

# **Chemical Advisory: Safe Storage, Handling, and Management of Solid Ammonium Nitrate Prills**



## INTRODUCTION

The Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) (“we”) issue this advisory<sup>1</sup> as part of an ongoing federal effort to improve chemical risk management, advance ammonium nitrate safety, and protect human health and the environment. This advisory contains information on incidents involving ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub> - commonly referred to as “AN”), AN hazards, hazard management, and steps for emergency planning, and safe emergency response.

The U.S. Department of Transportation (DOT) classifies solid AN prills (i.e., small beads) containing no more than 0.2 percent combustible substances as a Division 5.1 oxidizer.<sup>2</sup> There are two commercial forms of prills: (1) “technical grade” (TGAN) used in the manufacture of blasting agents,<sup>3</sup> and (2) “fertilizer grade” (FGAN) used as a fertilizer or in fertilizer blends<sup>4</sup>. The only difference between TGAN and FGAN is the density of the prills. TGAN has lower density to better retain additives used to produce blasting agents. The two forms are chemically identical and present the same hazards when involved in fires.

This advisory is meant to apply to both grades of AN prills and to all facilities and persons managing or using the material for any purpose. The advisory also provides a list of information resources, including relevant codes and standards, industry publications, and applicable statutes and regulations to help facilities safely handle AN, and emergency responders better understand AN hazards so they can effectively manage the associated risks. The information provided is **not intended** to cover all hazards, safe practices or technical challenges associated with the manufacturing of AN; the manufacturing, storage or use of explosives<sup>5</sup> or blasting agents containing AN; or the transportation of AN and AN containing products. For these situations, please consult other sources including the appropriate references, standards, and regulations cited at the end of this document.

## INCIDENTS

Incidents involving AN are rare, considering that the United States uses millions of tons of AN annually. Yet, as described below, they can have severe consequences. Pure AN is stable at ambient temperature and pressure. While the chemical itself does not burn, AN supports and accelerates the combustion of organic (and some inorganic) material, increasing the fire hazard and complicating firefighting challenges. AN may explode when exposed to a strong shock or when subjected to sustained high temperatures in confinement.

On April 17, 2013, a fire at an AN storage and distribution facility in West, Texas, resulted in a detonation of FGAN stored at the facility, killing 15, including some of the firefighters responding to the fire. The explosion injured more than 250 and caused extensive damage to nearby homes, businesses, and schools. This incident remains under investigation<sup>6</sup>, but preliminary CSB findings and separate investigations of the emergency response activities by the Texas State Fire Marshal and National Institute of Occupational Safety and Health (NIOSH) indicate that factors contributing to the incident include:

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<sup>1</sup> The statements in this document are intended solely as guidance. This document is not a substitute for EPA, OSHA, ATF or other agencies’ regulations, nor is it a regulation itself. It cannot and does not impose legally binding requirements on the agencies, states, or the regulated community. The measures described in this document may not apply to a particular situation based upon the circumstances. This guidance does not represent final agency action and may change in the future, as appropriate.

<sup>2</sup> An oxidizer is a material that readily yields oxygen or other oxidizing gas or that reacts readily to promote or initiate combustion of combustible materials.

<sup>3</sup> A blasting agent is any material or mixture, consisting of a fuel and oxidizer, intended for blasting, not otherwise classified as an explosive and in which none of the ingredients are classified as an explosive, provided that the finished product, as mixed and packaged for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined (see 29 CFR 1910.109(a)(1)) and 27 CFR 555.11).

<sup>4</sup> The explosives industry can use FGAN particularly in the production of explosive emulsions.

<sup>5</sup> *Explosive* means any substance or article, including a device, which is designed to function by explosion (i.e., an extremely rapid release of gas and heat) or which, by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion (see 49 CFR 173.50(a)) and 27 CFR 555.11).

<sup>6</sup> Both the Chemical Safety Board and the Bureau of Alcohol, Tobacco, Firearms and Explosives have open investigations of the West explosion.

- Large, wooden (combustible) commercial structure
- Storage of combustible and sensitizing materials near AN storage piles
- Poor awareness of explosion hazards leading to inappropriate firefighting strategy and tactics
- Limited or no pre-incident emergency planning
- Lack of incident management system for emergency responders
- No community emergency plan involving AN

**In general, the conditions of AN storage are crucial to the safety and stability of the AN. Materials co-located or stored with AN may play a role in its sensitivity to explosion.**

Much has been learned from other AN explosions:

- On September 21, 2001, an enormous explosion occurred in a warehouse at the Azote de France fertilizer factory in Toulouse, France, involving between 200 and 300 tons of bulk FGAN stored in a hangar. The explosion resulted in 30 deaths, 2500 injuries, the destruction of the factory, and heavy damage to about 10,000 off-site buildings. The exact cause of this incident remains unknown. Storage of incompatible material with AN may have been a factor.
- On October 2, 2003, a fire and explosion occurred in a two-story farm warehouse in St. Romain en Jarez, France, involving 3 to 5 tons of FGAN stored in bags. This incident injured 26, including 18 firefighters. In this incident, improper storage methods possibly played a role.<sup>7</sup>

Explosions of stored AN are responsible for some of the worst chemical disasters on record. Several of these incidents, including two in Germany in 1921<sup>8</sup>, occurred during attempts to break up large piles of solidified or caked AN or AN/ammonium sulfate mixtures using explosives. In both cases, the initial blast intended to break up solid AN or AN/ammonium sulfate mixtures initiated an unintended detonation of the materials.

In another incident, fires involving AN in confined spaces triggered large explosions. In 1947 in Texas City, Texas, two cargo ships carrying AN intended for use as a fertilizer caught fire and exploded. In that case, the first ship is thought to have exploded due to a fire in the cargo hold involving AN that had been manufactured with a wax coating and stored in paper bags. The wax was one potential source of fuel that could have reacted with the AN, creating an explosive situation. The second ship exploded some time later, likely due to a fire caused by the first explosion. These two explosions resulted in deaths of nearly 600, including all but one member of the Texas City Fire Department.

