred to as thermal stabilisation [Ref 11].

Table 2 Crystalline forms of AN

| Form | Crystal system | Temperature range [°C] | Specific volume [cm ³ /g] | Density ^[1] [g/cm ³] |
|-----------|----------------|------------------------|--------------------------------------|---|
| Liquid | - | >169 | 0.697 | 1.435 |
| Phase I | Cubic | 169.6 to 125.2 | 0.642-0.627 | 1.563-1.595 |
| Phase II | Tetragonal | 125.2 to 84.2 | 0.612-0.603 | 1.634-1.658 |
| Phase III | Rhombic | 84.2 to 32.3 | 0.613-0.605 | 1.631-1.653 |
| Phase IV | Rhombic | 32.3 to -18 | 0.582-0.572 | 1.718-1.748 |
| Phase V | Tetragonal | Below -18 | 0.589 | 1.698 |

^[1] Density is the inverse of the specific volume.

Figure 1 Effect of temperature on density and crystalline forms of AN



3 Density and Bulk density

The material density of solid AN [crystalline block] is 1725 kg/m³ at a room temperature.

Prilled or granular fertilisers have loose bulk densities typically in the range of 850 to 1100 kg/m³, depending on the source materials and the manufacturing process used. Indicative values of bulk density for some of the main products based on AN are given below.

AN 850 – 1100 kg/m³

CAN 900 – 1050 kg/m³

AN+CaSO₄ 950 – 1100 kg/m³

NPK 900 – 1100 kg/m³

4 Hygroscopicity and critical relative humidity

AN and AN-based fertilisers, like many other fertilisers, are hygroscopic and will tend to absorb moisture from the atmosphere [depending on the relative humidity, RH], when left exposed. This can cause product deterioration, which is seen as caking and/or dust formation.

The CRH of fertilisers based on AN is affected by other source materials, blending components and additives, which can be present. Relevant data are given in Guidance for Compatibility of Fertilizer Blending Materials, published by EFMA [Ref 12].

5 Solubility

AN is very soluble in water and heat is absorbed when it goes into solution, making it difficult to dissolve large quantities quickly in water.

6

Thermal conductivity

AN has very low thermal conductivity, and thus can provide good insulating effect. This is of significance in practical situations where frictional heat is generated [e.g. by a moving conveyor belt] in contact with heaps of AN or AN dust. This heat may not be readily dissipated and thus can lead to local heating, decomposition or fire of any combustible material present.

7 Chemical properties

It has oxidizing properties and, therefore, assists the combustion of combustible materials enabling them to burn even in the absence of air. When heated it decomposes by way of a number of reactions. For further information see section 2.2.3.

8 pH

It is common industrial practice to express the pH of AN as that of a 10 wt% solution at 25°C. Accordingly, pH of a neutral AN solution is not 7, but is in the region of 4.5. The pH of AN fertiliser should be above the neutral point i.e. the product should not be acidic.

