SAFEX International

# SAFEX Good Practice Guide:

# Transportation of Technical Grade Ammonium Nitrate

By

The International Industry Working Group on Ammonium Nitrate

SAFEX Good Explosives Practice Series

GPG 06(01)

## SAFEX Good Explosives Practice Series

Good Explosives Practice (GEP) is a generic term used to describe a method for working with explosives and precursors. GEP ensures that explosives hazards are understood and practical measures applied to reduce:

- Likelihood of initiation and
- Potential consequences of initiation if it occurs.

The use of the term “Best Explosives Practice” has been avoided for several reasons such as:

- What is best for one explosive may not be the best for another
- There may be financial or process constraints as to the practices that can be implemented
- It is often difficult to get people to agree on an absolute best.

The initiative is an attempt to capture the expertise that is still available in our business. This expertise is under threat due to influences such as the transfer of classical processes to newer technologies; the concentration of companies inside the explosives business; the retirement of experienced colleagues grounded in the fundamentals of explosives; and the shorter time practitioners have available to acquire an appreciation of explosives and shorter time explosives practitioners have available to acquire an appreciation of the basis of safety in their operations.

To assess hazards and risks systematically without such a basic understanding of explosives practices for these types of operations is almost impossible. Hopefully the GEP approach will grow over time to a database of good practices in our business and address this need

GEP can be regarded as the recommended practice the explosives industry follows.

They can be captured in several ways: Standard Operating Procedures, Statutes, Maintenance manuals, Operating Manuals, etc. A Good Practice Guide (GPG) is one of the ways SAFEX has elected to document some of the essentials that result in GEP. GPG is synonymous with a “Code of Practice”. The latter may suggest everyone concerned has signed off on it which is not necessarily the case with GPG.

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## 1. Introduction

This document was developed by the global manufacturers of ammonium nitrate (AN) to provide guidelines for the transportation of Technical Grade Ammonium Nitrate (TGAN). TGAN is ammonium nitrate, which meets the definition of UN1942 and in some cases UN2067. TGAN is in the form of porous prills or granules and is used in the manufacture of commercial explosives. TGAN is also known as Porous Prilled AN (PPAN), Low Density AN (LDAN) or Industrial Grade (IGAN).

Ammonium nitrate is a product manufactured and used in increasingly significant quantities, both in the agricultural industry as fertiliser and in the mining industry as an explosives precursor. Due to its chemical properties, ammonium nitrate is classified as a

Dangerous Good under the United Nations Recommendations on the Transport of Dangerous Goods – Model Regulations 19th Edition and the International Maritime Dangerous Goods Code.

This Good Practice Guide (GPG) covers more than transportation; it includes the activities post manufacture (not including storage, which is covered in the SAFEX TGAN Storage GPG) through transfer to the final destination.

**The TGAN Transport GPG is structured as follows**:

Section 2 provides a glossary of terms and definitions used in the document.

Section 3 covers the Safe Transport of TGAN by first providing general guidelines on good practice for each of the ways that TGAN is transported, namely, loose bulk, and packaged in FIBCs, IBCs, and poly bags. It then covers specific considerations for each of the three packaging methods being considered.

**The Appendices list**:

(i) The hierarchy used for this document which shows the main topics covered by this GPG and lists all the relevant areas, i.e. Modes of Transportation, Activities, Hazards, Security, etc. (for the three packaging methods included in this GPG.) This section is presented in point form for ease of reviewing. The main use of this section is to allow a quick determination of whether a topic of interest is covered in Section 3.
(ii) The containment type for the TGAN product (i.e., bulk or packaged), with the associated equipment used for the loading, unloading and transloading;
(iii) Images of loading, unloading and transloading, and
(iv) references.

## 2.DEFINITIONS

***Ammonium nitrate or AN:*** Substance which meets the classification as a Dangerous Good UN1942 and UN2067 See also the definitions for Technical Grade Ammonium Nitrate (TGAN). For the purpose of this Good Practice Guide all references to AN shall be interpreted to mean Technical Grade Ammonium Nitrate.

***Authorised person:*** A person (in addition to the authority holder) who is named in the security plan and authorised under that plan by the organisation, or where required the regulatory authority, to have unsupervised access to TGAN.

***Basis of Safety:*** Set of guiding principles for any operation. It contains the hazards and controls for a given process, engineering standards, design standards, etc.

***Bulk bags:*** Refer to the definition for FIBC.

***Contaminated TGAN:*** Covers, for example, TGAN which is contaminated with materials or chemicals that are not part of the manufacturing process. It also includes contamination of product returned from off site. Note that product contaminated with organic material at a total organic content greater than 0.2% is to be treated as explosive (UN0222) and is not covered by this code.

***EMS:*** Engine Management System of a vehicle.

***ERP:*** Emergency Response Plan

***ERG:*** Emergency Response Guidebook. The document referred to in this GPG is that jointly put out by the Departments of Transportation of Canada, USA, and Mexico.

***FIBC:*** Flexible intermediate bulk container. This can be a bulk bag, big bag or super sack, which is made of flexible fabric that is designed for storing and transporting dry, flowable product. FIBC is a type of IBC.

***FLT:*** Fork Lift Truck

***GPG:*** Good Practice Guide – document issued by SAFEX.

***Hazmat:*** Is the abbreviation for the words "hazardous materials".

***IMDG Code:*** International Maritime Dangerous Goods Code

***Intermediate Bulk Container (IBC):*** Portable packaging for hazardous substances that (1) has a capacity of not more than three cubic meters or 3000 litres; (2) is designed for mechanical handling; (3) is resistant to stresses produced in handling and transport, as determined by tests; and (4) conforms to the standards in the chapter on Recommendations On Intermediate Bulk Containers (IBCs) of the UN Recommendations On The Transport Of Dangerous Goods.