Because of such incidents and subsequent studies of the properties of AN, caked AN is no longer broken up with explosive materials, and organic materials, such as paraffinic wax, are no longer used to coat AN prills.

- **Piles of AN can compress/consolidate or cake under some conditions. Never use explosives to break-up caked or consolidated AN deposits.**
- **AN is at risk for explosion when stored near materials that can add fuel to the AN (see section on Contamination)**
- **AN is a powerful oxidizer and a rich source of nitrate, which provides energy to an explosion. Thus, the presence of fuel and/or heat (and especially both) near AN is a very high hazard situation.**

The incidents described above led to the development of important AN safety principles. The safe practices in this advisory should become normal practices for all businesses handling, storing, manufacturing, or blending AN.

<sup>7</sup> Fire inside a barn and explosion of fertiliser 2 October 2003, Saint Romain-en-Jarez (Loire), France. French Ministry for Sustainable Development No. 25669.

<sup>8</sup> [http://en.wikipedia.org/wiki/Oppau\\_explosion](http://en.wikipedia.org/wiki/Oppau_explosion).

# AMMONIUM NITRATE HAZARD INFORMATION

## Hazard Classification

DOT classifies AN (both FGAN and TGAN) as a Division 5.1 oxidizer if it contains not more than 0.2 percent combustible substances, or, if it is an AN fertilizer blend, if it contains not more than 0.4 percent combustible substances. See page 19 for detailed DOT ammonium nitrate hazard classifications.

The National Fire Protection Association (NFPA) assigns solid oxidizers to Class 1, Class 2, Class 3, or Class 4 where Class 4 is the most oxidizing. AN is a Class 2 oxidizer. NFPA also assigns AN an instability rating of 3 (in a range of 0-4 with 4 being the most unstable) to alert emergency responders that AN is capable of detonation, explosive decomposition, or explosive reaction when exposed to a strong initiating source or when confined at high temperature. AN explosions occur more readily when fuels or sensitizing contaminants are present.

**“Pure” solid ammonium nitrate is fairly stable and will explode only under extreme conditions.**

**However, the addition of combustible contaminants, even in low percentages, creates a dangerous combination and the ammonium nitrate mixture becomes far more susceptible to detonation. Avoiding ammonium nitrate contamination underlies many of the recommendations for safe handling contained in this advisory.**

## Decomposition Chemistry

AN does not burn, but melts and begins to undergo decomposition at 337° F (170° C). Decomposition creates toxic gases containing ammonia and nitrogen oxides, and heat. The resulting nitrogen oxides can support combustion, even in the absence of other sources of oxygen. When confined, the heat and gases cannot dissipate. As the pressure and temperature rise the rate of decomposition increases and may cause an explosion.

During a fire in a facility where AN is present, the AN may melt and decompose making the material more sensitive to shock and detonation. In large AN piles, localized areas of high temperature may be sufficiently confined by the mass of material to initiate an explosion. The explosion of a small quantity of AN in a confined space (e.g., a pipe) may act to initiate an explosion of larger nearby quantities.

Shock sensitivity may be further increased if the AN is contaminated with incompatible materials.

## Contaminants

AN mixed with a fuel, such as oil<sup>9</sup> may detonate when exposed to fire or shock. Organic materials (e.g., packing materials, seed, etc.) will increase the likelihood of an explosion and will make the AN explosion more energetic.

Certain inorganic contaminants, including chlorides and some metals, such as aluminum powder, chromium, copper, alloys of copper, cobalt, and nickel can sensitize AN making it more likely to detonate.

AN prills readily absorb moisture, which can lead to caking, self-compression, and self-confinement. This compression and confinement increases the likelihood of detonation during a fire.

<sup>9</sup> From 1910.109(i)(5)(i)(a) incompatible materials can include organic chemicals, acids, or other corrosive materials, materials that may require blasting during processing or handling, compressed flammable gases, flammable and combustible materials or other contaminating substances, including but not limited to animal fats, baled cotton, baled rags, baled scrap paper, bleaching powder, burlap or cotton bags, caustic soda, coal, coke, charcoal, cork, camphor, excelsior, fibers of any kind, fish oils, fish meal, foam rubber, hay, lubricating oil, linseed oil, or other oxidizable or drying oils, naphthalene, oakum, oiled clothing, oiled paper, oiled textiles, paint, straw, sawdust, wood shavings, or vegetable oils. For a more extensive compilation of incompatible materials, see NFPA 400.

Manufacturers can combine AN with ammonium sulfate or with carbonate materials to reduce the risk of explosion in common industrial and agricultural storage and handling applications. More information on additives is discussed in *Guidance for the Storage, Handling and Transportation of Solid Mineral Fertilizers*, listed in the Reference section. Solid fertilizers may be coated with an inorganic, non-combustible anti-caking compound to prevent sticking and clumping.

In general, fertilizer blends with larger percentages of AN pose a greater explosion hazard. Blended fertilizers containing AN and chloride compounds, and blended fertilizers containing AN contaminated with combustible materials or incompatible substances pose increased explosion hazards. A large number of blended fertilizers are produced from AN mixed with rock phosphate, and/or potassium chloride or other materials which can introduce contaminants. Individual components of fertilizer blends are not necessarily compatible with each other and some may produce undesirable effects when mixed. These undesirable effects can include chemical reaction(s) and physical effects (e.g. stickiness, which can cause handling difficulties, or moisture migration giving rise to caking tendencies). Users of these products can consult *Guidance for Compatibility of Fertilizer Blending Materials* listed in the Reference section to assess potential incompatibility. The Safety Data Sheet (SDS) (formerly “MSDS” or Material Safety Data Sheet) of the AN product should be used as one source of information to assess the overall hazard. The effects of added components can only be determined after careful review of the SDS and other available hazard literature.

The addition of contaminants or otherwise incompatible materials to AN creates a danger of explosion. Confinement and the addition of heat to contaminated AN can lead to disaster.

