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PERFORMANCE MATERIALS

# Acrylonitrile Group
# Guideline for the Safe Handling and Distribution of Acrylonitrile
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Ascend Performance Materials is a member company of the American Chemistry Council. Ascend is committed to the principles of Responsible Care® and to the proper stewardship of its products. Ascend is a member of the Acrylonitrile Group, a US based organization dedicated to the safe production and Use of An and AN based products. Together with other global AN producing companies, Ascend supports scientific research related to AN. This document was prepared by the AN Group as a joint project of member companies.

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## 1.0. Introduction

### 1.1. Overview

Acrylonitrile (AN), also known as vinyl cyanide ($CH_2$=CH-C≡N), is a high volume commodity chemical with worldwide production of more than 10 billion pounds per year. Acrylonitrile is used as a monomer in the production of acrylic and modacrylic fibers, which accounts for approximately 50% of its global use. Acrylic fiber is used for clothing, carpeting and other fabrics and in the production of rugged plastics for automotive components, computers, appliances. Acrylic fiber is also used in the manufacture of polyacrylonitrile (PAN)-base carbon fibers; which are increasingly important materials for lightweight, high-strength applications in aeronautics, automotive, engineering, etc. Acrylonitrile is used as a co-monomer the production of acrylonitrile, butadiene, styrene (ABS) and styrene acrylonitrile (SAN) polymers, which accounts for an additional 31% of use. These polymers are used in a wide range of oil- and chemical-resistant nitrile rubber for industrial hoses, gaskets and seals. Acrylonitrile is also used as an intermediate in the production of other industrial chemicals, such as adiponitrile and acrylamide.

Acrylonitrile is a hazardous material in terms of flammability, polymerization activity and toxicity, as such appropriate precautions must be taken for it to be distributed and handled safely. While the processes to manufacture, distribute and use acrylonitrile are highly controlled and designed to minimize exposure to individuals, there are some instances where contact with acrylonitrile liquid or vapors may occur. In these instances, it is important to exercise appropriate work practices, hygiene and use specific procedures when handling acrylonitrile or responding during emergencies. Exposure to acrylonitrile may occur in any number of settings including:

- the manufacture of acrylonitrile,
- processes which use acrylonitrile,
- transfer of acrylonitrile,
- laboratory use of acrylonitrile, and
- emergency response to accidents involving acrylonitrile.

### 1.2. Scope/Purpose of Guideline

This Guideline has been prepared by the Acrylonitrile (AN) Group to provide guidance on the safe handling, transportation and use of AN. The primary focus of this guide is for the handling of AN in the U.S./North America, though many of the principles and practices discussed herein would be applicable to other regions. A separate guide is available from CEFIC for the handling of AN in Europe (http://www.petrochemistry.net/ftp/pressroom/Guidelines_Acryl_WEB.pdf).

This Guideline addresses design elements for distribution and loading facilities, the transport of acrylonitrile in on-road truck tankers, railroad tank cars, ocean-going

tankers, river barges, and drums/IBCs, properly handling procedures, first aid and emergency response.

The Guideline may make occasional reference to existing regulations relevant to the handling of AN, but readers are cautioned not to use this document for regulatory guidance or compliance.

This Guideline replaces all previous safe handling guidelines and programs prepared by the AN Group.

### 1.3 Sponsor Information

This Guideline was developed by the AN Group, a trade group representing chemical producers and users of acrylonitrile, including:

- Ascend Performance Materials LLC
- Cornerstone Chemical Company
- Cytec Industries, Inc.
- The Dow Chemical Company
- INEOS Nitriles
- SABIC Innovative Plastics

### 1.4 Acrylonitrile Group Contact Information

For more information about the Acrylonitrile Group or to request additional copies of this Guideline, please contact us at:

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### 1.5. Disclaimer

The Guide is intended to supplement training, Material Safety Data Sheets (MSDSs), Safety Data Sheets (SDSs), and product labels for workers who handle, transport, process or may otherwise contact AN, as well as for safety, engineering and health professionals responsible for implementation of safe management practices. There are also numerous national, regional and local regulations that need to be followed. All these documents should be consulted before handling AN.

The following information and statements contained in this guideline are believed to be reliable but are not and should not be construed as a warranty or representation for which AN Group assumes legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any

information or product referred to herein. The Guide is not intended as a statement of legal requirements or remedies. While the AN Group believes that the information contained in this Guide is current and accurate, ALWAYS CONSULT YOUR SUPPLIER'S SAFETY DATA SHEET, PRODUCT LABEL AND OTHER SAFE HANDLING INSTRUCTIONS FOR THE MOST CURRENT RECOMMENDATIONS. It is the responsibility of all persons handling AN to respect proprietary rights and observe all existing laws. Consult with legal counsel and/or appropriate government authorities to ensure compliance with local, regional, national and international laws and regulations.

## 2.0 About Acrylonitrile

### 2.1 General Description, Manufacture, and Uses

Acrylonitrile (AN) is commercially produced by a reaction of propylene and ammonia in the presence of a catalyst. The commercial product is a clear colorless to pale yellow flammable liquid. Having both olefinic (C=C) and nitrile (C≡N) groups permits a large variety of reactions and makes AN a versatile chemical intermediate. The nitrile group can undergo hydrolysis, hydrogenation, esterification and reduction. Reactions of the carbon double bond include polymerization, copolymerization, cyanoethylation, cyclization and halogenation. In its liquid state, acrylonitrile has a tendency to polymerize, which is prevented by the addition of phenolic or amine-based stabilizers and small quantities of water (preventing uncontrolled polymerization is a critical issue for the safe handling of acrylonitrile and is discussed further in Section 2.3.4).

**General Information on Acrylonitrile**

**Synonyms:** AN, propenenitrile, vinyl cyanide, cyanoethylene, acrylo, acrylon, carbacryl, fumigrian, ventox.

**CAS Number:** 107-13-1

**EINECS Number**: 203-466-5

**Physical description:** Acrylonitrile is a colorless to pale yellow liquid with a pungent odor.

**Chemical Formula:** CH2 = CH – CN

**Chemical Class.** Acrylonitrile is classified as a substituted allyl nitrile.

**Uses:** Monomer in the production of acrylic polymers, fibers, plastics, resins.

Acrylonitrile is used in acrylic and modacrylic fibers, acrylic plastics and resins, specialty polymers, nitrile rubbers, and other organic compounds. One of the reasons for the versatility of acrylonitrile is that it can form copolymers with other unsaturated compounds, such as styrene and butadiene, for example a raw material for acrylic acid, acrylic esters, acrylic amide in the synthesis of compounds used for the production of adhesives, anti-oxidants, binders and emulsifiers.

### 2.2 Physical and Chemical Properties

Acrylonitrile's physical and chemical properties are presented below (addition information on solubility, vapor pressure, and density are also available in Appendix III). Acrylonitrile is a relatively volatile, flammable chemical that will react or polymerize under the right conditions. Due to its volatility, there is high risk of inhalation exposure and/or fire from an uncontrolled release of acrylonitrile. In addition, uncontrolled polymerization, especially in a vessel or tank, can be exceptionally dangerous as the heat and pressure from the polymerization reaction can lead to over-pressurization, vessel rupture, uncontrolled release and fire/explosion. Understanding these properties is critical to properly handling acrylonitrile.

**Physical and Chemical Properties of Acrylonitrile**

**Appearance:** clear colorless to pale yellow liquid
**Odor:** pungent odor
**Melting point :** -83.5°C (-118.3°F)
**Boiling point:** 77.3°C (171.1°F)
**Flash points:**
open cup: -5°C (23°F)
closed cup: -1 °C (30.2°F)
**Flammability Limits** at 25°C (vol % in air):
lower limit: 2.8%
upper limit: 17%
**Burning velocity:** 0.47 m/s
**Density** (at 20° C): 806 kg/$m^3$
**Molecular weight:** 53.1
Water solubility: [25 C] see Appendix III
**Vapor pressure** (at 20° C): 0.12 bar (12 kPa)
**Viscosity** (at 20° C): 0.4 cP (0.4 mPa/s)
**Heat of combustion** (25°C) - 7928 kcal/kg - 33173 kJ/kg
**Heat of polymerization** - 337 kcal/kg - 1412 kJ/kg

**1. Boiling and freezing points.** Acrylonitrile boils at 77 degrees Celsius (171 degrees Fahrenheit) and freezes at -84 degrees Celsius (-118 degrees Fahrenheit ).