***In Transit:*** the goods are travelling or being taken from one location to another.

***NFPA:*** National Fire Protection Association (USA)

***Off-spec TGAN:*** Product that meets the criteria of UN1942 but does not meet the manufacturers' detailed product specification.

***RRA:*** Route Risk Assessment

***Safety Data Sheet (SDS):*** Also called Material Safety Data Sheets, are a widely used system for cataloguing information on chemicals, chemical compounds and chemical mixtures. SDS information may include instructions for the safe use and potential hazards associated with a particular material or product. SDSs will be available wherever chemicals are being used.

***Safety Management System (SMS):*** That part of the overall management system which includes organizational, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the safety policy, and so managing the risks associated with the business of the organization.

***Secure:*** Ways or means to allow for detectable theft, and/or detect seals having been compromised, unexplained loss, and/or prevent from sabotage, and/or unauthorised access.

***Secure store or compound:*** A physically secure place where ammonium nitrate is kept under lock and key or constant surveillance and where there are procedures for controlling access; the secure control of keys; and documenting the receiving and dispatching of measured quantities of TGAN.

***Security Plan*****:** Is a plan that has been put in place to minimize effectively all security risks relevant to the storage and transportation of TGAN.

***Security risk:*** Risk of theft; unexplained loss, possible sabotage, tampering and/or unauthorised access to TGAN.

***Site Emergency Response Plan (SERP)****:* A document developed specifically for a location that defines all the potential emergencies and the actions to be taken as a result of the emergency. Actions are defined for on-site and off-site responses (e.g. site fire brigade, evacuation, local fire department).

***Standard operating procedures (SOPs):*** Written procedures containing an explicit description of how a job is to be performed. The SOPs identify precautions required to complete the task safely, including :

- Personal protective equipment (PPE) required.
- Hazards specific to the job and/or site.
- The level of authority, responsibility and training required to complete the job safely.
- Reporting relationships identified by management as well as any other relationships that may interact with other jobs, SOPs, or work instructions.

***Technical Grade Ammonium Nitrate or TGAN:*** Ammonium nitrate, which meets the definition of UN1942 and/or UN2067 (HSE) and has a bulk density of less than 0.9g/cc. Generally, TGAN is in the form of porous prills, granules or crystals and is used in the manufacture of commercial explosives. TGAN is also known as Porous Prilled AN (PPAN), Low Density AN (LDAN) or Industrial Grade (IGAN).

***Tonne:*** Also referred to as a **metric ton.** It is not an SI unit but accepted for use with the SI as a measurement of mass equal to 1,000 kg.

***Transload:*** A change in the mode of transportation in which TGAN is loaded from one mode to another, for example, from rail to road.

***UN Numbers:*** These are four-digit numbers ranging from UN0001 to about UN3500 that identify dangerous goods, hazardous substances and articles (such as explosives, flammable liquids, toxic substances, etc.) in the framework of international transport. They are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods and are listed in *Recommendations on the Transport of Dangerous Goods*, also known as the *Orange Book*. These recommendations are adopted by the regulatory organization responsible for the different modes of transport.

***Under lock and key:*** Would normally include one of the following:

- Locked building; or
- Secure shed with lockable entrances, and if windows are in the shed, they are locked or barred; or
- Secure and lockable freight container or explosives magazine.

# 2. Safe Transport of TGAN

## 3.1 General Considerations

General considerations are valid regardless of AN packaging type, although some issues/hazards will be more valid for some packaging types.

For reference, **loading** is **to** mode of transport, **transload** is **from-and-to** mode of transport, **unloading** is **from** mode of transport. In transit is when the product is being transported.

### 3.1.1 General Hazards: Loading/Unloading/Transloading/In Transit

All equipment involved should be free of contaminants and dry. Other loading operations adjacent to AN loading should not result in the contamination of the AN. Bulk AN should not be in contact with wood.

#### *3.1.1.1 Contamination*

- Contamination of AN should be avoided in general; and contamination by some materials must be avoided due to increased risk of reactivity which could in very worst case lead to an explosion
    - See list of contaminants in Appendix IV
    - To ensure the absence of contaminants, it is important to inspect:
        - The conveyance before loading
        - The conveying equipment before loading
        - The transport (recipient container) before loading
        - The reclaiming equipment and/or ensure that reclaimed AN is not the source of contaminants.
    - It is important to ensure that the loading equipment is well-maintained and not the source of hydrocarbon contaminants.

#### *3.1.1.2 Compatibility/materials of construction*

- Contact of AN with some metals should be avoided due to corrosion and to increased risk of reactivity which in very worst case may lead to an explosion.
- See list of materials of construction that should be avoided (SAFEX TGAN Storage Good Practice Guide).

### 3.1.2 Requirements for Road Transport of TGAN

- Ensure a maintenance regime for all vehicles is in place that meets the manufacturer's specifications/log book requirements and considers the duty in which the vehicle is used. The maintenance regime as a minimum should ensure:
    - Tyres are rated for the loads and speeds.
    - Tyre wear is within manufacturer's guidelines.
    - Tyre is in proper shape and within right pressure range.

The maintenance regime should also consider how and to which extent re-tread (or recapped) tyres and re-grooved tyres may be or not used, in general, and specifically on steer axles.