| Appendix C | Key Legislation |
|------------|---|
| 1 | <p data-bbox="363 499 464 521">General</p> <p data-bbox="363 544 954 566">There are three different sources of regulatory controls:</p> <ul data-bbox="363 589 1453 763" style="list-style-type: none"> <li data-bbox="363 589 628 611">• National, i.e. UK <li data-bbox="363 629 1453 723">• European Union [EU] which can be in the form of directive or regulation. In case of directive the member states have to put in place their own national legislation to give effect to directives; whereas regulations apply directly in the member states. <li data-bbox="363 741 1070 763">• International, e.g. transport regulations by United Nations. <p data-bbox="453 775 1401 797">Some of the main pieces of legislation in the above categories are briefly described below.</p> <p data-bbox="453 815 1390 880">It is important that the users of this guide consult the up-to-date legislation as these can get amended from time to time and therefore what is given here may not be applicable.</p> |
| 2 | <p data-bbox="363 909 794 931">Fertiliser Regulation EC 2003/2003</p> <p data-bbox="363 949 1506 1048">This is the most important legislation concerning the specification/quality aspects, trading and marketing of fertilisers in the EU and covers several important aspects such as permitted materials, nutrient declaration, tolerances, labelling, handling, safety criteria and tracing etc.</p> |
| 3 | <p data-bbox="363 1077 1305 1142">Registration, Evaluation, Authorisation and Restriction of Chemicals [REACH] Regulation [EC] No 1907/2006</p> <p data-bbox="363 1160 1398 1261">This is far reaching legislation which affects the whole of the chemical industry. It requires the evaluation and registration of hazardous substances together with the provision of standardised safety data sheets for classified products.</p> |
| 4 | <p data-bbox="363 1290 1190 1355">Classification, Labelling and Packaging of Substances and Mixtures, Regulation [EC] No 1272/2008</p> <p data-bbox="363 1373 1469 1541">This applies to the labelling of products. The classification scheme specified in the revised CPL Directive is based on the Globally Harmonized System of Classification and Labelling of Chemicals [GHS] scheme. The test and criteria for classification of solid oxidisers in the GHS scheme is identical to that applied in the UN transport regulations. Packages of classified fertiliser now require labelling for both supply and transport purposes. For further details, see Chapter 4.</p> |
| 5 | <p data-bbox="363 1570 1318 1592">The Control of Major Accident Hazards Regulations 2015 [COMAH Regulations]</p> <p data-bbox="363 1610 1485 1675">This is the most important major accident hazard legislation; it is based on an EU directive. There are four categories of AN defined in the regulations.</p> <p data-bbox="363 1693 1225 1715">AN-based fertilisers are listed under AN as named substance in three categories:</p> <ul data-bbox="363 1733 1118 1832" style="list-style-type: none"> <li data-bbox="363 1733 863 1756">• those which have oxidising properties. <li data-bbox="363 1774 1118 1796">• those capable of self-sustaining decomposition [cigar burners] <li data-bbox="363 1814 810 1836">• those which are off specification . <p data-bbox="363 1854 1366 1877">Technical grade AN is also separately listed .[See COMAH List of AN-Based Substances below]</p> <p data-bbox="363 1924 1294 1946">Potassium nitrate-based fertilisers are listed in two categories depending on their form.</p> <p data-bbox="363 1964 1414 2022">For full details of their definitions, scope and qualifying quantities, reference should be made to the corresponding UK regulation, COMAH Regulations [Ref 28].</p> |

COMAH LIST OF AN-BASED PRODUCTS

It should be noted that where more than one qualifying dangerous substance is present an 'aggregation rule' applies.

1. AN [5,000/10,000]: fertilisers capable of self-sustaining decomposition [UN 2071].

This applies to AN-based compound/composite fertilisers [compound or composite fertilisers containing AN with phosphate and/or potash] in which the nitrogen content as a result of AN is –

- [a] between 15.75% and 24.5% by weight and either with not more than 0.4% total combustible or organic materials or which satisfy the detonation resistance test described in Schedule 2 to the AN Materials [High Nitrogen Content] Safety Regulations 2003[2]“the detonation resistance test”; or
- [b] 15.75% or less by weight and unrestricted combustible materials, and which are capable of self-sustaining decomposition according to the UN Trough Test specified in United Nations Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria [3rd revised Edition], Part III, subsection 38.2.

2. AN [1,250/5,000]: fertiliser grade.

This applies to straight AN-based fertilisers and to AN-based compound/composite fertilisers in which the nitrogen content as a result of AN is –

- (a) more than 24.5% by weight, except for mixtures of AN with dolomite, limestone and/or calcium carbonate with a purity of at least 90%;
- (b) more than 15.75% by weight for mixtures of AN and ammonium sulphate; or
- (c) more than 28% by weight for mixtures of AN with dolomite, limestone and/or calcium carbonate with a purity of at least 90%,and which satisfy the detonation resistance test.