**2. Flash point.** The flash point is the temperature at which a chemical will give off sufficient vapors to ignite (in the presence of an ignition source). The flash point for acrylonitrile is -5°C (23°F) using the open cup method and -1 °C (30.2°F) by closed cup.

**3. Flammability.** Acrylonitrile is readily flammable and has a flammable range of 3% to 17% in air. In that range of concentration, acrylonitrile will ignite in the presence of an ignition source.

**4. Specific gravity.** Specific gravity refers to density of a liquid with respect to water. The specific gravity for acrylonitrile is 0.81 (water has a specific gravity of 1.0). Therefore, acrylonitrile is lighter than water and will tend to float on top of water when spilled.

**5. Solubility.** Acrylonitrile is miscible with many organic solvents such as alcohols, ethers, acetone, carbon tetrachloride, ethyl acetate, ethylene cyanohydrin, toluene, and aliphatic hydrocarbon solvents, and partially miscible in water (see Appendix III).

**6. Vapor pressure.** Acrylonitrile is relatively volatile and has a vapor pressure of 0.12 bar, 12 kPa, or 83 mm Hg at room temperature. Acrylonitrile will readily create vapors under most spill conditions.

**7. Vapor density.** Vapor density is the ratio of a chemical's vapor density compare to air. Since acrylonitrile vapor is heavier than air, it can congregate in low lying areas.

**8. Material incompatibility.** Acrylonitrile is incompatible with strong oxidizers, strong bases, brass, copper, copper alloys, ammonia, and amines. It does not react with water.

## 2.3 Hazards

Acrylonitrile hazards include:

- Flammability
- Environment Effects
- Human Health Effects
- Uncontrolled Polymerization

In the U.S., workplace hazards are regulated by the Occupational Safety and Health Administration (OSHA), which has a specific regulation for acrylonitrile (29 CFR 1910.1045) in addition to general workplace regulations. See Section 3 provides more information about the OSHA acrylonitrile standard and its requirements. Readers of this Guide are encouraged to fully review this OSHA regulation.

The Globally Harmonized System (GHS) for Hazard Classification and Labeling (UN 2007, GHS 2nd ed.) was developed to provide a common basis for chemical classification and labeling throughout the world. The GHS system is in the process of being implemented (or has been implemented) in the U.S., Canada, EU and elsewhere in the world. While there may be slight differences in how GHS is implemented globally from country to country, a summary of the current GHS classifications for AN (based on the EU GHS regulation) is presented below in Table 1.

**Table1: Summary of Acrylonitrile Hazard Classification by GHS/CLP[1] Criteria**

| Hazard | Classification | Signal Word | Hazard Statement | Symbol |
|---|---|---|---|---|
| **PHYSICAL HAZARDS** | | | | |
| Flammable Liquids | Category 2 | Danger | Highly Flammable Liquid and Vapor |  |
| **ENVIRONMENTAL HAZARDS** | | | | |
| The Aquatic Environment | | | | |
| Acute Toxicity | Not Classified | | | |
| Chronic Toxicity | Category 2 | None | Toxic to aquatic life with long lasting effects |  |
| **HEALTH HAZARDS** | | | | |
| Acute Toxicity | Category 3 | Danger | Toxic if swallowed, in contact with skin, or if inhaled |  |
| Skin Corrosion / Irritation | Category 2 | Warning | Causes skin irritation |  |
| Serious Eye Damage / Eye Irritation | Category 1 | Danger | Causes serious eye damage |  |
| Respiratory or Skin Sensitization | Category 1 (skin) | Warning | May cause an allergic skin reaction |  |
| Germ Cell | Not Classified | | | |

[1] Based on 2010 acrylonitrile dossier for the EU Classification , Labeling and Packaging (CLP) regulation.

| | | | | |
|---|---|---|---|---|
| Mutagenicity | | | | |
| Carcinogenicity | Category 2 | Warning | Suspected of causing cancer |  |
| Reproductive Toxicity | Category 2 | Warning | Suspected of damaging fertility or the unborn child |  |
| Specific Target Organ Toxicity | | | | |
| - Single Exposure | Category 3 | Warning | May cause respiratory irritation |  |
| - Repeated Exposure | Not Classified | | | |
| Aspiration Hazard | Not classified | | | |

### 2.3.1 Fire and Explosion Hazards

Acrylonitrile is a highly flammable liquid and its vapor can form explosive mixtures with air under ambient conditions. Acrylonitrile vapors are heavier than air and can move along the surface of the ground, potentially reaching an ignition source. Limiting spills/releases and controlling the formation of vapors after a spill are critical aspects of acrylonitrile safe handling and are discussed further in Sections 4 and 5 of this Guideline.

### 2.3.2 Environmental Hazards

Acrylonitrile is biologically degradable and is not expected to be persistent in the environment or to bioaccumulate/bioconcentrate. Studies of aquatic species have demonstrated that acrylonitrile can cause adverse effects in aquatic species. AN should not cause adverse effects at waste water treatment plants if properly added at appropriate concentration levels, though high concentrations of AN in wastewater can disrupt/kill the flora in the wastewater treatment system.

### 2.3.3 Health Hazards

Acrylonitrile is readily absorbed by the body if inhaled. Harmful effects can occur after brief exposure to acrylonitrile vapor concentrations above safe occupational exposure limits. The symptoms are not specific and take the form of irritation of the eyes and respiratory tract, headache, sleeplessness, sickness, vomiting, diarrhea, fatigue, and mild jaundice. In serious cases unconsciousness, convulsions and death may occur.

Liquid acrylonitrile is absorbed into the body via the skin, and can produce the same non-specific symptoms of systemic poisoning (noted above) that occur with inhalation of exposure of acrylonitrile. Moreover, acrylonitrile exposure to the skin (either from liquid or high concentrations of acrylonitrile vapor) can cause skin irritation, redness and

blistering. These effects may progress over a few hours after skin contact. Liquid acrylonitrile and high concentrations of acrylonitrile vapor have a burning effect on the eyes. Development of allergic dermatitis is possible after skin contact.

#### 2.3.3.1 Acute (Short-term) Exposure

- **Short term exposure to vapors.** Short term exposure to acrylonitrile in air above safe occupational exposure limits (see Section 3) can cause eye or respiratory tract irritation, nausea, vomiting, headaches, weakness, a feeling of confusion or lightheadedness. These effects have been reported at concentrations of 35 mg/m$^3$ (16 ppm) and higher for 20 to 45 minutes. At higher concentrations, the effects of acrylonitrile exposure can progress to loss of consciousness and death. Acrylonitrile absorbed into the body is metabolized to release cyanide. A classic symptom of exposures to very high levels is 'air starvation', or a feeling of suffocation, which can cause victims to panic (and potentially make things worse). Specific levels of acrylonitrile exposure associated with irreversible effects or death in humans have not been established. Based on experimental animal data, the National Advisory Committee for AEGLs has proposed interim AEGL-2 values for acrylonitrile ranging from 290 ppm (10 minutes) to 8.6 ppm (8 hours). AEGL-2 values are airborne concentrations above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. Simultaneous exposure to some organic solvents may enhance the toxicity of acrylonitrile.
- **Odor threshold.** The odor detection level of acrylonitrile has been reported to be in the range of 1.5 to 36.3 ppm (EU 2004, US EPA 2008) and acrylonitrile's odor has been described as a sharp onion-garlic odor. If you can smell acrylonitrile, you are likely being exposed to a dangerous concentration.
- **Oral (ingestion) exposure.** Ingestion of acrylonitrile produces nausea, vomiting, abdominal pain, pneumonia from aspiration into the lungs, and possible death. In occupational settings, ingestion of acrylonitrile might occur when cigarettes or food are contaminated by acrylonitrile due to poor workplace hygiene.
- **Dermal (skin) and eye exposure.** Short-term skin exposure to acrylonitrile may produce blisters or other symptoms consistent with skin burns. Blister formation may not be accompanied by pain or inflammation. Skin exposure to acrylonitrile can produce the same systemic effects as described following inhalation. Acrylonitrile contact with the eyes causes severe irritation.