- All vehicles transporting AN should be fitted with seat belts for all occupants, and seat belts worn by all occupants.
- All vehicles carrying AN should be fitted with approved firefighting equipment.
- Establish a pre-departure inspection regime.
- Maintain records to demonstrate that vehicles are registered, licenced, insured and roadworthy according to local regulations.
- Only licensed personnel should drive vehicles transporting TGAN.
- Assess vehicle configuration and load for stability and product compatibility.
- Have a contract in place with all third-party carriers.
- Where the primary contractor subcontracts any AN movement, the subcontractor should comply with the same conditions specified for the primary contractor.
- Consider Route Risk Assessments (RRA) for all routes used to carry TGAN and review at a frequency not exceeding 3 years. The RRA should consider factors relative to risk including but not limited to:
    - Population density
    - Traffic density
    - Driving surface condition
    - Road design (corners, intersections, bridges, hill crests, steep hills, signage)
    - Terrain (flat, hilly mountainous)
    - Visibility
    - Climate
    - Communications
- In jurisdictions where there are no applicable regulations, the carrier should provide a process for drivers transporting AN which may include:
    - conducting background checks
    - managing excessive speed
    - managing driver fatigue
    - managing driver behaviour
    - testing for drug and alcohol impairment
- Consider developing an emergency response plan for events during transport of AN, which endanger or threaten to endanger human life or the environment. Consider reviewing and updating response plans at a frequency not exceeding 2 years. It is recommended that a drill be conducted periodically.

### 3.1.3 Requirements for Sea Transport of AN

- Select vessel based on product being shipped and the operating environment.

- All charters should be approved.
- Ensure Vessel Pre-loading and Vessel Discharge Surveys are conducted for all Voyage and Time Charter AN product shipments.
- Ensure a Draft Survey is conducted for Voyage Charters of Bulk AN product.
- Ensure a loading and lashing plan is generated for bagged AN product and ensure the vessel is loaded to the plan.
- Ensure a stowage plan is generated for each voyage prior to loading.
- Conduct an assessment of port operations (including storage) prior to first use and at a frequency not exceeding 2 years thereafter.
- Only use shipping containers with a valid safety approval plate.
- All shipping containers should be inspected prior to use.

### 3.1.4 Spillage (Loading/Transloading/Unloaded)

- Spillage of AN can result in an environmental issue and/or contamination of the AN if recovered and used
    - A good practice is to have a contained loading area where the AN is very simply recovered and used normally
        - Contained implies curbed, paved and covered
        - See the **SAFEX AN Storage GPG** for details
    - If the AN spill results in contamination of the AN, the material should not be reclaimed and one must follow local regulations to deal with the contaminated material
        - Typically, this will be dilution with an allowed material to 50% or below and then use as a fertilizer.
        - This is not allowed in all countries, e.g. India, where other clean-up methods should be used.
        - There should be formal procedures to deal with this and operators need to be aware of/trained in the procedure.
    - If the AN spill results in contamination of the environment, one must follow local regulations to deal with the environmental contamination.

- **No evacuation zone is required if there is no fire**.
- The area should be assessed for risk/hazards prior to entry by responders.
- For vehicles, all precautions should be taken to minimize the risk of fire, e.g. battery disconnect. Note: some jurisdictions will extract the data from the vehicle EMS before disconnecting the battery.
- If the incident involves spills of fuel, the fuel and AN spills should be kept separate to the fullest extent possible. The fuel spill should have priority in clean up.
- There is a product stewardship responsibility by the shipper for the safe and environmentally sound transport and/or disposal of spilled material.
- The Security Plan needs to be maintained to minimize the possibility of theft. It may be necessary to alert relevant authorities in some jurisdictions.

**It is general Good Practice to minimize the potential for spills; this should be an inherent consideration in the design of any loading/unloading/transloading facility.**

Spillage (Road)

- Good practice is to have an operator present/observing the operation to ensure proper alignment and no overfill

Spillage (Rail)

- Good practice is to have an operator present/observing the operation to ensure proper alignment and no overfill

Spillage (Marine)

- AN spills during the transfer process are treated as normal; however, recovery/ decontamination will either be impossible (e.g. loose prills) or very difficult. It is therefore particularly important to design the process to minimize the potential for spills

Spillage (In Transit)

- Spills in transit are likely to occur on public or third party land or into a body of water
- Response to any spill and quantity adjustment due to the spill needs to meet all relevant regulations
- ERP (Emergency Response Plan) needs to cover spills

- Carrier should have emergency contact information and relevant documents available

### 3.1.5 Fires

#### *3.1.5.1 Fires (General)*

- Notify the relevant authorities
- Execute your ERP; By default, fires directly involving/affecting AN should not be fought and should trigger an appropriate evacuation.
    - This does not apply to vessels where emergency response is the responsibility of the transporter. The shipper should provide full details of the material being shipped

- The ERP should clearly define roles and responsibilities for Incident Management. Fires involving transport equipment may necessarily involve the immediate response of the transport operator until Incident Management by responsible parties can begin. Transport operators should be properly trained to respond to fires involving their specific equipment.