## HAZARD REDUCTION

### Storage/Process Conditions to Avoid

Persons engaged in the handling, storage, movement, and management of AN must be aware of the material’s hazards and work to avoid conditions that lead to explosions. Measures that facility owner/operators should take include:

- Avoid heating AN prills in a confined space.
  - Avoid localized heating of AN, potentially leading to development of high temperature areas. For example, AN should not be stored near sources of heat such as steam pipes, radiators, hot ducts, light bulbs, etc.
- Ensure that AN is not exposed to strong shock waves from explosives. AN storage near high explosives or blasting agents must conform to ATF’s Table of Separation Distances. 27 CFR 555.220.<sup>10</sup>
  - Do not use explosives to break-up caked or consolidated AN deposits.
- Avoid contamination of AN with combustible materials or organic substances such as packing materials, dust, seed, oils, and waxes. 29 CFR 1910.109(i)(5)(i)(a).
  - If possible, do not co-locate AN, especially bulk AN in bins, with dust-producing organics such as grains or seeds without a firewall or a separation distance of at least 30 feet.
  - See the advisory’s Contaminants section for additional information.
- Avoid contamination of AN with inorganic materials that may contribute to its sensitivity to explosion, including chlorides and some finely divided metals, such as aluminum powder, chromium, copper, alloys of copper, cobalt, and nickel. 29 CFR 1910.109(i)(5)(i)(a).
  - Use care in selecting the materials used to build storage areas, bins and cribs. Metal or concrete construction is preferred. Wood used for bins must be specially treated to prevent impregnation. 29 CFR 1910.109(i)(4)(ii)(b). Metal materials that can corrode should be coated to prevent corrosion.
  - See the advisory’s Contaminants section for additional information.

<sup>10</sup> Here and elsewhere in the document, agencies include regulatory citations to indicate required elements.

Additional safety and handling instructions apply for safe handling and storage of AN<sup>11</sup> under certain conditions:

- OSHA's standard at 29 CFR 1910.109(i) contains requirements for AN stored in the form of crystals, flakes, grains or prills including FGAN, nitrous oxide grade, TGAN, and other mixtures containing 60 percent or more of AN by weight.
- *NFPA 400 - 2016 Hazardous Materials Code, Chapter 11* contains comprehensive information on AN hazards and hazard mitigation techniques.

### **Building Design**

- Store only in one-story buildings and buildings with no basements, unless the basement is open on at least one side. 29 CFR 1910.109(i)(2)(iii)(a). Non-combustible construction is strongly preferred.
- Use fire resistant walls within 50 feet of combustible building or materials. 29 CFR 1910.109(i)(2)(iii)(c).
- Use noncombustible flooring in storage and handling areas or protect flooring from AN impregnation. 29 CFR 1910.109(i)(2)(iii)(d).
- Use floors with no open drains, traps, tunnels, pits or pockets into which solid or molten AN could settle or flow and be confined in the event of fire. 29 CFR 1910.109(i)(2)(iii)(d).
- Keep buildings dry and free of water seepage through roofs, walls and floors. 29 CFR 1910.109(i)(2)(iii)(f).
- Ventilate buildings or construct buildings to self-ventilate in the event of a fire to avoid pressurization. 29 CFR 1910.109(i)(2)(iii)(b) and 29 CFR 1910.109(i)(4)(i)(a).
- Place AN into storage only when the temperature of the product is 130°F (54.4°C) or below. 29 CFR 1910.109(i)(3)(ii)(a) and (4)(iii)(c).
- Ensure that all electrical components/systems are in compliance with the National Electrical Code.
- All facility access points should be posted with a durable, reflective warning sign at least 4 ft. x 4 ft. where it is visible to emergency responders and police. The warning sign text and important hazard information should state, at a minimum: "WARNING: Do not fight fires at this facility without consulting the facility operator. Refer to DOT ERG Guide 140 and Safety Data Sheet (SDS). In case of emergency CALL 9-1-1 or (insert local emergency response number) and the facility owner/operator."
- Bins where AN is stored should be marked with a hazard rating "fire diamond" meeting the standards of NFPA 704. Place the NFPA fire diamond, with concurrence of the authority having jurisdiction, where it is clearly visible to emergency responders, police, or other individuals attempting to access the area.
- The NFPA diamond codes for AN are generally recognized to be:
  - Health Hazard (Blue).....1
  - Flammability (Red).....0
  - Reactivity (Yellow).....3
  - Other.....(OX)

### **Storage in bags, drums or other containers**

- Piles of bags, drums and other containers should be no closer than 36 inches below the roof or supporting beams. 29 CFR 1910.109(i)(3)(ii)(c)
- Bags should be stored no less than 30 inches from walls or partitions. 29 CFR 1910.109(i)(3)(ii)(b)

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<sup>11</sup> AN-based materials that are DOT Hazard Class 1 explosives must be handled and stored in accordance with requirements of OSHA's Standard for Explosives and Blasting Agents (29 CFR 1910.109) and ATF's Table of Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents (27 CFR 555.220). Facilities should also follow the NFPA 495 - Explosive Materials Code, where applicable.

- Piles of bags, drums, and other containers should not exceed a height of 20 feet, width of 20 feet, and length of 50 feet, unless the building is of noncombustible construction or protected by automatic sprinklers. 29 CFR 1910.109(i)(3)(ii)(c)
- Aisles should be at least 3 feet wide between piles. 29 CFR 1910.109(i)(3)(ii)(d)

### Storage in bulk

- Bins for storing bulk AN should be kept clean and free of contaminants. Bins should not be constructed of galvanized iron, copper, alloys of copper, lead, or zinc unless suitably protected. Aluminum or wooden bins should be protected against impregnation by AN. 29 CFR 1910.109(i)(4)(ii)(a) and (4)(ii)(b)
- Piles must be adequately sized and materials stored in bins must be moved periodically to minimize caking. 29 CFR 1910.109(i)(4)(iii)(a). Height or depth of piles shall be limited by pressure-setting tendency of the product, but in no case should pile be higher than 36 inches below roof or supporting beams. 29 CFR 1910.109(i)(4)(iii)(b)
- Dynamite, explosives, or blasting agents shall NOT be used to break up or loosen caked AN. 29 CFR 1910.109(i)(4)(iii)(d)
- Protect piles of AN from absorbing moisture from humid air by covering them with water-impermeable sheeting or using air conditioning.
- Store AN away and isolated from possible contaminants. AN stores should be separated from incompatible substances by using separate buildings, 1-hour fire resistant walls, or a minimum separation distance of 30 feet. 29 CFR 1910.109(i)(5)(i)(a)
- The contents of each bin should be clearly identified by the proper shipping name of the material, "AMMONIUM NITRATE" written in 2-inch high, capital letters below the NFPA fire diamond (see above).