#### 2.3.3.2 Chronic (Repeated) Exposure

Repeated or prolonged exposure to acrylonitrile may cause irritation, dermatitis, and allergic skin responses. Acrylonitrile has been classified as a Category 2 reproductive toxicant based on effects seen in developing rat fetuses. These effects have been seen only at doses that also produced overt toxicity to the rat mothers.

#### 2.3.3.3 Carcinogenicity

Acrylonitrile has been shown to cause cancer in laboratory animals and the potential for acrylonitrile to cause cancer in workers has been extensively evaluated. In 1979, the International Agency for Research on Cancer (IARC) originally classified acrylonitrile as "probably carcinogenic to humans" (2A), stating that "while confirmatory evidence in experimental animals and humans is desirable, acrylonitrile should be regarded as if it were carcinogenic to humans". However, in 1999, IARC downgraded its classification to "possibly carcinogenic to humans" (2B) based on a lack of evidence for increased cancer risk among acrylonitrile workers. Despite the lack of evidence for increased cancer risk among acrylonitrile workers, as recognized by IARC, it is very important to minimize exposure to acrylonitrile.

### 2.3.4 Polymerization (Uncontrolled) Hazards

The storage of inhibited acrylonitrile does not normally constitute a polymerization hazard. However, under some conditions (such as contamination), acrylonitrile may undergo uncontrolled polymerization. The polymerization reaction is highly exothermic and the heat generated can lead to additional polymerization and/or the volatilization of acrylonitrile monomer leading to overpressure and possibly the rupture of storage tanks and vessels. In the most extreme situations this can lead to a BLEVE (boiling liquid expanding vapor explosion) which are extremely dangerous and life-threatening (see Section 5 on firefighting and emergency response).

**Substances and conditions that MUST be avoided with acrylonitrile (even if it is properly inhibited):**

- Free radical catalysts such as peroxides and hydroperoxides.
- Basic/alkaline material such as sodium hydroxide, potassium hydroxide or ammonia (*).
- Lewis acid catalysts such as boron trifluoride, titanium tetrachloride and sodium borohydride.
- Strong mineral or organic acids.
- High-energy radiation such as UV light, X-rays and gamma rays.

* In low concentrations (30 - 55 ppm), ammonia is acceptable as a polymerization inhibitor

#### 2.3.4.1 Inhibitors for Acrylonitrile

Two inhibitor systems are typically used to prevent the polymerization of acrylonitrile during storage and transportation:

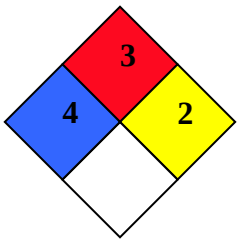
1. Water: 0.25 - 0.5 % by weight and monomethylether of hydroquinone (MEHQ) 30-50 ppm storage stability : 6 months maximum

2. Water: 0.25 - 0.5 % by weight and Ammonia: 30-55 ppm storage stability: 6 months maximum

Chemical analysis is recommended when storing acrylonitrile for more than short periods of time in order to detect signs of uncontrolled polymerization and/or the decrease of inhibitor levels. If required, inhibitors must be restored to the normal levels. Restoring correct inhibitor levels will not reverse any polymerization that has occurred or remove the cloudy appearance (See Section 4 for more information on acrylonitrile storage).

## 2.4 Shipping and Storage

1. Acrylonitrile is primarily shipped on-road truck tankers, railroad tank cars, ocean-going tankers, river barges, and in drums/IBCs.
2. UN Identification Number. The United Nations identification number for acrylonitrile is 1093. This number is used to identify acrylonitrile on placards for transportation vehicles.
3. DOT Label category. The U.S. Department of Transportation classifies acrylonitrile as a flammable liquid and as a poison. Specific placards on these classes should accompany containers of acrylonitrile.
4. NFPA 704 (Diamond)




Red - Flammability: 3 -- Ignites at normal temperatures
Blue - Health Hazard: 4 -- Can be lethal
Yellow – Reactivity: 2 -- Violent chemical change possible at high temperatures or pressures.

5. Storage. Acrylonitrile must be stored is tightly closed containers in a cool, well-ventilated area, away from heat, sparks, flames, strong oxidizers, strong bases, copper, copper alloys, ammonia, and amines (see Section 2.3.4 on polymerization hazards). Acrylonitrile has no corrosive effect on metals and can be stored in a variety of metal tanks (e.g., stainless steel, carbon steel); however, for product quality reasons, avoid contact with copper or copper alloys (such as brass).

6. Material Safety Data Sheet (MSDS). Most information about acrylonitrile can be obtained from the material safety data sheet. The MSDS provides a comprehensive source of information on its properties, hazards, and transportation information (check with your supplier for the most current MSDS on acrylonitrile).

## 3.0 Acrylonitrile Health and Safety Practices

### 3.1 Overview of Good Hygiene and Work Place Practices

Workers should avoid all exposure to acrylonitrile. Good work practices include:

- Ensuring that your actions do not endanger yourself or others,
- Avoiding a complacent attitude,
- Keeping acrylonitrile contained within the process/equipment,
- Not venting acrylonitrile to the atmosphere (Acrylonitrile vapors should be recycled, scrubbed, or incinerated), and
- Practicing strict personal cleanliness and good workplace housekeeping at all times.

**1. Workplace exposure.** Avoid dermal contact with acrylonitrile liquid, spray or vapors. Do not breathe acrylonitrile vapors or spray. Ensure that workplace exposure limits are not exceeded.

**2. Eating, drinking and smoking.** Do not bring food, beverages, candy, tobacco, or similar items to work or store them in the work area. Wash hands and face thoroughly before eating, drinking, or smoking.

**North American Exposure limits:**
8-hr Time Weighted Average (TWA):
USA (OSHA): 2 ppm (4.5 mg/m$^3$)

USA (ACGIH): 2 ppm (4.5 mg/m$^3$)

Canada (Ontario, Quebec, Alberta, BC):
2 ppm (4.5 mg/m$^3$)

**3. Ventilation and engineering controls.** Ensure that adequate ventilation and other engineering controls are provided in areas where acrylonitrile vapors may be present.

**4. Use of personal protective equipment (PPE).** Wear appropriate personal protective clothing, or PPE, including respirators, protective clothing, and protective face and eyewear. See Section 3.2, "Selection of Personal Protection Equipment for Acrylonitrile" for detailed information for selecting appropriate PPE for acrylonitrile.

**5. Safety showers and eyewash fountains.** Make sure that safety showers and eyewash fountains are available wherever acrylonitrile is handled.

**6. Accidental acrylonitrile exposure.** Wash spills of acrylonitrile from the skin immediately by flushing with plenty of water.

**7. Clothing contamination.** If clothing becomes contaminated, or is suspected of being contaminated, remove it immediately and launder before reuse. Wear impervious gloves while removing clothing to prevent additional skin contact. Wash gloves thoroughly in running water before removing them.

**8. Spill removal.** Remove spills of acrylonitrile promptly to prevent widespread contamination of the work area.

**9. Cleaning surfaces.** Do not use dry sweeping or compressed air cleaning to clean surfaces of acrylonitrile.

**10. Enclosure of storage vessels.** Make sure that all containers, vessels, or storage tanks containing acrylonitrile are enclosed.

**11. Use of non-sparking tools/bonding and grounding of containers.** Use non-sparking tools when opening or closing metal containers of acrylonitrile. Containers

must be bonded and grounded when pouring or transferring liquid acrylonitrile.

**12. Cleaning PPE.** Respirators and other contaminated protective equipment should be washed at the end of each shift and stored in a dust-free area. Dispose of single-use or other contaminated PPE items as hazardous waste.

**13. Problems with leather products.** Do not wear leather items such as boots, belts, or wallets when working around acrylonitrile. Do not reuse any leatherware that has been contaminated with acrylonitrile.

**14. Laundering of work clothing.** Shower after the completion of each work shift and launder work clothing prior to reuse. Do not launder work clothing with street clothing or at home or in public laundering facilities.

**15. Storage of work clothing.** Street clothing should be stored separately from work clothing and protective equipment. Never take work clothing and shoes home.

## 3.2 Selection of Personal Protection Equipment for Acrylonitrile

A hazard analysis should be performed of each work activity to determine what specific personal protective equipment (PPE) should be worn by anyone working with AN.