The emergency response plan should include an evacuation plan. If a fire adjacent to the AN cannot be extinguished and becomes uncontrollable, then the ERP should include a recommendation to the responsible authorities that an evacuation should be carried out to the required distance

- Many jurisdictions will mandate a safety distance for such evacuations
- Where the distance is not mandated, the recommendation is minimum 0.8 km[1]
- Use of remote (unmanned) fire-fighting equipment is allowed
- There should be no re-entry into the evacuation zone until the responsible authorities deem it safe. After re-entry, the Security Plan should be implemented to prevent the theft of any of the remaining load

#### *3.1.5.2 Fires (Site)*

- Appropriate fire extinguishers should be available to fight any fires near or in the loading equipment, e.g. front end loaders and truck cabs.
- Small fires involving small quantities of AN may be fought if the site has carried out a prior risk assessment, which covers how the fire will be fought and what extinguishing media will be used, and the operators are trained in handling such an emergency
- If possible, the vehicle should be moved away from the loading point
- Large fires directly affecting AN should trigger a full evacuation
    - Evacuation procedures should be part of the Site ERP and employees should be trained in it

The following section is taken whole from the SAFEX AN Storage GPG and is also largely relevant here (and for all fires involving significant quantities of AN):

#### *3.1.5.3 Fire Fighting Considerations*

TGAN is an oxidising agent. It does not burn but is a strong supporter of combustion. The presence of some contaminants may increase the consequence of a fire. In a fire, TGAN will decompose and produce toxic combustion products such as oxides of nitrogen, ammonia and nitric acid fumes.

The properties of TGAN, its mass and location of the store influence detailed fire-fighting requirements. They should be determined by a fire risk assessment carried out by competent personnel.

[1] The 2016 edition of the ERG recommends 800 meters in all directions

**Key design and operational considerations**:

- If a fire is out of control, the facility should be evacuated. (See Section 3.1.5.1 for evacuation distance guidelines.)
- Only those employees trained in fighting TGAN fires should be involved in the emergency response
- Appropriate PPE including self-contained breathing apparatus (SCBA) should be made available
- Fire protection strategies should be based on minimizing the presence (both potential and actual) of combustibles around TGAN.
- For a fire involving TGAN, the prompt application of water is the most effective means of control. It is the cooling and dissolution effect of water that controls the fire.
- Water from hoses and e.g. fixed monitors should be able to reach all parts of the store.
- Foam and/or dry chemical extinguishers should be available to deal with vehicle or electrical fires. Foam and/or dry chemicals are not effective on AN fires and should not be used for fires directly involving AN.
- Fire-fighting systems should be capable of single person operation (Typically TGAN stores would be operated by a small number of people. An exception is if the TGAN store is part of a large complex. Equipment operated by a fire fighting team may be appropriate.)
- The Site Emergency Response Plan (SERP) should provide guidance for scenarios which involve the release of NOx.

### *3.1.5.4 Fires (Road)*

- The most likely source of fires will be on the vehicle, e.g. an electrical, fuel or tyre fire. Tyre fires are the most dangerous (i.e. highest potential to lead to an explosion of the inventory, based on data over the past 20 years) due to the high heat released over an extended time period. These fires should be fought with on-vehicle fire extinguishers and any local fire extinguishers or hoses. Fire extinguishers are very unlikely to work on an advanced tyre fire. Only copious amounts of water will succeed with advanced tyre fires.
- If possible, the vehicle should be moved away from population centres
- If possible, e.g. the fire is on the tractor, isolate the fire source from the load. In this case, the Security Plan should be implemented to prevent theft of the load.
- If the fire cannot be extinguished and involves the AN, it should trigger the evacuation plan
    - Evacuation procedures should be part of the Transport ERP and the driver(s) should be trained in those procedures

### *3.1.5.5 Fires (Rail)*

- The most credible fire scenario is an external fire close to the loading area
    - It is possible for a fire to occur in a contaminated railcar. The prevention of this is covered above in the preloading inspection procedures. Firefighting should follow the general guidelines, i.e. fires not directly involving the AN can be fought. Fires

directly involving the AN should not be fought and should trigger the ERP which should include an evacuation plan.

- It is possible to have a wheel/brake fire involving the lubricant on flatbed railcars
    - This practice needs to be addressed by a Risk Assessment

#### *3.1.5.6 Fires (Marine)*

- The most likely sources for a fire are the conveyor or a truck feeding the conveyor and these are covered above
- Containers may be above deck
- For any fire in a hold of a vessel containing AN, never attempt to smother the fire by closing the hatches

#### *3.1.5.7 Fires (In Transit)*

- Notify the relevant authorities
- Execute the relevant ERP

### 3.1.6 High Temperatures (all Transport Modes)

- TGAN should not be loaded when its temperature is above the temperature stated in any relevant local or national regulations. In the absence of such legislation the limit should be either the value quoted above (80$^{o}$C, 176$^{o}$F) or determined by a risk assessment.
- High ambient temperatures can increase the external fire risk, and should be considered as part of the transport risk assessment

### 3.1.7 Weather/ Acts of God

- Electrical Storms
    - If the loading is carried out in a covered, grounded structure, the loading operation can continue.
    - If the above conditions are not met and if there is a lightning risk to personnel deemed unacceptable by a risk assessment, loading should be discontinued.
- Rain
    - There can be quality and environmental issues involved.
- If the weather conditions result in a vehicle breakdown or accident, refer to the relevant section above.

- The ERP should consider regional/prevalent weather conditions and ‘Acts of God’ which can strand the transportation means for many days.
- For many ‘Acts of Gods’, preplanning is not possible but there should be an emergency response planning system in place to manage them on a ‘one off’ basis.

### 3.1.8 Security

For reference, **loading** is **to** mode of transport, **transload** is **from-and-to** mode of transport, **unloading** is **from** mode of transport. In transit is when the product is being transported.