3. AN [350/2,500]: technical grade.

This applies to –

- [a] AN and preparations of AN in which the nitrogen content as a result of the AN is –
 - [i] between 24.5% and 28% by weight, and which contain not more than 0.4% combustible substances; or
 - [ii] more than 28% by weight, and which contain not more than 0.2% combustible substances; and
- [b] aqueous AN solutions in which the concentration of ammonium nitrate is more than 80% by weight.

4. AN [10/50]: “off-specs” material and fertilisers not satisfying the detonation resistance test.

This applies to –

- [a] material rejected during the manufacturing process and to AN and preparations of AN, straight AN-based fertilisers and AN-based compound/composite fertilisers referred to in Notes 2 and 3, that are being or have been returned from the final user to a manufacturer, temporary storage or reprocessing plant for reworking, recycling or treatment for safe use, because they no longer comply with the specifications of Notes 2 and 3; or
- [b] fertilisers which do not fall within Notes 1[a] and 2 because they do not satisfy the detonation resistance test, other than fertilisers which –
 - [i] at the time of delivery to a final user satisfied the detonation resistance test; but
 - [ii] later became degraded or contaminated; and
 - [iii] are temporarily present at the establishment of the final user prior to their return for reworking, recycling or treatment for safe use or to their being applied as fertiliser.

Summary Table of AN categories and qualifying quantities

| Description | Lower Tier [tonnes] | Top Tier [tonnes] |
|--|---------------------|-------------------|
| 1. Fertilisers capable of self-sustaining decomposition | 5,000 | 10,000 |
| 2. Fertiliser grade | 1,250 | 5000 |
| 3. Technical grade | 350 | 500 |
| 4. Off-spec material and fertilisers not satisfying the detonation resistance test | 10 | 50 |

There are two levels or tiers of controls defined in the legislation corresponding to two different qualifying quantities present. Various requirements are specified such as the preparation and submission of a detailed safety report, the provision of emergency plans, and the provision of information to the public etc. The qualifying quantities do not represent maximum limits for storage but represent different levels of controls and requirements.

Public Information – all COMAH sites to make certain information about their sites and hazards permanently and electronically available to the public. Safety reports, notifications, and emergency plans, together with broader duties in relation to domino effects, particularly sharing information with neighbouring sites are also covered.

6 **Dangerous Substances [Notification and Marking of Sites] Regulations 1990, [NAMOS] SI 1990 No. 304 [as amended] [See INDG 467] [Ref 29]**

- a. If you propose to store or are storing 25 tonnes or more of 'dangerous substances' you must:
 - i. Notify your local Fire and Rescue Service.
 - ii. Mark the entrance of the site with the designated warning sign.
 - iii. Notify the Enforcing Authority [HSE].
- b. If you propose to store or are storing more than 150 tonnes or more of 'relevant AN mixtures', defined as a mixture containing AN where the nitrogen content exceeds 15.75% of the mixture by weight, you must notify your local Fire and Rescue Service.

7 **The Planning [Hazardous Substances] Regulations 2015**

A 'Consent' is required from the Hazardous Substances Authority for storing AN-based Fertiliser in excess of 1250 tonnes. The objective is to identify such locations for land use planning purposes. Land use involving hazardous substances will be permitted only after the safety implications and wider implications for the community have been considered by the responsible authorities. Consents granted by the local authority may include conditions.

The risk assessment methodology that was used by the HSE for AN-based fertilisers has been reviewed and amended to take into consideration potential explosion events. The size of a bulk heap or bagged stack is a significant parameter in the assessment of the explosion risk; it is therefore advisable to keep heap or stacks as small as possible.

8 **The Management of Health and Safety at Work Regulations 1999**

Make explicit what employers are required to do to manage health and safety under the Health and Safety at Work Act. Like the Act, they apply to every work activity. The main requirement on employers is to carry out a risk assessment. Employers with five or more employees need to record the significant findings of the risk assessment

9 **The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 ["CDG 2009"], SI 2009 No 1348 and European Agreement concerning the International Carriage of Dangerous Goods by Road [ADR]**

The CDG and ADR regulations together regulate the carriage of dangerous goods by road in GB; they are highly prescriptive. The GB regulations were substantially restructured for 2009 with direct referencing to ADR for the main duties. Amending regulations were made in 2011, mainly to reflect changes to the EU Transportable Pressure Equipment Directive. They require a DGSA to be used.