PPE is not an appropriate substitute for safe working conditions, such as engineering controls and compliance with safety procedures. However, in some instances PPE is the only practical means of protecting the worker, particularly in emergency situations. The proper use of PPE requires adequate training of workers. The PPE described in the following sections should be readily available for use when there is potential exposure to AN.

See the special note about leather goods below. Leather should not be used in areas where acrylonitrile is in use. Leather cannot be safely decontaminated after contact with acrylonitrile and must be disposed as hazardous waste. Contaminated leather products present an exposure hazard.

### 3.2.1 Respiratory Protection

All employees who are required to wear respiratory protection must undergo a medical evaluation and be properly trained on respirator use. Respiratory protection training should include:

- The reasons why respirators must be worn.
- The limitations of the respirator.
- Proper maintenance and inspection procedures.
- Hands-on demonstration on the proper fit and adjustment of the respirator.
- Conditions to avoid, such as the presence of facial hair, or interference with the respirator's sealing surface which can be caused by eye glasses.

Respirators should be tested for proper fit at the time the respirator is assigned to the employee and rechecked on a semi-annual basis. Used respirator cartridges should be discarded at the end of each work shift. These respirators must be selected specifically

for use with acrylonitrile. The appropriate respirator must be approved by NIOSH or the specific national authority for your country.

### 3.2.2 Eye protection

All employees working with acrylonitrile must wear eye protection where eye contact with acrylonitrile is possible. Splash-proof safety goggles and face shields must be worn in all areas where liquid acrylonitrile is handled. Contact lens users should consult with facility medical department to determine whether or not they may be worn when working with acrylonitrile.

### 3.2.3 Skin Protection

Appropriate PPE should be employed to avoid skin (dermal) contact with AN. For operations where it is possible for acrylonitrile to come into contact with skin, wear fully impervious protective clothing to prevent such contact. The head, face, hands, and feet must be protected. Suitable impervious protective clothing, including gloves, boots, and suits should be selected based on the potential level of exposure. Permeation and material degradation must be considered when evaluating protective clothing (see break-through times below).

**Break-through times (emersion)**

- Butyl rubber: 480 minutes
- Neoprene rubber: 20 minutes
- PVA: 42 minutes
- DuPont Tychem SL: 50 minutes
- DuPont CPF4: 377 minutes
- DuPont Responder: 480 minutes
- Siebe North Silver Shield: 480 minutes

**Hand protection**
Gloves of suitable material (e.g., high quality butyl rubber or neoprene) should be worn when handling AN (see break-through times above).

**Foot protection**
Butyl rubber boots (preferred) or neoprene rubber boots should be used for operations with potential exposure to acrylonitrile (see break-through times above). Leather footwear can absorb acrylonitrile and not release it, resulting in skin burns to the feet after a certain period of exposure. Contaminated leather footwear must be disposed of as hazardous waste.

**Body protection**
In circumstances where full body protection is need, coveralls of a suitable material (see break-through times above) can be used with a tight fitting hood and elastic fittings around wrists and ankles to avoid vapor and splashes of AN from touching the skin per

manufacturer's use recommendations. In circumstances with higher exposure potential (e.g., spills, upsets, etc.) a butyl rubber gas-tight suit or a compatible HazMat Level A suit with an independent air supply may be needed to provide adequate whole body protection to AN exposure.

**Note about Use of Leather**

Leather goods should not be used in areas where acrylonitrile is in use. Contaminated leather products, such as shoes, gloves, belts, wallets, and watchbands, must be disposed of as properly. Leather cannot be safely decontaminated after contact with acrylonitrile.

## 3.3 Rescue, First Aid and Emergency Medical Response

### 3.3.1 Rescue

Victims of accidental exposure, uncontrolled exposure or overexposure to acrylonitrile need immediate removal from exposure and urgent medical care. While urgent removal of victims is critical, rescuers must be properly protected from exposure themselves in order to avoid also becoming victims. Do not attempt to rescue someone unless you are properly trained and equipped.

**Rescue Procedures for Initial/Immediate Response**

1. Get help (call emergency personnel)
2. Use proper PPE and rescue equipment
3. Rescue victim and apply first aid, which includes the following (some of these can be done simultaneously):
   - Evacuate person from affected area
   - Remove contaminated clothing (assume clothing is contaminated unless certain it is not)
   - Assess cardiac condition and apply CPR as needed
   - Apply oxygen as needed
   - Remove exposed clothing
   - Wash affected areas with cool water
   - Apply antidote as necessary (see Section 3.3.3.5)
4. Keep victim warm and transport to hospital/medical facility as soon as possible.

**Warning: Don't become a victim yourself! Never expose yourself to hazardous concentrations of acrylonitrile without proper equipment!**

### 3.3.2 Symptoms of Overexposure

The symptoms of overexposure to acrylonitrile are generally not specific and can take the form of headache, sleeplessness, sickness, vomiting, diarrhea, fatigue, mild jaundice, cyanosis (symptoms of cyanosis are dark red, blue or purple skin color, especially in lips, gums or fingernails) and irritation and inflammation of the eyes and respiratory system, including nose and throat. In serious cases unconsciousness, convulsions and death may occur.

Exposure of the skin to liquid acrylonitrile can cause skin irritation, redness and blistering. Local injury can occur a few hours after contact with the liquid. Liquid acrylonitrile has a burning effect on the eyes. Development of allergic dermatitis is possible after skin contact.

### 3.3.3 First Aid/Emergency Response

If exposure to acrylonitrile occurs, skilled medical treatment is necessary. The first priority for most exposures is to get the exposed person to a hospital or other urgent care medical facility. You should call your medical provider or emergency services (e.g., 911) for all cases of exposure. Those treating victims of acrylonitrile poisoning should make sure that they are equipped with the necessary personal protective

equipment (see warning below). In cases involving acrylonitrile poisoning, pay attention to the vital functions (breathing and blood circulation) and the effects on the skin, eyes, liver and central nervous system. Acrylonitrile can normally be absorbed via inhalation or contamination of the skin. Drastic medical treatment is necessary only in cases involving serious exposure (e.g., contamination of a large area of the skin, serious irritation, unconsciousness). Antidote treatment of AN exposure, when necessary, may differ from country to country with different antidote regiments being preferred in different regions (see Section 3.3.3.5 Antidotes).

**Important Note to First Aid Responders, Medical/Hospital Personnel**

Treatment personnel may be at risk of AN exposure from an exposed individual's contaminated clothing, stomach contents, etc. and should consider appropriate PPE to don during treatment of an exposed individual.

#### 3.3.3.1 Response Protocol for ingestion exposures.

For exposure by ingestion:

- If area/clothing is contaminated, move victim to fresh air and start decontamination (e.g. remove contaminated clothing and equipment) as soon as possible.
- Do not induce vomiting.
- Administer oxygen as needed.
- If the victim is not breathing, give artificial respiration.
- If victim is unconscious, initiate antidote treatment (see Section 3.3.3.5 Antidotes). Do not interrupt artificial respiration while doing this.
- Continue antidote regiment until the victim's condition improves or medical response arrives.

- Seek immediate medical help.

#### 3.3.3.2 Response Protocol for inhalation exposures.

For exposure by inhalation:

- Move the victim to fresh air and start decontamination (e.g. remove contaminated clothing and equipment) as soon as possible.
- Administer oxygen as needed
- If the victim is not breathing, give artificial respiration.
- If the victim is unconscious, initiate antidote treatment (see Section 3.3.3.5 Antidotes). Do not interrupt artificial respiration while doing this.
- Continue antidote regiment until the victim's condition improves or medical response arrives.

Seek immediate medical help.

#### 3.3.3.3 Response Protocol for skin absorption exposures.

For skin exposure:

- Remove contaminated clothing and wash affected areas with soap and water as soon as possible.
- Move the victim to fresh air.
- Administer oxygen as needed.
- If the victim is not breathing, give artificial respiration.
- If the victim is unconscious, initiate antidote treatment (see Section 3.3.3.5 Antidotes). Do not interrupt artificial respiration while doing this.
- Continue antidote regiment until the victim's condition improves or medical response arrives.
- Seek immediate medical help.

#### 3.3.3.4 Treatment of eye exposures.

For eye exposure, hold eyelids apart and wash with a continuous gentle stream of cool water for at least 15 minutes.