### Fire Protection

- Facilities constructed of combustible materials should have an automated water based sprinkler system and a fire detection system which should automatically activate a local audible and visual alarm system to notify occupants.
- Automatic sprinkler systems, if installed, should be in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems. 29 CFR 1910.109(i)(7)(i).
- Suitable fire control devices such as hoses and appropriate portable fire extinguishers (AN is an oxidizer and not all fire extinguishers are appropriate) shall be provided throughout the warehouse and loading and unloading areas. A source of water for firefighting and/or fire hydrants should be available to fight fires not in contact with the AN. 29 CFR 1910.109(i)(7)(ii)(a) and (b).
- Store AN in separate buildings or separated by approved fire walls from organic, combustible or incompatible materials. 29 CFR 1910.109(i)(7)(ii)(a).
- Unless meeting the requirements of ATF's Table of Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives and Blasting Agents, 27 CFR 555.220, DO NOT store AN in buildings also storing explosives or blasting agents. 29 CFR 1910.109(i)(5)(ii)(b) and (c).
- Prohibit smoking in AN storage areas.

**AN is safest when stored in facilities/buildings of non-combustible construction, separated from potential contaminants, and not subject to high heat (even in a small area of a large stockpile) or to water infiltration.**

# PRE-INCIDENT AND EMERGENCY ACTION PLANNING

## Facility

AN is a hazardous chemical covered under the OSHA Hazard Communication Standard. Facilities handling and storing AN must submit information regarding chemical hazards (including AN) to their State or Tribal Emergency Response Commission (SERC or TERC), Local Emergency Planning Committee (LEPC), and local fire department in accordance with the Emergency Planning and Community Right-to-Know Act (EPCRA).

Facilities regulated under EPCRA must submit the following:

- SDS providing the chemical's hazard information and emergency response guidelines (EPCRA Section 311 and 40 CFR 370) and
- A Hazardous Chemical Inventory form that provides, among other things, the quantity, storage types, and locations of the AN at their facility (facilities handling FGAN do not qualify for the EPCRA "routine agricultural activity" exemption). (EPCRA Section 312 and 40 CFR 370).

Owner/operators of storage facilities should develop a site emergency response plan which includes, for example:

- Coordination with local emergency responders
- Joint training with emergency responders if possible
- Employee training
- Community and LEPC outreach
- Analysis of what may be at risk in a serious accident and appropriate planning, including explosion, exposure to toxic gases, and exposure to local populations
- Signs that clearly mark high hazard areas, safe areas, emergency contact numbers, firefighting equipment, and other essential areas during an emergency response
- A site and area evacuation plan

Owners and operators of facilities holding AN should ensure that emergency responders are aware of the hazards associated with the AN. Reliance on a report may not always be sufficient. It is recommended that owners and operators should take a pro-active approach to reach out to their local emergency response officials and ensure that the hazards of AN and relevant characteristics of the facility are understood by responders.

For more information on EPCRA, see <http://www2.epa.gov/epcra>

## Emergency Responders

Fire departments should ensure the pre-incident plan includes:

- AN hazard information and emergency response guidelines
- Potential muster point and incident command post location remote from the facility
- Quantity, storage types, and locations of AN at facilities in their community
- Specific response procedures; including a decision process to determine under which conditions a fire should be fought or whether the fire should be allowed to burn
- Evacuation procedures for the community
- Training requirements for all response personnel
- A schedule for exercising the response plan related to AN accidents

Fire services should regularly visit any facility reporting AN and review the conditions of storage and manner of handling compared to the practices described in this advisory. Fire service and other emergency responders should develop a pre-incident plan and make note of the specific location(s), amounts and packaging of stored AN. Conditions of storage should be reviewed with the facility operator in light of the information provided in this document.



Local fire departments should use the information to determine what precautions they may need to take in responding to an accident at a facility and ensure emergency responders have the appropriate training to respond to incidents involving AN.

## Community

The LEPC, in conjunction with the fire department, should use the pre-incident plan to develop a community emergency response plan, in case of a fire or explosion involving AN or any other hazardous substance. The facility should consult with the LEPC and local responders to provide the necessary information to help develop the community emergency response plan (see <http://www2.epa.gov/epcra/local-emergency-planning-committees>). The elements should include:

- Identification of facilities and transportation routes of hazardous substances
- Description of emergency response procedures, on- and off-site
- Designation of a community coordinator and facility emergency coordinator(s) to implement the plan
- Outline of emergency notification procedures
- Description of how to determine the probable area and population affected by releases
- Description of local emergency equipment and facilities and the persons responsible for them
- Outline of evacuation plans
- A training program for emergency responders (including schedules)
- Methods and schedules for exercising emergency response plans

**In the interest of community safety, it is necessary and appropriate for emergency response officials to reach out to AN storage facility owners and operators to determine if unreported risks are present in their community. Helping a neighbor, facility operator, or employer to understand and meet their obligations to the community and to workers is in everyone's best interest.**

Owners and operators of facilities holding AN are required to report the AN hazard to local response officials in accordance with EPCRA. Unfortunately, that obligation is not universally understood, and so some facilities may fail to report. AN is typically found at those businesses that provide direct logistical support to agriculture. This may include crop service operations, farm co-ops, grange stores, and similar operations. Although there is an exemption from SDS and Hazardous Inventory reporting for fertilizer held for sale by a retailer to the ultimate customer, agricultural retail facilities that mix AN are not exempted from hazardous chemical inventory reporting.