#### *3.1.8.1 Security: Loading*

General Consideration

- All relevant regulations must be complied with
- Operations should be attended at all times
- No unauthorized persons should be in the area during operations
- Once loaded, the container should be secured
- Correct placarding and markings should be in place
- Tracking systems may be used to follow loads
    - As appropriate, use this system to trigger an internal investigation or emergency response

##### *3.1.8.1.1 Security (Road)*

- Transport company should be vetted
- Drivers should be vetted and should have valid credentials to enter site
- Vehicle should be inspected to ensure it meets all required standards
- Route risk assessment should be considered
- Once the vehicle leaves the site, the delivery confirmation should be made at the destination within its allotted transportation time frame. Where possible, progress may be monitored to ensure that the vehicle arrives within this allotted time frame (if regulations require). If the vehicle does not arrive within this time frame, it should trigger an investigation.
- Security plan should be in place
- Once the AN is loaded onto the vehicle, it should be properly secured to reduce the risk of unauthorized entry and/or to detect if seals have been compromised

##### *3.1.8.1.2 Security (Rail)*

- All regulations must be complied with
- Rail company should be vetted
- Railcar should be inspected to ensure it meets all required standards

- Once the AN is loaded onto the railcar, it should be properly secured, i.e. all hatches and gates should be secured with security seals
- Where possible, railcar tracking systems should be used

#### *3.1.8.1.3 Security (Marine)*

- All regulations must be complied with
- Shipping company should be vetted
- Vessel should be inspected to ensure it meets all required standards
- Once the AN is loaded onto the vessel, it should be properly secured, i.e. all hatches should be secured with security seals
- Where possible, vessel tracking systems should be used

### *3.1.8.2 Security: Transloading*

**General Consideration**

- Prior to transloading, check to ensure seals, where present, have not been compromised
    - See below for procedures if seals broken or compromised
- Transloading operation should be attended at all times, if not carried out in a secured area
- No unauthorized persons should be in the area during transloading
- This will normally be on public or third party land
- This section considers only the 'to' aspect of a transload; for the 'from' aspect, see the appropriate 'unloading' section
- All relevant regulations must be complied with
- The transportation company (road, rail marine) should be vetted
- The Transload operator should be vetted

#### *3.1.8.2.1 Security (Road)*

- Drivers should be vetted and should have valid credentials to enter site
- Vehicle should be inspected to ensure it meets all required standards
- Route risk assessment should be done; transload facility should be included
- Security plan should be in place
- Once the AN is loaded onto the vehicle, it should be properly secured

#### *3.1.8.2.2 Security (Rail)*

- Railcar should be inspected to ensure it meets all required standards
- Once the AN is loaded onto the railcar, it should be properly secured, i.e. all hatches and gates should be secured with security seals

- Where available, railcar tracking systems should be used

#### *3.1.8.2.3 Security (Marine)*

- Vessel should be inspected to ensure it meets all required standards
- Once the AN is loaded onto the vessel, it should be properly secured, i.e. all hatches should be secured with security seals
- Vessel tracking systems may be used

### *3.1.8.3 Security: In Transit*

#### 3.1.8.3.1 General Considerations

- Some jurisdictions require armed escorts for AN shipments.
- Some jurisdictions also require notification of the route to be traversed.
- To improve security consider using GPS monitoring of the vehicle
- 'Man-down' devices can also be used for added security
- Communication with the driver should be used as a back up to the electronic systems

#### 3.1.8.3.2 Tracking/on route monitoring

- Vehicles/railcars/vessels should be tracked using an appropriate system for the shipping mode.
- Tracking systems may be used to follow loads
    - As appropriate, use this system to trigger an internal investigation or emergency response

#### 3.1.8.3.3 Emergency Response Plans

- Should cover escorted and unescorted scenarios
- The Emergency Response Guide issued by the US Department of Transportation provides an example of guidance on response for events involving TGAN[2]
- The driver of vehicle should be adequately trained in the security aspects of TGAN and can advise the Emergency Responders .

### *3.1.8.4 Security: Unloading*

[2] http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2016.pdf

#### 3.1.8.4.1 General Consideration

- Prior to unloading, check to ensure seals, where present, have not been compromised
    - See below for procedures if seals are compromised
- For shipment on flatbeds, ensure quantity and integrity of bags
- Unloading should be attended at all times
- No unauthorized persons should be in the area during unloading
- All relevant regulations must be complied with

#### 3.1.8.4.2 Security (Road)

- Drivers should have valid credentials to enter site
- Once the vehicle reaches the site, the time of delivery is documented
- If the seals of the load have been compromised (e.g. seals broken or physical damage)
    - Determine whether the product has been tampered with or product is missing
    - Inform the shipper and carrier
    - Do an internal investigation to determine whether it is necessary to inform the authorities and take the necessary steps

#### 3.1.8.4.3 Security (Rail)

- Railcar should be inspected to ensure that it has not been tampered with
- If the seals of the load have been compromised (e.g. seals broken or physical damage)
    - Determine whether the product has been tampered with or product is missing
    - Inform the shipper and carrier
    - Do an internal investigation to determine whether it is necessary to inform the authorities and take the necessary steps
- Tools for the unloading/moving of railcars should be secured when not in use

#### 3.1.8.4.4 Security (Marine)

- If the seals of the load have been compromised (e.g. seals broken or physical damage)
    - Determine whether the product has been tampered with or product is missing
    - Inform the shipper and carrier
    - Do an internal investigation to determine whether it is necessary to inform the authorities and take the necessary steps

### 3.1.9 Emergency Response (General)

**Note:** In many jurisdictions the following recommendations are mandatory for transportation

Shipper (consigner) should prepare and maintain a written Emergency Response Plan (ERP).