#### 3.3.3.5 Antidotes

Recommended antidotes differ from country to country, and are under constant review. Please refer to your national authorities for current recommendations. The following are current antidotes recommended for AN exposure (by country):

U.S.A.: Amylnitrite, sodium nitrite, and sodium thiosulphate (Lilly cyanide antidote kit) and Cyanokit ® (hydroxycobalamine)
Canada: Amylnitrite, sodium nitrite, and sodium thiosulphate (Lilly cyanide antidote kit)
U.K.: N-acetylcysteine
Germany / Austria: 4-DMAP and sodium thiosulphate
France: Hydroxycobalamine plus sodium thiosulphate
Italy: Hydroxycobalamine and sodium thiosulphate
Spain: Hydroxycobalamine plus sodium thiosulphate plus eventually n-acetylcysteine

#### 3.3.3.6 First-aid Kit

Acrylonitrile plants, tankers, barges, etc. should be equipped with a first-aid kit that includes appropriate antidotes.

### 3.4 OSHA Acrylonitrile Exposure Monitoring /Medical Surveillance Regulations

Requirements for occupational exposure monitoring and medical surveillance for the handling of acrylonitrile[2] in the U.S. are specified in OSHA's acrylonitrile regulation (29 CFR 1910.1045). Readers of this Guide are encouraged to fully review this OSHA regulation in addition to the information provided below and the information provided by your supplier (e.g. MSDS).

### 3.4.1 Personal monitoring.

Personal monitoring is undertaken to establish the level of respiratory exposure of workers in the workplace.

- The action level for acrylonitrile is 1 part per million (ppm). OSHA regulations require monitoring of work places where acrylonitrile is used.
- If monitoring shows acrylonitrile concentrations over 1 ppm, but under the permissible exposure limit of 2 ppm, monitoring must be repeated every three months.
- If monitoring shows acrylonitrile concentrations over 2 ppm, monitoring must be performed monthly.

**Additional Monitoring**

- **Requirements.** Monitoring must also be performed when changes in production, processes, controls, or personnel result in new or additional exposures to acrylonitrile.
- **Regulated areas.** Facilities must establish regulated areas where acrylonitrile concentrations exceed the permissible exposure limit.
- **Posting Results.** When measured concentrations of acrylonitrile are above the permissible exposure limit, the results of monitoring and planned corrective action must be posted.

### 3.4.2 Medical Surveillance

Medical surveillance is also required for employees who work with acrylonitrile. Medical surveillance involves an initial medical examination followed by periodic medical examinations.

**Initial medical exam**

The initial medical exam establishes the baseline medical condition for the employee. In the initial medical examination, the physician takes a health and work history of the prospective employee. The physician gives particular attention to:

- peripheral and central nervous system,
- gastrointestinal system,
- respiratory system,

[2] 1910.1045 specifically exempts the handling of ABS resins, SAN resins, nitrile barrier resins, solid nitrile elastomers, and acrylic and modacrylic fibers, when these listed materials are in the form of finished polymers, and products fabricated from such finished polymers.

- skin, and
- thyroid.

**Periodic medical exams**
Periodic physical exams are then conducted every year for employees who work around acrylonitrile. Other medical exams are to be conducted whenever employees show symptoms of acrylonitrile exposure.

## 4.0 Storage and Transport

### 4.1 Prevention of Polymerization/Compatibility

The polymerization hazards of acrylonitrile are discussed in Section 2.3.4. Prevention of polymerization is critical to the proper storage of acrylonitrile. Polymer formation during the storage of acrylonitrile is normally due to:

- Low inhibitor concentrations, including water
- Presence of contaminants which can act as polymerization initiators
- High ambient temperature
- Evaporation and condensation. When the acrylonitrile monomer vaporizes and then condenses in cooler parts of the storage container or vessel, the condensed monomer is essentially uninhibited and is at greater risk of polymer formation than the main volume of acrylonitrile.

In order to minimize polymer formation, the following countermeasures should be taken:

- Store acrylonitrile only in clean, dedicated containers or vessels
- Avoid storage times of longer than 6 months; transfer the product on a first-in, first-out basis
- Recirculate fresh acrylonitrile through lines and pumps to prevent long storage times in stagnant areas
- During storage, test the pH, the inhibitor and water content and restore to the normal levels if required. Testing frequency will vary with conditions (e.g., weather, volume, turn-over frequency, etc.). Check with your supplier for recommended testing frequency.

In general, dedicated storage vessels (tanks, rail car, tank trucks, ISO containers, etc.) are preferable to switch loading of acrylonitrile. However, switch loading can be done assuming proper precautions are met, including:

- Only acceptable previous cargo[3] was in the storage vessel;
- No unacceptable[3] previous cargo was in the storage vessel
- The vessel, line, etc. have been properly cleaned and dried (see Verwey 2011, guide to tank cleaning).

#### 4.1.1 Color Formation

Acrylonitrile, which is normally clear, can develop color while in storage. In addition to the fact that this color will impact polymer end products, it is also usually the first sign that storage problems are developing. Color formation in storage can be minimized by the following steps:

- Do not use copper or copper alloys in any part of the storage and handling system
- Control the temperature of tank contents

[3] Manufacturers have lists of acceptable and unacceptable previous cargo; please contact your supplier for this information.

- Avoid storage times of more than 6 months; transfer the product on a first-in, first-out basis
- Recirculate fresh acrylonitrile through lines and pumps to prevent long storage times in stagnant areas.

If color is formed, it can usually be reduced to a normal or acceptable level by redistillation.

## 4.2 Acrylonitrile Storage and Loading Equipment

The equipment used for storage and handling of acrylonitrile is subject to a variety of regulations and other controls, which may vary by jurisdiction.

### 4.2.1 Storage Tank Design and Construction

Storage and handling of acrylonitrile must comply with regional government and good engineering/storage practices such as API 620, 650, 653, NFPA 30. These regulations and standards must therefore be considered in the design of any acrylonitrile storage facility (see Appendix IV for diagram of typical storage tank system).

#### 4.2.1.1 Tank Location and Site Considerations

The location of storage tanks should be based on:

- Accessibility for normal operations.
- Routine maintenance activities.
- Access for emergency response personnel and equipment.
- Tank farm design should take into account the possibility of accidental spills and fires. Segregated storage of other chemically reactive materials is required to prevent accidental mixing of acrylonitrile with these materials.

Storage tanks should be constructed at ground level and in the open air. If a leak develops, ground level construction improves the detection of any vapor emissions and allows natural ventilation to disperse these vapors.

Storage tanks must be located away from potential sources of ignition. Heat radiation from fires in an adjacent area should also be considered in choosing the tank location.

All storage tanks should be surrounded by a concrete dike capable of containing 110% of the largest tank within the dike plus the collected rainfall from a 24-hour, 25-year storm. The dike wall and floor should be impervious to liquid acrylonitrile and designed to withstand a full hydrostatic head. The height of the dike walls should not be higher than five feet to ensure
adequate ventilation of the storage area, and to allow easy access and escape for emergency personnel. Intermediate dike walls are recommended to divide tanks into groups to contain any accidental leakage and to minimize the surface area of the spill. The tank should be equipped with a leak detection system.

The floor of the diked area must be sloped to prevent small spills from collecting below any storage tank.

Drainage of collected precipitation within the storage dike should be accomplished using an air-driven pump or an electric pump with a flameproof motor. If dike drains are used for the removal of collected precipitation, then the drain valves should be located outside the dike walls. Written procedures should ensure that the valves remain closed and locked, except when collected precipitation is being removed. Contaminated precipitation must be pumped to a suitable container for proper disposal according to local regulations.

#### 4.2.1.2 Tank Design and Construction

The storage tank design should consider the expected delivery vehicle and the required capacity.
The tanks should be the smallest compatible with shipping and receiving requirements. Storage times in excess of six months should be avoided to prevent the degradation of acrylonitrile quality (e.g., polymerization). Storage tanks may be constructed from carbon steel or stainless steel. Copper or copper alloys should never be used as copper may discolor the acrylonitrile and can initiate polymerization.

Carbon steel tanks must be cleaned by chemical or physical means to remove rust prior to initial use. To reduce the potential for chemical reaction, further cleaning with water is required, if chemical cleaning procedures were used.