## EMERGENCY RESPONSE

When responding to a fire at a facility where AN is stored; it is critical for firefighters to approach the facility with an accurate and up-to-date pre-incident plan. The plan should include information on the construction and layout of the structure involved, especially the AN storage location and quantities. Incident commanders, fire captains, and responders familiar with the facility's pre-incident plan should first consider if they can safely fight the fire or if AN involvement makes this approach too hazardous. If responders confirm or suspect AN involvement, incident command and responders should move to a safe location. Once at a safe location, responders should focus efforts on evacuating nearby residents and preventing further hazards for the surrounding community.

- If firefighters consider it safe and appropriate to attack a fire that does not involve AN, then appropriate actions must be taken to prevent the AN from becoming involved in the fire.
- Water is the only satisfactory extinguishing agent for attacking small fires involving AN and large quantities should be applied as quickly as possible to prevent heat exposure to the AN. The following information should be considered when attacking small fires involving AN:

- Apply flooding quantities of water to the AN pile from a distance as promptly as possible. It is important that the mass of AN be kept cool and that melting and decomposition be prevented. Keep adjacent fertilizers cool by spraying with large amounts of water. When possible and appropriate, only use unmanned hose holders or monitor nozzles.
- Use only water as other extinguishing and smothering agents are ineffective.<sup>12</sup>
- If practicable and safe, attempt to prevent AN from entering the drains where explosive confinement could occur. Remember AN may be washed into drains by fire water, but it can also melt and flow without impetus from water.
- Prevent or minimize contamination of water bodies or streams to reduce the potential for environmental effects.
- Firefighters should always follow the facility pre-plan and not fight an AN facility fire if the AN storage is engaged. Everyone, including fire fighters, should be evacuated to a safe distance if they observe any of the following:
  - The fire is impacting the AN storage area; or
  - Brown/orange smoke is detected, indicating the presence of nitrogen dioxide, which is a toxic byproduct of AN fire exposure and decomposition; or
  - There is a rapid increase in the amount/intensity of smoke or fire in the area of AN storage.
- When evacuation is deemed necessary, fire-fighting personnel should immediately evacuate the area within 1 mile (or the distance as determined by the Emergency Response Plan) in all directions.

## ***STATUTES AND REGULATIONS***

Statutes and regulations applicable to the manufacture of or processes involving AN, are listed below.

### **Clean Air Act Accident Prevention- General Duty (EPA)**

Section 112(r) of the Clean Air Act (CAA) focuses on prevention of chemical accidents. Under this provision of the CAA, all facilities with regulated substances or other extremely hazardous substances have a general duty to prevent and mitigate accidental releases. Under Section 112(r)(1), the general duty is:

to identify hazards ...using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.

This general duty applies to facilities producing, processing, handling or storing extremely hazardous substances. While not a regulated substance, AN may be considered extremely hazardous under certain circumstances.

### **Emergency Planning and Community Right-to-Know Act (EPA)**

The Emergency Planning and Community Right-to-Know Act (EPCRA), requires information on the presence of hazardous chemicals above designated threshold quantities at regulated facilities be provided to state and local emergency planning authorities. This information facilitates development of emergency response plans required by section 303 of EPCRA, enhances community awareness of chemical hazards and helps emergency responders to respond to chemical accidents. The chemicals covered under these requirements are a specific list of chemicals known as Extremely Hazardous Substances (EHSs) found at 40 CFR Part 355 Appendices A and B and any chemicals that meet the criteria as hazardous chemicals under OSHA's Hazard Communication

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<sup>12</sup> Ammonium nitrate is an oxidizer – that is – it provides its own oxygen and once combustion begins, it cannot be smothered. Moreover, the combination of heat and confinement will accelerate combustion, perhaps to the point of detonation.

Standard. AN is not an EHS but is considered a hazardous chemical (oxidizer) and therefore subject to the EPCRA provisions described below.

Section 311 of EPCRA requires facilities to submit Safety Data Sheets for the EHSs and hazardous chemicals to their State or Tribal Emergency Response Commission (SERC or TERC), Local Emergency Planning Committee (LEPC) and local fire department. Section 312 requires facilities to submit annually to their SERC or TERC, LEPC, and local fire department, Hazardous Chemical Inventory forms for these chemicals. The SDS provides the chemical's hazard information and emergency response guidelines and the Hazardous Chemical Inventory form provides the quantity, storage types and locations of the chemical at their facility. Regulations covering these requirements are found at 40 CFR Part 370.

Section 311(e)(5) of EPCRA does not include the following as a hazardous chemical: any substance used in routine agricultural operations or a fertilizer held for sale by a retailer to the ultimate customer. At fertilizer distributors, AN is commonly blended with other chemicals to produce a fertilizer mix according to customer specifications. Any AN that is mixed or formulated with other chemicals by facilities is not covered by the Section 311(e)(5) exemption. The exemption was intended to apply only to retailers of the substance, not to manufacturers and wholesalers – who typically have large quantities of fertilizers, and may use and manufacture a wide range of chemical compounds. These manufacturers and wholesalers can present significant risks that need to be addressed by emergency response authorities. For more information about EPCRA hazardous chemical reporting, see <http://www.epa.gov/emergencies/content/epcra/index.htm>.

Environmental Protection Agency (EPA)  
Phone: (800) 424-9346 or (703) 412-9810  
Website: <http://www.epa.gov>

### **Ammonium Nitrate Safety Standards (OSHA)**

OSHA's standard at 29 CFR 1910.109(i) contains requirements for AN stored in the form of crystals, flakes, grains or prills including fertilizer grade, dynamite grade, nitrous oxide grade, technical grade, and other mixtures containing 60 percent or more of AN by weight. For more information see [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9755](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9755).

### **Explosives and Blasting Agents Standards (OSHA)**

OSHA regulates the manufacture, keeping, having, storage, sale, transportation, and use of explosives and blasting agents under its Occupational Safety and Health Standards for explosives and blasting agents (29 CFR 1910.109). Blasting agents are frequently formulated with AN. For more information about OSHA's standards covering explosives and blasting agents, including ammonium nitrate and storage of all grades of ammonium nitrate, see [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9755](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9755).