- Carry out ERP exercises/practices
- Shipper should have trained personnel available for emergencies (can be contracted)

Shipper should supply an SDS to transporter

Shipper should have 24 hr Emergency Response Contact number

Shipper should assist in awareness development for emergency responders

Shipper should vet any outside contractor involved in emergency response

- Covers clean up and disposal

Shipper's ERP should include advising relevant authorities as required

Shipper should consider having prepared spill disposal packaging available

#### *3.1.9.1 Accidents*

In the event of an accident, the Emergency Response Plan should be activated.

The ERP should prohibit any hot work to be carried out without first performing a risk assessment.

If the accident involves a fire or spill, the preceding sections apply.

#### *3.1.9.2 Vehicle Breakdowns*

In the event of a breakdown, the Emergency Response Plan should be activated.

The ERP should include no hot work to be carried out without a risk assessment.

The Security Plan needs to be maintained to minimize the possibility of theft. It may be necessary to alert relevant authorities in some jurisdictions.

If the breakdown cannot be quickly and safely rectified or if the vehicle cannot be attended at the site, the product should be transferred to another vehicle.

## 3.2 Bulk (Loose Prills or granules)

### 3.2.1 General Considerations

Good practice is to have an operator present/observing the operation to ensure proper load distribution, prevent overfilling, etc. The sections below list the special/additional considerations that should be included for operations with bulk AN.

- For loose bulk transport in marine vessels in open seas, TGAN must comply with the IMDG Code detonability test.

### 3.2.2 General Hazards: Loading/Unloading/Transloading

Contamination

- Contamination of bulk AN is more likely than with bagged AN or AN in FIBCs; therefore, the precautions/standards listed in 3.1 General Considerations are particularly important.

Compatibility/materials of construction

- Contact of AN with some metals should be avoided due to increased risk of reactivity which could lead to an explosion. This is particularly applicable to bulk AN; therefore, the precautions/standards listed in 3.1 General Considerations are important.

### 3.2.3 Spillage (Loading/Transloading/Unloaded)

- If the AN spill results in contamination of the AN, the material should not be reclaimed and one should follow local regulations to deal with the contaminated material.

**It is general Good Practice to minimize the potential for spills; this should be an inherent consideration in the design of any loading/unloading/transloading facility.**

#### 3.2.3.1 Spillage (Road & Rail)

- Good practice is to have the prill loading system, e.g. chute, through the entry point of the vehicle or railcar.

#### 3.2.3.2 Spillage (Marine)

- Typically material transfer is done by belt conveyors or clamshells from the AN store to/from the vessel. This process is prone to the generation of some spillage so the design should include spill containment where possible.

### 3.2.4 Fires

There are no special considerations involving bulk AN/loose prills. Refer to the General Section above for guidelines and recommendations.

### 3.2.5 High Temperatures (all Transport Modes)

The loading of high temperature AN is likely to be only relevant for bulk AN/loose prills. Refer to the General Section above for guidelines and recommendations.

### 3.2.6 Weather

It is not a good practice for bulk TGAN to be stored outdoors due to the possibility of product quality degradation. Loading, unloading and transloading operation design should consider local environmental conditions.

### 3.2.7 Security

Managing bulk inventory is different than managing packaged inventory. Companies should implement inventory management and security controls (to prevent theft or diversion) specific to bulk TGAN.

This applies to the entire supply chain.

### 3.2.8 Emergency Response

There are no special Emergency Response considerations for operations/shipments involving bulk AN. In the event of an accident, the ERP should consider the potential contamination of the TGAN.

## 3.3 IBC/FIBC

### 3.3.1 General Considerations

Good practice is to have an operator present/observing the operation to ensure proper load distribution, prevent overfilling, etc. After completing any transfer operation, the load should be properly secured before starting the transportation phase.

The sections below list the special/additional considerations that should be included for operations with AN packaged in IBCs/FIBCs (also covers palletized poly bags).

### 3.3.2 General Hazards: Loading/Unloading/Transloading

#### *3.3.2.1 Contamination*

- Contamination of AN in an IBC/FIBC is less likely than with bulk AN; however, the precautions/standards listed in General Considerations should be considered. It is therefore critical to maintain the integrity of the packaging to minimize the potential for hazardous contamination to occur.

#### *3.3.2.2 Compatibility/materials of construction*

- Contact of AN with incompatible metals (e.g. copper/copper alloys) should be avoided due to increased risk of reactivity which could lead to an explosion. This is less likely with AN in IBCs/FIBCs than bulk AN; however, the precautions/standards listed in General Considerations should be considered. It is therefore critical to maintain the integrity of the packaging to minimize the potential for hazardous contact to occur.

### 3.3.3 Spillage (Loading/Transloading/Unloaded)

Spillage of AN from an FIBC/IBC should be treated as bulk AN spillage; refer to section 3.2.3.

**It is general Good Practice to minimize the potential for spills; this should be an inherent consideration in the design of any loading/unloading/transloading facility.**

### 3.3.4 Spillage (Road/Rail/Marine)

- Spills cannot occur if the IBC/FIBC remains intact. Therefore, it is important to select processes, equipment and 'vehicles' that minimize the potential to damage the IBC/FIBC

### 3.3.5 Fires

A special consideration involving AN in IBCs/FIBCs on combustible pallets is the increased propensity for the fire to spread. Risk assessment should take into account the use of combustible pallets and the risk of fire escalation. Also, refer to the General Section above for other guidelines and recommendations.

### 3.3.6 High Temperatures (all Transport Modes)

Refer to the General Section above for guidelines and recommendations.

### 3.3.7 Weather

No additional considerations for AN in IBCs/FIBCs.