The use of a multi-compartmented tank is not recommended because of the risk of product contamination or heating from adjacent compartments.

While acrylonitrile storage tanks generally do not require insulation or refrigeration, the tanks should be painted white or with aluminum paint to reduce any temperature rises, and thus, the amount of acrylonitrile vapor discharged from any vents.

Capability for storage tank agitation or circulation is recommended for uniformity of product sampling and for addition and circulation of inhibitors, which are usually added to the product during the production process.

A manhole of a minimum of 20-24 inches should be included on all tanks to allow for internal inspection and cleaning.

To prevent possible build-up of static charge in a top-loading system, the inlet pipe must extend nearly to the bottom of the tank to prevent free-falling of a flammable liquid. Storage tanks should be constructed to allow full drainage of the tank contents, sloped to an outlet with no trapped areas.

The tank design must allow for measuring liquid level and temperature by a method which does not require opening a tank gauge hatch. Opening a gauge hatch increases the potential for employee exposure to acrylonitrile. Closed gauging systems are

commercially available. Tank liquid levels may be measured by any reliable system. Level indicators should be intrinsically safe for use with acrylonitrile based on nationally accepted standards. High level alarms and interlocks should be included to prevent overfilling.

### 4.2.2 Piping

Piping should also be constructed out of an acceptable material, carbon steel or stainless (see discussion under tank design) and of sufficient diameter for the application. The tank discharge line should be installed on the bottom or side of the tank and should be fitted with an isolating valve as close to the tank wall as possible. Discharge from the tank must be made by pump. The discharge pump and controls are generally placed outside the containment dike.

Tanks must be designed with a capacity for draining. This drain piping should be fitted from the lowest point on the tank and have an isolation valve. The isolation valve should be closed and locked out when not in use. Wherever possible, continuously welded pipework should be used. Flange joints may be used where pipes are periodically disconnected for maintenance or inspection. Flanges should conform to the ANSI Standard and should use Teflon®, Grafoil®[4] or stainless steel spiral wound or equivalent gaskets. Use of threaded fittings should be limited to stainless steel instrument fittings where the instrument can be isolated with non-threaded block valves.

Piping should not be located over doorways or windows or close to possible sources of ignition.

Fixed, dedicated loading/unloading arms are recommended. All hoses used for loading or unloading must be acrylonitrile-resistant lined armored asthenic steel flex hose. Hoses must be inspected for wear or damage on a frequent basis and replaced as necessary.

### 4.2.3 Pumps

Pumps must be located outside of tank dikes on an impervious base in an open space. Pumps should not be located in a walled-off or confined area.

Centrifugal pumps designed to ANSI Standards are normally used for acrylonitrile. Single or double mechanical, self-flushing seals should be used. Seal face materials should be compatible for AN service, such as those made of carbon against silicon carbide or carbon against tungsten carbide. Likewise, many seal gasket elastomer materials are not compatible with acrylonitrile and will swell or dissolve. Some perfluoro-elastomers (e.g., PTFE or Kalrez®[5]) o-rings are acceptable for acrylonitrile service, check specific compatibility with the manufacturer before using o-ring.

[4] Trademark of Union Carbide Corporation.
[5] Trademark of DuPont Dow Elastomers.

Pumps should be constructed of either cast steel or stainless steel. Plastic pumps should not be used.

Pumps may be driven pneumatically, hydraulically or electrically. Where electric motors are used to drive the pump, the National Electrical Code (NFPA 70: NEC) should be followed. If pumps are remotely controlled, then a stop button must be installed at the pump delivery point. Pump output should not exceed the recommended design capacity of the piping system.

Note that gravitational flow may occur in a centrifugal pump when the pump is stopped. This flow should be anticipated, and the design should compensate for it.

### 4.2.4 Valves

Valves should be installed directly on all bottom outlets of a tank unless these branches are blanked off. Isolating valves may be ball or gate valves with hard face or PTFE seats. Angle or globe valves are also acceptable on acrylonitrile service.

Note that diaphragm valves must not be used with acrylonitrile.

Valve bonnet gaskets may be soft iron, spiral wound or equivalent. Valve stem packings should be Garlock 9000 EVSP graphite packing or equivalent.

### 4.2.5 Vapor Containment and Recovery

The vapor pressure of acrylonitrile is sufficiently high as to result in relatively significant storage tank breathing and fill losses. A closed-loop balance venting system should be installed so that vapors from the storage tank are returned to the rail car or tank

Vapors discharged from the vents during normal breathing, due to temperature-pressure changes and evaporation rate, should be controlled according to local government regulations. Depending on specific needs and circumstances, use one or more of the following control methods:

1) Pressure storage or conservation vents
2) Floating tank roof
3) Refrigerated condenser
4) Wet scrubbing
5) Flaring or incineration

### 4.2.6 Electrical Concerns

The tank, pumps, valves and piping should be electrically grounded to prevent the accumulation of static electrical charges. Tanks should be bonded and fitted with a grounding point and connected to a good ground with a resistance of at most five ohms at any point in the system. The same guideline applies to the grounding point of all

discharge equipment, which should be connected to the same ground. If discharge equipment is grounded independently, the ground should have minimal resistance between the discharge equipment and the tank pipework system.

The equipment used for storage and handling of acrylonitrile is subject to a variety of regulations and other controls, which may vary by jurisdiction.

### 4.3 Shipping Containers

Acrylonitrile is shipped in drums, tank cars, tank trucks, ISO tanks, barges and ships, all of which are unlined. Each brand new drum is made of 20 gauge black steel and is nonreturnable. Tank cars and trucks are constructed of either carbon steel (ASTM A-285, Grade C), stainless steel (316), or aluminum (61ST). Drums used to ship, store or handle acrylonitrile in any manner should be thoroughly cleaned, since contaminated containers may catalyze polymerization of acrylonitrile or cause rapid decomposition. Specifically, the presence of concentrated caustic alkali will initiate violent, exothermic polymerization of acrylonitrile. Large amounts of acid may promote hydration of the acrylonitrile or may hydrolyze the acrylonitrile to acrylic acid.

### 4.4 AN Transfer Procedures and Handling

Written operating procedures should be developed and available when transferring AN, including the following:

- Tank truck/ISO Container transfers (loading and unloading)
- Rail car transfers (loading and unloading)
- Marine transfers (loading and unloading)
- Drum receipts

Note: marine procedures must be approved by the U.S. Coast Guard.

Personnel involved in loading and unloading should be fully trained in these procedures. The instructions should recognize the specific hazards of acrylonitrile, and ensure the correct operation of unloading equipment in both normal and emergency situations.

The following are some of the special procedures required for AN transfers:

- Bottom outlets are not authorized for tank trucks, rail cars or ISO containers handling AN.
- Dedicated equipment is recommended, otherwise special care is required to avoid cross contamination (see Section 4.1).
- Ensure only appropriately trained and equipped personnel perform loading/unloading operations.
- Check the shipping papers/bill of lading (BOL) against the placards, labels and seals as appropriate to assure proper identification.
- Pressure test all connections prior to loading and unloading to ensure tightness.

- Check that the car or truck is parked within the designated containment area and that the transfer hose has the correct fittings and is of appropriate length.
- Check that the tank truck driver is out of the truck during loading/unloading.
- If hoses are run across vehicular byways, set up protective barricades.
- Ensure that the transfer equipment contains nothing to contaminate the AN.
- It is recommended that AN be pumped off of transportation containers with the use of nitrogen as a carrier.

Operators engaged in the unloading procedures should wear personal protective equipment or PPE, including respirator, eye and face protection, splash suit, rubber gloves, and rubber boots especially during the connecting and disconnecting of transfer lines (see Section 3.2 on PPE). Be aware of emergency procedures. Check the availability and proper operating condition of emergency water, eye wash, and shower for washdown.

### 4.4.1 Loading and Unloading Tank Trucks and Rail Cars

Below are elements to consider for transfer procedures involving tank trucks, ISO containers, and rail cars.