10 **The AN Materials [High Nitrogen Content] Safety Regulations 2003, Statutory Instrument 2003 No. 1082**

These regulations require AN-based fertilisers with more than 28%N derived from AN [i.e. containing more than 80%AN] to be subjected to a Detonation Resistance Test [DRT] and satisfy its criteria.

11 **The Control of Explosives Precursors Regulations 2014**

Regulates the sale of certain chemicals that can be used in the illicit manufacture of explosives. Members of the public who want to acquire or import these chemicals must hold a licence issued by the Home Office and an associated photographic identity document.

Members of the public who want to possess or use these chemicals must hold a licence issued by the Home Office and an associated photographic identity document.

Businesses who sell or supply such chemicals must report suspicious transactions and significant losses and thefts.

12 **The Control of Explosives Precursors etc. Regulations (Northern Ireland) 2014 (2014 No. 224)**

Special provisions for Northern Ireland only.

13. **SPECIAL PROVISIONS IN THE UN TRANSPORT REGULATIONS, ORANGE BOOK**

SP 186

In determining the AN content, all nitrate ions for which a molecular equivalent of ammonium ions is present in the mixture shall be calculated as AN.

SP 193

This entry may only be used for uniform AN-based fertiliser mixtures of the nitrogen, phosphate or potash type, containing not more than 70% AN and not more than 0.4% total combustible/organic material calculated as carbon or with not more than 45% AN and unrestricted combustible material. Fertilisers within these composition limits are only subject to these Regulations when transported by air or sea and are not subject to these Regulations if shown by a Trough Test [See Manual of Tests and Criteria, Part III, sub-section 38.2] not to be liable to self-sustaining decomposition.

[It should be noted that some model regulations apply requirements of UN 2071, even if the Trough Test does not show self-sustaining decomposition behaviour].

SP 306

This entry may only be used for substances that do not exhibit explosive properties of Class 1 when tested in accordance to Test Series 1 and 2 of Class 1 [See Manual of Tests and Criteria, Part I].

SP 307

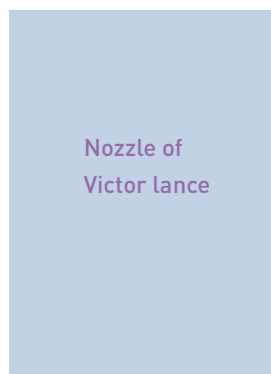
This entry may only be used for uniform mixtures containing AN as the main ingredient within the following composition limits:

- a) Not less than 90% AN with not more than 0.2% total combustible/organic material calculated as carbon and with added matter, if any, which is inorganic and inert towards AN; or
- b) Less than 90% but more than 70% AN with other inorganic materials or more than 80% but less than 90% AN mixed with calcium carbonate and/or dolomite and/or mineral calcium sulphate and not more than 0.4% total combustible/organic material calculated as carbon; or
- c) Nitrogen type AN-based fertilisers containing mixtures of AN and ammonium sulphate with more than 45% but less than 70% AN and not more than 0.4% total combustible/organic material calculated as carbon such that the sum of the percentage compositions of AN and ammonium sulphate exceeds 70%.

D

Victor Lances

The Victor lance was developed by Gewerkschaft Victor and is especially useful to extinguish decompositions in small quantities of a few hundred tonnes or in piles of bagged fertilisers. The lance consists of a nozzle [see diagram] fitted to a tube of 3m length and a diameter of 25mm. If necessary this lance can be lengthened by connecting other 3m pieces with the aid of screw couplings. At a water pressure of 8 bars this nozzle has a water capacity of about 280 l/min. The lance is easy to handle and pierces through the fertiliser very quickly to reach the heart of the decomposition, even if the product is caked. Furthermore, extinguishing can be achieved with less water compared to a normal nozzle or spray.