### **Hazard Communication Standard (OSHA)**

OSHA's Hazard Communication Standard (HCS) at 29 CFR 1910.1200 requires chemical manufacturers and importers to evaluate the hazards of the chemicals they produce or import, and prepare labels and Safety Data Sheets (SDS) to convey the hazard information to their downstream customers. All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately. AN is a hazardous chemical covered under the HCS. The HCS is now aligned with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). All hazardous chemicals shipped by manufacturers and importers after June 1, 2015 must be labeled according to GHS requirements. [Distributors may continue to ship containers labeled by manufacturers or importers in compliance with the HazCom 1994 standard until December 1, 2015.] Employers are required to train workers

on the new labels elements and safety data sheets format to facilitate recognition and understanding. For more information, see <http://www.osha.gov/dsg/hazcom/index.html>.

Occupational Safety and Health Administration  
Phone: (800) 321- OSHA (6742)  
Website: <http://www.osha.gov>

Facilities located within one of the [27 OSHA State Plans](#) should contact their State Plan office for the specific requirements in their state, which may differ but must be at least as effective OSHA standards. OSHA also provides help to employers. OSHA's [On-site Consultation Program](#) offers free and confidential advice to small and medium-sized businesses in all states across the country, with priority given to high-hazard worksites. For more information or for additional compliance assistance, contact OSHA at 1-800-321-OSHA (6742).

### **Chemical Facility Anti-Terrorism Standards (DHS)**

The Department of Homeland Security's (DHS) Chemical Facility Anti-Terrorism Standards (CFATS) program applies to facilities that possess threshold quantities of certain types of ammonium nitrate. Facilities in possession of Chemicals of Interest (listed in 6 CFR Part 27 Appendix A) meeting or exceeding specific threshold quantities are required to complete a "Top-Screen" questionnaire to identify the types and quantities of Chemicals of Interest the facility possesses. CFATS regulates facilities that possess two forms of AN. The first is a form with more than 0.2% combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance. The second is ammonium nitrate in solid form, with a minimum nitrogen concentration of 23%, or any mixture containing 33% solid ammonium nitrate or greater. The CFATS program, authorized by P.L. 113-254, the Protecting and Securing Chemical Facilities from Terrorist Attacks Act of 2014, identifies and regulates high-risk chemical facilities to ensure they have security measures in place to reduce the risks associated with these chemicals. CFATS regulations are found in 6 CFR Part 27.

Based on the Top-Screen, if DHS initially determines the facility to be high-risk, the facility must complete and submit a Security Vulnerability Assessment, which is then reviewed by DHS to make a final determination on whether the facility is high-risk. Facilities receiving a final high-risk determination must develop and submit for DHS's review, a Site Security Plan (SSP), or alternatively, an Alternative Security Program, that describes the specific security measures the facility will utilize to meet the 18 applicable risk-based performance standards under CFATS. The agency must then review the facility's SSP to determine if it should be approved. For more information about CFATS program, see <http://www.dhs.gov/chemical-facility-anti-terrorism-standards>.

### **Handling of Dangerous Cargo in Waterfront Facilities (USCG)**

The U.S. Coast Guard (USCG) regulates the handling and storage of AN in waterfront facilities. For more information, see 33 CFR 126.

### **Hazardous Materials (DOT)**

The Department of Transportation (DOT) regulates transportation of AN under its Hazardous Materials Regulations. For more information see 49 CFR Subchapter C.

The following forms of ammonium nitrate are listed in the DOT Hazardous Materials Table (49 CFR 172.101) with their Hazard Class or Division and identification number assigned to each proper shipping name:

- Ammonium nitrate based fertilizer, Division 5.1, UN2067
  - Special Provisions Code 150 - This description may be used only for uniform mixtures of fertilizers containing ammonium nitrate as the main ingredient within the following composition limits:

- Not less than 90% ammonium nitrate with not more than 0.2% total combustible, organic material calculated as carbon, and with added matter, if any, that is inorganic and inert when in contact with ammonium nitrate; or
- Less than 90% but more than 70% ammonium nitrate with other inorganic materials, or more than 80% but less than 90% ammonium nitrate 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
- Ammonium nitrate-based fertilizers containing mixtures of ammonium nitrate and ammonium sulphate with more than 45% but less than 70% ammonium nitrate, and not more than 0.4% total combustible, organic material calculated as carbon such that the sum of the percentage of compositions of ammonium nitrate and ammonium sulphate exceeds 70%.
- Ammonium nitrate based fertilizer, Class 9, UN2071 (when shipped by air or water)
  - Special Provisions Code 132 - This entry may only be used for uniform, ammonium nitrate based fertilizer mixtures, containing nitrogen, phosphate or potash, meeting the following criteria: (1) Contains not more than 70% ammonium nitrate and not more than 0.4% total combustible, organic material calculated as carbon or (2) Contains not more than 45% ammonium nitrate and unrestricted combustible material.
- Ammonium nitrate emulsion or Ammonium nitrate suspension or Ammonium nitrate gel, intermediate for blasting explosives, Division 5.1, UN3375.
- Ammonium nitrate-fuel oil mixture containing only prilled ammonium nitrate and fuel oil, Division 1.5D, NA0331.
- Ammonium nitrate, liquid (hot concentrated solution), Division 5.1, UN2426.
- Ammonium nitrate, with more than 0.2 percent combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance, Division 1.1D, UN0222.
- Ammonium nitrate, with not more than 0.2% total combustible material, including any organic substance, calculated as carbon to the exclusion of any other added substance, Division 5.1, UN1942.

Explanation of Hazard Class numbers:

- Division 1.1 - Explosives (with a mass explosion hazard) A mass explosion is one which affects almost the entire load instantaneously.
- Division 1.5 - Very insensitive explosives; blasting agents
- Division 5.1 - Oxidizer
- Class 9 - Miscellaneous Hazard Material

Refer to the DOT hazardous materials table at 49 CFR 172.101 for additional information.