Loading and Unloading Areas

Tank truck, ISO container and rail car unloading areas should have the following characteristics:

- Isolation from traffic
- Level, open, paved area with adequate lighting
- Stairs and platforms that provide safe access to top of tank truck, ISO container or rail car
- Provisions for spill containment to prevent run-off
- 50 foot spacing from adjoining buildings and equipment

Authorized Equipment (per 49 CFR 173.243)

Tank Trucks: MC 304, MC307, MC330, and MC331 cargo tanks.
Railcars: DOT 103, 104, 105, 109, 111, 112, 114, 120 Fusion Welded, 106, and 110
ISO Portable Tanks: DOT Spec. 51, 60

Unloading responsibility

Usually the receiving location is responsible for the unloading of the truck with the cooperation of the driver. Throughout the unloading, all transfer operations should be under the surveillance of the receiving location operator.

Routine inspections should be performed on all truck and rail transport equipment before each load of acrylonitrile is loaded. After loading is complete, truck, rail, or ISO portable container transport equipment should be nitrogen blanketed at a pressure of 1-3 psi.

Checklist for Tank Trucks and ISO Tanks

Checklist should be used for loading and unloading tank trucks and ISO tank.

Steps for Loading:

1. Park vehicle only in appropriate loading area (see Loading and Unloading Area).
2. Ensure that truck is de-energized (e.g., remove keys from truck) and driver is outside of vehicle[6].
3. Set double chocks.
4. Ground truck and verify grounding/bonding.
5. Check all seals.
6. Check to ensure the internal/external valves are closed.
7. Check for truck pressure rating, capacity, safety valve set point, and verify annual inspections are current.
8. Set regulator pressure to the recommend level[7] .
9. Visually inspect hoses for damage and last test date.
10. Attach nitrogen or vapor balance.
11. Connect loading hose and check for leaks.
12. Proceed with loading (Note: attendance is required per DOT regulations).
13. Clear transfer lines with nitrogen after loading. Close internal valve followed by external valve and ensure zero pressure before disconnection.
14. Disconnect all loading equipment and secure truck/ISO tank for transport prior to release tank truck to carrier.
15. Ensure bill of lading is provided.
16. Ensure that vehicle placarding is in place.

Steps for Unloading:

1. Park vehicle only in appropriate loading area (see Loading and Unloading Area).
2. Ensure that truck is de-energized (e.g., remove keys from truck) and driver is outside of vehicle.
3. Set double chocks.
4. Ground truck and verify grounding/bonding.
5. Check all seals.
6. Check bill of lading.
7. Check to ensure the internal/external valves are closed.
8. Check for truck pressure rating, capacity, safety valve set point, and verify annual inspections are current.
9. Set regulator pressure to the recommend level[8] .
10. Visually inspect hoses for damage and last test date.
11. Attach nitrogen or vapor balancing.
12. Connect unloading hose and check for leaks.
13. Proceed with unloading (Note: Attendance is required per DOT regulations).

[6] Locations should consider developing a designated waiting area for the driver to keep him/her clear of loading operation.

[7] Recommended pressure may vary location to location, but should be kept at a minimum (and well under the truck safety-valve set point) to reduce hazards.

[8] Recommended pressure may vary location to location, but should be kept at a minimum (and well under the truck safety-valve set point) to reduce hazards.

14. Clear transfer lines with nitrogen after unloading. Close internal valve followed by external valve and ensure zero pressure before disconnection.
15. Disconnect all unloading equipment and secure truck/ISO tank for transport prior to returning to carrier.

Checklist for Rail Cars

Checklists should be used for both loading and unloading rail cars.

Steps for Loading:

1. Rail car loading area must have containment (see Loading and Unloading Area).
2. Ensure that chocks/hand brakes are properly set when tank car is spotted.
3. Check for rail car for appropriate DOT class (see section on Authorized Equipment), pressure rating, capacity, safety relief valve test date, and verify inspections are current.
4. Post FRA (blue flag) (49 CFR 173.31 g(2)) warning signs.
5. Set and lock derailer.
6. Attach ground cable and verify grounding/bonding.
7. Check manway gasket.
8. Place vapor control system in service.
9. Connect loading line.
10. Test load line for percentage of oxygen.
11. Load rail car to pre-set weight.
12. Disconnect all loading equipment and secure rail car for transport prior to returning to carrier.
13. Ensure that rail car placarding is in place.

Steps for Unloading

1. Rail car loading area must have containment (see Loading and Unloading Area)
2. Ensure that chocks/hand brakes are properly set when tank car is spotted.
3. Check for rail car for appropriate DOT class (see section on Authorized Equipment), pressure rating, capacity, safety relief valve test date, and verify inspections are current.
4. Post FRA (blue flag) (49 CFR 173.31 g(2)) warning signs.
5. Set and lock derailer.
6. Attach ground cable and verify grounding/bonding.
7. Connect transfer hose/loading arm.
8. Check for leaks.
9. Proceed with unloading.
10. After unloading, clear lines with nitrogen.
11. Disconnect all unloading equipment and secure rail car for transport prior to returning to carrier.

Procedures for disconnecting tank truck and rail car

When disconnecting tank trucks or rail cars, close all valves and secure caps or plugs tool-tight before releasing the tank truck or rail car. Ensure all required placards and bulk tags are in place.

Prohibited practices

U.S. Department of Transportation regulations prohibit bottom outlet valves on acrylonitrile rail cars, trucks, ISO container or any surface transportation container. As such, the unloading system must be capable of unloading the container through the dip tube. Unloading should be accomplished using a self-priming pump. If it becomes necessary to unload with pressure assist, an inert gas such as nitrogen should be used. In no cases, should compressed air be used for this purpose.

### 4.4.2 Marine Transfers

a. U.S. Coast Guard requirements. All barges and ships should be approved for cargo transfer based on U.S. Coast Guard or other regulations. A U.S. Department of Transportation Declaration of Inspection (ship/shore checklist) should be completed to ensure that the vessel and the terminal are compatible for safe transfer of acrylonitrile.

b. Transfer lines. All cargo transfer lines should be pressure tested to ensure their integrity.

c. Reduction of flammability. To reduce flammability, cargo tanks can be nitrogen purged to reduce the oxygen level below 8%, but should not be purged to less than 3% in order to avoid reducing the effectiveness of AN inhibitor MEHQ. MEHQ remains effective due to adequate dissolved oxygen in the product (recommended between 3-7% oxygen in vapor space). Ship cargo tanks containing acrylonitrile cannot, by international law, be nitrogen blanketed because of the detrimental effects that blanketing may have on the polymerization inhibitor during a prolonged voyage.

d. Special requirements
   1. All barges transfers will be conducted by a licensed tankerman
   2. All personnel must wear life jackets while on a barge
   3. No smoking or open flames on barges or docks
   4. No tugs are allowed to tie up to the barge or dock during transfer.
   5. Cross tie barges with a minimum of four mooring lines
   6. Check rake tanks for leaks of water or cargo
   7. Personnel entry of rake tanks and cargo tanks is strictly prohibited
   8. Shut down transfers during an electrical storm
   9. A flame screen is required to be in place on all open barge hatches

### 4.4.3 Drums

Prior to unloading any drums, the delivery vehicle should be ventilated for several minutes by opening the vehicle doors. The vehicle should be inspected for any evidence of drum leakage. If a leak is discovered, all personnel should evacuate the area and report the leak to the facility's emergency response team. The shipper should also be

informed of the leak.

In order to reduce the possibility of fire, drums of acrylonitrile must be grounded electrically, with a proven grounding method, while the product is being withdrawn. For unlined drums, this ground connection may be made by attaching a screw clamp to the rim of the drum and connecting this clamp to a permanent ground with No. 4 insulated copper wire. For lined drums, a grounding rod must be inserted into the drum and attached to a ground wire connection. Use only non-sparking, properly fitting wrenches to remove the bung plug. The acrylonitrile is easily removed by any convenient method such as gravity flow, or pumping in accordance with NFPA 30.

Drums should be emptied of all product and rinsed three times. The rinse water should be drained into a suitable container for proper disposal. Drums should not be reused or recycled. Once emptied, drums should be disposed of in a safe, environmentally responsible manner. Check with a local environmental regulatory agency for proper disposal. NOTE: drums containing AN should not be reused (see Section 4.).