### 3.3.8 Security

There are no additional Security considerations for operations/shipments involving AN in IBCs/ FIBCs.

### 3.3.9 Emergency Response

There are no additional Emergency Response considerations for operations/shipments involving AN in IBCs/FIBCs

## 3.4 Poly Bags

### 3.4.1 General Considerations

Note: This section does not cover palletized poly bags; this is covered in Section 3.3 IBC/FIBC.

Good practice is to have an operator present/observing the operation to ensure proper load distribution, prevent overfilling, etc. After completing any transfer operation, the load should be properly secured before starting the transportation phase.

The sections below list the special/additional considerations that should be included for operations with AN packaged in poly bags.

**Used Polybags, which may contain AN dust, should be recycled or disposed of per shipper's recommendations or local requirements.**

### 3.4.2 Fires

There are no special considerations involving AN in Polybags. Refer to the General Section above for guidelines and recommendations.

### 3.4.3 High Temperatures (all Transport Modes)

Refer to the General Section above for guidelines and recommendations.

### 3.4.4 Weather

No special considerations for AN in Polybags.

### 3.4.5 Security

Companies should implement inventory management and security controls (to prevent theft or diversion) specific to TGAN in poly bags, since these are man-portable and the risk of theft is therefore higher. This applies to the entire supply chain.

A good practice regarding man-portable poly bags is to account for each bag delivered by documenting a physical count of bags at all intermediate shipping points and final destination.

### 3.4.6 Emergency Response

There are no special Emergency Response considerations for operations/shipments involving AN in Polybags.

# APPENDICES

## Appendix I. Hierarchy of the TGAN Transportation Good Practice Guide

### I. Overview

#### A. Packaging Method

Bulk: container must meet all required regulations

IBC/FIBC (bulk bags): construction of bags must meet all required regulations

Poly bags; paper bags; construction of bags must meet all required regulations. Paper bags are not recommended for use and will not be included in this GPG.

Where regulations do not exist, the UN regulations can be used as a model.

#### B. Modes of Transportation:

**1. Road**

- Container
  - Chassis
- Flatbed (with/without walls)
  - Container
  - FIBC (bulk bags: e.g. 800 to 1500 kg)
  - Palletized or unpalletized (e.g. 25, 40, 50 kg bags)
- Hopper Trailer
  - Secured tarp
- Pneumatic trailer
- Van trailer
- Dump truck/Tipper trailer
- Straight truck
- Road trains

**2. Rail**

- Flat bed
- Hoppers
- Boxcars

**3. Vessel and Barges**

- Container
- FIBC or bulk (break or loose bulk)
- Palletized bags

## C. Activity (will be packaging specific)

- Loading
- In transit
- Transloading
- Unloading

## D. General Hazards

- Contamination Prevention
    - Preloading Inspection
    - Clean out procedures (decontamination)
    - Recycling of bags
- Spillages
- Fires
- High Temperatures (>80 C/176 F)

## E. Security

Sealing of loads

Delivery confirmation – proof of delivery

Customer vetting

- Pre-delivery inspection

Positive handoff

Employee vetting (minimum company employee)

Chain of custody (every handoff documented/recorded where practicable)

- Will not be possible in all regions/countries

In transit, short term ‘storage’ (if required)

Transloading

Route planned/risk assessment

Driver misconduct

- Unauthorized passengers
- Unauthorized stops/detours
- Illegal substances
- Unauthorized loads
- Speeding/reckless driving

## F. **Contractor** Selection **and Management**

- Driver vetting

## G. Power Unit (truck tractor)

## H. Marking/Placarding

## I. Emergency Response

- Fire fighting
- Spills
- Accidents
- Breakdowns
- Weather condition related

## J. Housekeeping (prevention of contamination)

## II. Pre-Transportation Considerations

a) Contamination Prevention

- Preloading Inspection
- Clean out procedures (decontamination)
- Recycling of bags

b) Contractor Selection and Management

- Contractor vetting
- 'Driver' competency
- 'Driver' certification/credentials

c) Power Unit (truck tractor)

d) Transport

- Vessel vetting and inspection
  - Transporter has proper stowage plans and controls
- Railcar vetting and inspection (new cars)
  - Transporter has proper segregation plans for AN from fuels

e) Marking, track and trace

f) Route planning and risk assessment

# Appendix II. Loading/Transloading/Unloading Methods

## A. Bulk (Loose Prills)

### 1. Loading Methods

#### *a) Truck: Loading methods*

- Gravity feed
  - Overhead silo
- Mechanical feed
  - Auger
  - Bucket elevator
  - Conveyor belt
  - Pneumatic
  - Aero-mechanical conveyors
- Mobile equipment
  - Front end loaders

#### *b) Rail: Loading methods*

- Gravity feed
  - Overhead silo
- Mechanical feed
  - Auger
  - Bucket elevator
  - Conveyor belt
  - Pneumatic
  - Aero-mechanical conveyors
- Mobile equipment
  - Front end loaders
- Crane (bulk containers)

#### *c) Vessel: Loading methods*

- Mechanical
  - Conveyor belt
- Mobile equipment
  - Dump truck
- Crane (bulk container)

## 2. Transloading Methods

| Railcar to truck | Barge to rail or truck or vessel | Multi- or Inter-modal |
|---|---|---|
| ○ Augers<br>○ Underbelly self-propelled unit<br>○ Front end loader | ○ Clamshell | ○ Crane<br>○ FLT (forklift) |

## 3. Unloading Methods

### *a) Truck: Unloading methods*

- Gravity Feed
  - Tipper trucks
  - Dump trucks
- Mechanical feed
  - Auger
  - Bucket elevator
  - Conveyor belt
  - Pneumatic
  - 'Floveyors'
- Manual (not recommended)