DOT also requires safety and security plans for persons offering for transportation or transporting any quantity of a Division 1.1 material and placarded quantities of Division 1.5 material, or large bulk quantities (greater than 6,614 lbs. or 792 gals.) of ammonium nitrate, ammonium nitrate fertilizers, or ammonium nitrate emulsions, suspensions, or gels. The safety and security plan must conform to requirements in 49 CFR 172 Subpart I.

Department of Transportation

Phone: (202) 366-5580

Public Information Website: <http://www.dot.gov>

## **Federal Explosives Regulations (ATF)**

The Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) of the Department of the Justice regulates the importation, manufacture, distribution, and storage of explosive materials including blasting agents and other

explosive materials containing AN. ATF's explosives regulations, 27 CFR Part 555, can be found at <https://www.atf.gov/files/publications/download/p/atf-p-5400-7.pdf>.

Bureau of Alcohol, Tobacco, Firearms, and Explosives  
Phone: (202) 648-7120  
Website: <http://www.atf.gov>

## **INFORMATION RESOURCES**

### **CODES AND STANDARDS**

NFPA codes and standards are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing various viewpoints and interests to achieve consensus on safety issues. These codes and standards are not binding but may be adopted by reference into laws or regulations. Users of the codes and standards should consult applicable federal, state and local laws and regulations for conflicts or additional requirements.

**NFPA 400 Code Chapter 11** addresses the storage, use, and handling of solid AN, including fertilizer grade, industrial grade and mixtures containing 60 percent or more AN by weight.<sup>13</sup> It also covers liquid AN solutions 70% or more AN by weight. It does not cover AN or AN mixtures that are DOT Hazard Class 1 (explosives and blasting agents) which are covered in NFPA 495 and includes explosives and blasting agents containing AN.

**NFPA 400 — Hazardous Materials Code, Chapter 11 - Ammonium Nitrate Solids and Liquids. (2016).**<sup>14</sup> The 2016 edition likely includes enhanced safety standards:

- Noncombustible construction for new storage buildings
- Fire detection and suppression system for existing buildings constructed of combustible materials and new storage buildings
- An emergency action plan should establish a safe evacuation distance based on approved analysis
- Emergency action plans for facilities storing AN must be prepared in accordance with accepted standards and approved by the Authority Having Jurisdiction

**NFPA 495 — Explosive Materials Code (2013).**

National Fire Protection Association

1 Batterymarch Park

PO Box 9101

Quincy, MA 02169-7471

Phone: 800-344-3555 (toll free)

Website: <http://www.nfpa.org/freeaccess>

### **GENERAL REFERENCES**

**1. Safety and Security Guidelines for Ammonium Nitrate (2013).** Institute of Makers of Explosives (IME) and National Stone, Sand and Gravel Association (NSSGA), IME, Washington, DC, [https://www.ime.org/uploads/userfiles/files/AN%20Guidelines\\_IAFC-IME-NSSGA-ISEE\(FINAL\)\(3\).pdf](https://www.ime.org/uploads/userfiles/files/AN%20Guidelines_IAFC-IME-NSSGA-ISEE(FINAL)(3).pdf)

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<sup>13</sup> In 2010, NFPA incorporated the requirements of NFPA 490, which had covered storage of AN fertilizers containing 60% or more AN by weight, into NFPA 400 Chapter 11 and then withdrew NFPA 490.

<sup>14</sup> The 2016 edition of NFPA 400 is expected to be released May 2015.

- 2. Fertilizer Grade Ammonium Nitrate Safety and Security Guidelines for the Storage and Transportation of at Fertilizer Retail Facilities (February 2014).** Agricultural Retailers Association and The Fertilizer Institute, Washington, DC, [http://www.tfi.org/sites/default/files/images/an\\_guidance\\_handbook\\_-\\_mar\\_6\\_-\\_lk.pdf](http://www.tfi.org/sites/default/files/images/an_guidance_handbook_-_mar_6_-_lk.pdf)
- 3. ResponsibleAg**, a joint venture of the Agricultural Retailers Association (ARA) and The Fertilizer Institute (TFI), is a Fertilizer Code of Practice management system that helps facilities establish basic Environmental, Health, Safety and Security (EHS&S) performance practices, <https://www.responsibleag.org/>. Other compliance tools available at Responsible Ag include:
- Responsible Ag Compliance Assessment Tool (web based)
  - Responsible Ag Auditor Training Course
- 4. First Responder Guidance- Building Productive Relationships with First Responders.** Agricultural Retailers Association, Washington, DC, [www.aradc.org/firstresponderguide](http://www.aradc.org/firstresponderguide)
- 5. Storing and Handling Ammonium Nitrate, INDG230 (First published August 1996, Reprinted November 2004).** Health and Safety Executive (HSE), United Kingdom, <http://www.hse.gov.uk/explosives/ammonium/>
- 6. Safe Storage and Handling of Ammonium Nitrate (AN), Technical Note 60 (February 28, 2006),** SafeWork, South Australia, [http://www.safework.sa.gov.au/uploaded\\_files/SSAN\\_Storage.T60.pdf](http://www.safework.sa.gov.au/uploaded_files/SSAN_Storage.T60.pdf)
- 7. Safe Practice: Safe Storage of Solid Ammonium Nitrate (2013).** Resources Safety, Division of Mines and Petroleum, Government of Western Australia (WA), East Perth, WA, [http://www.dmp.wa.gov.au/documents/Code\\_of\\_Practice/DGS\\_COP\\_StorageSolidAmmoniumNitrate.pdf](http://www.dmp.wa.gov.au/documents/Code_of_Practice/DGS_COP_StorageSolidAmmoniumNitrate.pdf)
- 8. Guidance for the Storage, Handling and Transportation of Solid Mineral Fertilizers (2007).** Fertilizers Europe (formerly European Fertilizers Manufacturers Association), Brussels, Belgium, <http://fertilizerseurope.com/index.php?id=6>
- 9. Guidance for the Safe Handling and use of Non-conforming Fertilizers and Related Materials (Producers) (2003).** Fertilizers Europe, Brussels, Belgium, <http://fertilizerseurope.com/index.php?id=6>
- 10. Guidance for the Safe Handling and Use of Non-conforming Fertilizers and Related Materials for Fertilizer Importers, Distributors and Merchants (2004).** Fertilizers Europe, Brussels, Belgium, <http://fertilizerseurope.com/index.php?id=6>
- 11. Guidance for the Storage of Hot Ammonium Nitrate Solution (2005).** Fertilizers Europe, Brussels, Belgium, <http://fertilizerseurope.com/index.php?id=6>
- 12. Guidance for Compatibility of Fertilizer Blending Materials (2006).** 2006 edition printed in 2014 by Fertilizers Europe Brussels, Belgium, <http://fertilizerseurope.com/index.php?id=6>
- 13. Ammonium Nitrate and Mixed Fertilizers Containing Ammonium Nitrate, FM Global Property Loss Prevention Data Sheet 7-89 (October 2013).** FM Global, Johnston, RI, <http://www.fmglobal.com/page.aspx?id=04010200> Free access with registration AN datasheet is under Individual Data Sheets-Hazards category
- 14. Ammonium Nitrate, Industrial Grade, Technical Information (2011).** Dyno Nobel Inc. [http://www.dynonobel.com/files/2010/04/1Ammonium\\_Nitrate\\_LomoDonora-Industrial.pdf](http://www.dynonobel.com/files/2010/04/1Ammonium_Nitrate_LomoDonora-Industrial.pdf)