Shah K D and Thompson D C, AN: Safety Aspects of Blended and Granulated Compound Fertilisers based on AN, The International Fertiliser Society, Proceeding 448, [2000].

E

Other Sources of Information

A great deal of information on AN-based fertilisers has been published by other organisations; these include in the main the following:

- Fertilizers Europe [previously known as EFMA] via their websites www.fertilizerseurope.com
- International Fertilizer Industry Association [IFA] www.fertilizer.org
- International Fertiliser Society via publication of written papers. website address: www.fertiliser-society.org.uk
- The Fertilizer Institute, Washington, USA. Website: www.tfi.org
- Technical information is also available on Technical Grades of AN from SAFEX International www.safex-international.org

12 Abbreviations

| | | | |
|----------|---|--------|--|
| ADR | Agreement concerning the international carriage of dangerous goods by road [French] | HPV | High Production Volume chemicals |
| AND | European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways | HSE | Health & Safety Executive [authority in the UK] |
| AIC | Agricultural Industries Confederation [UK] | IATA | International Air Transport Association |
| AICHe | American Institute of Chemical Engineering | IBC | Intermediate Bulk Container |
| AN | Ammonium nitrate-based fertilisers | ICCA | International Council of Chemical Associations |
| ANFO | AN Fuel Oil | IFA | International Fertilizer Industry Association |
| ANS/ANAS | Ammonium Nitrate Sulphate AN solution | IFDC | International Fertilizer Development Centre |
| APEA | Association des Producteurs Européens d'Azote | IFS | The International Fertiliser Society |
| AS | Ammonium Sulphate | IMDG | International Maritime Dangerous Goods [Code] |
| BAM | Bundesanstalt für Materialforschung und prüfung | IMO | International Maritime Organisation [Transport at sea] |
| BC | Bulk Cargo | IPCC | Intergovernmental Panel on Climate Change |
| CAN | Calcium Ammonium Nitrate | MAP | Monoammonium Phosphate |
| CAS | Chemical Abstracts Service | MOP | Muriate of Potash [Potassium Chloride] |
| CEFIC | Conseil Européen de l'Industrie Chimique [European Chemical Industry Council] | MSDS | Material Safety Data Sheet |
| CEN | Comité Européen de Normalisation [European Committee for Standardisation] | NOx | Nitrogen oxides |
| COMAH | Control of Major Accident Hazards | NOP | Nitrate of Potash, Potassium nitrate |
| COP | Codes of Practice | NPK | Fertilizer containing the nutrients Nitrogen, Phosphorus & Potassium |
| CPL | Classification, Packaging and Labelling | PDV | Productschap voor DierVoeder [the Netherlands] |
| CRH | Critical Relative Humidity | REACH | Registration, Evaluation, Authorisation and Restrictions of Chemicals |
| DAP | Diammonium Phosphate | RID | Regulations concerning International carriage of Dangerous goods by rail |
| DGSA | Dangerous Goods Safety Advisor | SDS | Safety Data Sheet |
| DIN | Deutsches Institut für Normung | SOP | Sulphate of Potash [Potassium Sulphate] |
| EC | European Community, European Council | SSD | Self-Sustaining Decomposition |
| EEC | European Economic Community | SSP | Single Superphosphate |
| EFMA | European Fertilizer Manufacturers' Association | TARMAC | Company in UK selling cement, asphalt, etc. |
| EINECS | European Inventory of Existing Commercial Chemical Substances | TFI | The Fertilizer Institute [USA] |
| EN | European Norme | TNO | Netherlands' Organisation for Applied Scientific Research |
| EQS | Environmental Quality Standards | TSP | Triple Superphosphate |
| ERIC | Emergency Response Intervention Cards | UAN | Urea AN |
| EU | European Union | UN | United Nations |
| GHS | Globally Harmonized System | VKP | Vereniging voor Kunstmest Fabrikanten [The Netherlands' National Association of Fertilizers Producers] |

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