### *b) Rail: Unloading methods*

- Gravity feed
  - Belly dump
- Mechanical feed
  - Auger
  - Bucket elevator
  - Conveyor belt
  - Pneumatic
  - disc conveyor e.g. floveyor$^{tm}$
- Mobile equipment
  - Front end loaders
- Crane (bulk containers)

### *c) Vessel: Unloading methods*

- Mechanical

- Clamshell

#### *d) Crane (bulk container)*

## B. IBC/FIBC

### 1. Loading Methods

#### *a) Truck: Loading methods*

- Mobile equipment
  - FLT (including modified front end loaders)
  - Pallet jacks
  - Crane

#### *b) Rail: Loading methods*

- Mobile equipment
  - FLT (including modified front end loaders)
  - Pallet jacks
  - Crane
- Crane (bulk containers)

#### *c) Vessel: Loading methods*

- Crane
  - Shore crane
  - Ship crane

### 2. Transloading Methods

| Railcar to truck | Vessel to rail or truck | Multi- or Inter-modal |
|---|---|---|
| • FLT<br>• Crane<br>• Roll on-Roll off | • Crane | • Crane<br>• FLT (forklift) |

### 3. Unloading Methods

Truck: Unloading methods

- Mobile equipment
  - FLT (including modified front end loaders)
  - Pallet jacks

- Crane

Rail: Unloading methods

- Mobile equipment
  - FLT
  - Crane
- Crane (bulk containers)

Vessel: Unloading methods

- Mechanical
  - Crane
- Crane (bulk container)

## C. Poly Bags

### 1. Loading Methods

#### *a) Truck: Loading methods*

- Mobile equipment
  - Fork Lift Truck (including modified front end loaders)
  - Pallet jacks / Trans-Pallets
  - Crane/Crane Truck
- Manual (not recommended beyond 25 kg)
- Pallet material of construction – wood pallets are common and these are a safety concern in a fire situation. Where practicable treated/fire retardant or non-combustible materials of construction should be used.
  Recommend shifting away from small bags to FIBCs where practicable. Where wooden pallets have to be used, they need to be inspected prior to use to ensure that it's not contaminated, nor damaged: has nails/screws sticking out, etc. When wooden pallets are used, consideration should be given to the increased risk during a fire situation when developing the site Emergency Response Plan.
- Where practicable, trucks transporting palletized AN bags should not be wood-lined.

#### *b) Rail: Loading methods*

- Mobile equipment
  - FLT (including modified front end loaders)
  - Pallet jacks
  - Crane
- Crane (bulk containers)
- Manual

### *c) Vessel: Loading methods*

- Crane
  - Shore crane
  - Ship crane

## 2. Transloading Methods

| • Railcar to truck | • Vessel to rail or truck | • Multi- or Inter-modal |
|---|---|---|
| ○ FLT<br>○ Crane<br>○ Ro-Ro | ○ Crane | ○ Crane<br>○ FLT (forklift) |

## 3. Unloading Methods

Truck: Unloading methods

- Mobile equipment
  - FLT (including modified front end loaders)
  - Pallet jacks
  - Crane
- Manual

Rail: Unloading methods

- Mobile equipment
  - FLT
  - Crane
- Crane (bulk containers)
- Manual

Vessel: Unloading methods

- Mechanical
  - Crane
- Crane (bulk container)

## Appendix III: Images of Loading/Unloading

**Figure 1. Small bags being loaded into a Truck**



**Figure 2. FIBCs being loaded into a Container**

**Figure 3. FIBCs loaded onto Vessel**


**Figure 4. FIBCs loaded from Vessel to Truck**

**Figure 5:FIBC being loaded from the Plant to Truck**

**Figure 6: Transload Facility – Rail to Truck**

**Figure 7: Railcar unloading Prill to Storage Bin**

**Figure 8: Direct Transload – Rail to Truck**

# Appendix IV: References

## A. List of Contaminants and Materials of Construction

Ammonium nitrate is an oxidizer, and substances that can react with it should be kept or stored separately from it. The National Fire Protection Association Code 400 has a detailed list of substances that should be separated from TGAN. Among the substances listed are fuels, chlorides, lubricating oils, and acids.

The full list is given below[3]:

(1) Organic chemicals, acids, or other corrosive materials
(2) Compressed flammable gases
(3) Pyrophoric materials
(4) Combustible materials
(5) Flammable and combustible liquids
(6) Other contaminating substances, including the following:
    (a) Wood chips
    (b) Organic materials
    (c) Chlorides
    (d) Phosphorus
    (e) Finely divided metals
    (f) Charcoals
    (g) Diesel fuels and oils
    (h) Animal fats
    (i) Baled cotton
    (j) Baled rags
    (k) Baled scrap paper
    (l) Bleaching powder
    (m) Burlap or cotton bags
    (n) Caustic soda
    (o) Coal
    (p) Coke
    (q) Charcoal
    (r) Cork
    (s) Camphor
    (t) Excelsior
    (u) Fibers of any kind
    (v) Fish oils
    (w) Fish meal

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(x) Foam rubber
(y) Hay
(z) Lubricating oil
(aa) Linseed oil or other oxidizable or drying oils
(bb) Naphthalene
(cc) Oakum
(dd) Oiled clothing
(ee) Oiled paper
(ff) Oiled textiles
(gg) Paint
(hh) Straw
(ii) Sawdust
(jj) Wood shavings
(kk) Vegetable oil