- 15. Ammonium Nitrate, Nutrient Source Specific (NSS) Fact Sheet, No. 22** International Plant Nutrition Institute, Norcross, GA,  
[http://www.ipni.net/publication/nss.nsf/0/67265A0AC9302CC5852579AF0076927A/\\$FILE/NSS-22%20Amm%20Nit.pdf](http://www.ipni.net/publication/nss.nsf/0/67265A0AC9302CC5852579AF0076927A/$FILE/NSS-22%20Amm%20Nit.pdf)
- 16. Fire Protection Guide to Hazardous Materials, 14<sup>th</sup> edition (2010).** National Fire Protection Association, Quincy, MA.
- 17. Guide No. 140 for Oxidizers, Emergency Response Guidebook (2012).** US Dept. of Transportation, Pipeline and Hazardous Materials Safety Administration.  
<http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2012.pdf>
- 18. EPA Chemical Accident Investigation Report, Terra Industries, Inc., Nitrogen Fertilizer Facility, Port Neal, Iowa (January 1996).** U.S. Environmental Protection Agency, Region 7, Emergency Response and Removal Branch, Kansas City, KS, <http://www.epa.gov/emergencies/docs/chem/cterra.pdf>
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- 20. A Public Health Report on Injuries Related to the West (Texas) Fertilizer Plant Explosion, April 2013 (June 24, 2014).** Waco-McLennan County Public Health District (WMCPhD), Waco, TX and Texas Department of State Health Services (DSHS), Austin and Temple, TX, <http://www.waco-texas.com/userfiles/cms-healthdepartment/file/pdf/West-Texas-Report-6-2014.pdf>
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- 22. A Summary of a NIOSH fire fighter fatality investigation- 9 Volunteer Fire Fighters and 1 Off-Duty Career Fire Captain Killed by an Ammonium Nitrate Explosion at a Fertilizer Plant Fire- Texas. Report # F2013-11 (November 12, 2014).** National Institute of Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention, Atlanta, GA, <http://www.cdc.gov/niosh/fire/pdfs/face201311.pdf>
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- 25. The National Safety Council data sheet Ammonium Nitrate Fertilizer, Data Sheet I-699 (1991)** discusses the health hazards, properties, and precautions for safe storage and handling of AN fertilizer.  
National Safety Council  
1121 Spring Lake Drive  
Itasca, IL 60143-3201  
Phone: (800) 621-7269 (toll free) or (630)-775-2199 (Library)  
Website: <http://www.nsc.org>



26. The Fertilizer Institute (TFI) produces information on various fertilizer products, including AN, and their uses.

The Fertilizer Institute  
425 Third Street SW, Suite 950  
Washington, DC 20024  
Phone: (202) 962-0490  
Website: <http://www.tfi.org>

27. For more detailed information on the safe handling practices for storage of explosive materials which may contain AN, please consult the following Safety Library Publications (SLPs) developed by the Institute of Makers of Explosives (IME).

- *Construction Guide for Storage Magazines*, IME SLP No. 1 (September 2006).
- *The American Table of Distances*, IME SLP No. 2 (October 2011).
- *Suggested Code of Regulations for the Manufacture, Transportation, Storage, Sale, Possession, and Use of Explosive Materials*, IME SLP No. 3 (October 2009).
- *Handbook for the Transportation and Distribution of Explosive Material*, IME SLP No. 14 (May 2013).
- *Safety in the Transportation, Storage and Use of Explosive Materials*, IME SLP No. 17 (October 2011).
- *Recommendations for the Transportation of Explosives, Division 1.5, Ammonium Nitrate Emulsions, Division 5.1, Combustible Liquids, Class 3, and Corrosives, and Liquids, Class 8 in Bulk Packaging*, IME SLP No. 23 (October 2011).
- *Explosives Manufacturing and Processing Guide to Safety Training*, IME SLP No. 25 (May 2011). SLPs are available at [https://www.ime.org/products/category/safety\\_library\\_publications\\_slps](https://www.ime.org/products/category/safety_library_publications_slps)

Institute of Makers of Explosives  
1120 Nineteenth Street NW, Suite 310  
Washington, DC 20036-3605  
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Website: [www.ime.org](http://www.ime.org)

28. SAFEX International is voluntary association of explosives and TGAN manufacturers from all over the world. SAFEX has published a guide for safe storage of TGAN listed below that is available to its members. <https://www.safex-international.org/index.php>.

***Good Practice Guide: Storage of Solid Technical Grade Ammonium Nitrate (March 2011).*** SAFEX International. SAFEX Good Explosive Practice Series, GPG 02 rev. 1