Procedures for Handling Drums

a. General safety. Acrylonitrile arriving in drums should not be unloaded until the delivery vehicle is in its final unloading position with all appropriate braking precautions in place.

b. Inspection. Prior to unloading, the driver should inspect the drums for leakage.

c. Protection from puncture. Drums should be unloaded with the appropriate equipment and protected from potential sources of puncture. Special care should be used when loading and unloading drums. A pallet jack may be preferable to a fork lift to minimize the risk of drum puncture.
NOTE: if a drum is punctured with a fork lift, shutdown all equipment and leave the area immediately. DO NOT attempt to remove the fork lift from the drum for risk of spark/fire.

d. Transfer Procedures
(1) Tool use. Non-sparking tools should be used for opening drums containing acrylonitrile. All drums should be grounded before opening.
(2) Drum clean-up. As a minimum, empty drums should be rinsed three times with the rinse water drained into a suitable water treatment system and the empty drum disposed.

e. Drum Storage. Acrylonitrile drums must be stored away from incompatible substances (e.g. caustics, acids - see Section 2.3.4) upright with the bungs up in a cool, well ventilated area. Do not stack drums more than two high, in accordance with NFPA 30. The drum storage area should be located on a concrete pad, or other suitable impervious surface. A curb should be provided around the pad. Warehouses storing drums of acrylonitrile should be properly equipped with safety showers and eye wash stations.

If stored outdoors, the best practice is to store drums upright on pallets in a covered area.

## 5.0 Emergency Operations

### 5.1 Spill Response

In the event of a spill or release of acrylonitrile, standard response procedures should be implemented. Initial control systems should be used to stop or control the release.

The source of the release should be shut off, and containment of released material should be implemented. Personal protective equipment should be used at all times in responding to an acrylonitrile release (see Section 3.2 on PPE).

For spills of acrylonitrile, berms, dikes, trenches, or other containment devices should be employed to reduce the horizontal extent of the spill. Firefighting foam is recommended for placement on the spill to minimize volatilization, reduce personnel exposure, and prevent potential ignition.

Once contained, a spill of acrylonitrile should be picked up without delay to avoid further contamination. Non-sparking equipment and methods that prevent friction or ignition should be employed. Although it is preferable to keep the quantity of waste small by avoiding dilution, in the interest of safety is may be necessary to dilute with water or other material to reduce exposure and ignition potential. Spills and contaminated media should be assessed for compliance with solid waste rules regarding storage and disposal.

Residue that remains after cleanup of the spill can be treated with sodium metabisulfite to more quickly degrade remaining low levels of acrylonitrile. The sodium metabisulfite should be left on the residue for several days. Sodium metabisulfite should NEVER be used on pure acrylonitrile as a violent reaction and fire could result.

Spill Response/Evacuation Procedures

- Call emergency response telephone number (appropriate agencies may also need to be contacted) provided from facility, supplier, MSDS, shipping paper, or other source.
- As an immediate precautionary measure, isolate the spill or leak area for at least 50 meters (150 feet) in all directions (ERG 2008). Larger spills will likely involve the need to isolate larger areas and/or the potential for downwind evacuation.
- Evacuate non-protected and non-professional personnel from the affected area. The 2008 Emergency Response Guidebook recommends an evacuating area of at least 300 meters (1,000 ft), though this recommendation expands to 800 meters (2,600 ft; ½ mile) in all directions if fire is involved.
- Keep non-emergency response personnel away.
- Stay upwind.
- Keep personnel out of low areas, where AN may collect.

- Immediately turn off or remove all possible sources of ignition.
- Provide adequate ventilation until area is clean.
- Prevent AN from contacting peroxides, hydroperoxides, hydrogen peroxide, azo compounds and other polymerization initiators, as well as strong acids, alkalis or oxidizing agents.
- Emergency transfer of remaining AN from tank/vessel; only if it is feasible and can be done safely (see transfer procedures in Section 4.4).

## 5.2 Firefighting Safety Practices

Acrylonitrile is flammable and may easily ignite by heat, sparks or flame. Vapors can form explosive mixtures with air and travel to an ignition source and flash back. AN vapors are heavier than air and will spread along the ground and collect in low or confined areas such as sewers or basements. These vapors could present an explosion or toxicity hazard. Information about flash point and vapor pressure can be found in Section 2.2.

### 5.2.1 AN Fire Fighting Agents

For small fires, use dry chemical, carbon dioxide, water spray, or alcohol-resistant foam. For large fires, use alcohol-resistant foam, water spray, or fog. Water spray may be ineffective as an extinguishing agent, but can be used to cool containers and disperse vapors. Do not use a solid stream of water, since the stream will scatter and spread the fire. Use dikes to control fire water for later disposal.

### 5.2.2 PPE

Wear self-contained, positive pressure breathing apparatus and full firefighting protective clothing. Structural firefighter's protective clothing is recommended for fire situations only and is not effective to adequately minimize exposures in AN spill situations.

### 5.2.3 Polymerization precautions/control of acrylonitrile polymerization during fires

Acrylonitrile will spontaneously polymerize when overheated due to fire. The heat released results in a temperature rise that can lead to additional polymerization, resulting in an over-pressurization hazard. AN manufacturers add inhibitors to the commercial product to reduce the risk of self-polymerization, but this does not eliminate all possibility of polymerization. Contamination can cause material to polymerize causing a pressure buildup that may violently rupture tanks or containers. In the event material begins to polymerize, isolate the area and use water fog or spray from unmanned hose streams to control vapors. Take defensive actions only. Let the reaction run its course. Once the reaction is complete, follow normal precautions for this material.

### 5.2.4 Large fires involving trucks, rail cars, barges or storage tanks

Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. For fires involving tanks or car/trailer loads, fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. If tank, rail car, tank truck or other large quantity of material is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions and consider initial evacuation for 800 meters (1/2 mile) in all directions.

For barge fires, remove personnel and isolate barge. Excess firewater may cause barge to sink so water should be applied carefully. Foam is preferred, if available, for barge fires involving AN, though water spray can be used to suppress vapors.

For deep sea chemical tankers, ship procedures will dictate fire response procedures.

## References

API (American Petroleum Institute).

620. Standard 620. Design and Construction of Large, Welded, Low-Pressure Storage. Tanks. 11th Edition. February 2008.

650. Standardd 650. Welded Tanks for Oil Storage. 11th Edition. June 2007

653. Standard 653. Tank Inspection, Repair, Alteration, and Reconstruction. 4th Edition. April 2009

EU (European Union) 2004, Risk Assessment Report: Acrylonitrile. European Chemicals Bureau. 2004.

NFPA (National Fire Protection Association) 30: Flammable and Combustible Liquids Code. Current Edition: 2008.

NFPA (National Fire Protection Association) 70: National Electrical Code® Current Edition: 2011

Verwey. 2011. Tank Cleaning Guide. 8th (2011).

U.S EPA (Environmental Protection Agency). 2008. Interim Acute Exposure Guideline Levels (AEGL) for Acrylonitrile. December 8, 2008. (http://www.epa.gov/opptintr/aegl/pubs/rest186.htm)

## Appendix I: EMERGENCY RESPONSE, TRANSPORTATION AND OTHER REGULATORY AUTHORITIES

North America

- CHEMTREC: 800-424-9300 or http://www.chemtrec.com/Chemtrec/

Canada

- CANUTEC: 613-996-6666

United States

- National Response Center: 800-424-8802 or http://www.nrc.uscg.mil/nrchp.html
- State Emergency Response Commission (SERC): obtain individual state contacts at: http://www.epa.gov/emergencies/content/epcra/serc_contacts.htm
- Local Emergency Planning Committee (LEPC): obtain contacts at: http://yosemite.epa.gov/oswer/LEPCDb.nsf/HomePage?Openform
- Federal Emergency Management Act (FEMA) State Offices and Agencies of Emergency Management: obtain contact information at: http://home.fema.gov/about/contact/index.shtm
- National Emergency Management Association (NEMA): http://www.nemaweb.org/home.aspx

European Union

- ICE – European Emergency Response Network http://www.cefic.org/Templates/shwStory.asp?NID=492&HID=379

## Appendix II: GLOSSARY

| Term | Definition |
|---|---|
| Absorbent | A material used to cleaning up liquid spills |
| ACGIH | American Conference of Governmental Industrial Hygienists Private organization which sets exposure limits for hazardous substances |
| Acrylo | Synonym for acrylonitrile |
| Acrylon | Synonym for acrylonitrile |
| Alcohol Foam | A type of fire extinguishing agent which uses alcohol to create a foam to blanket a fire |
| American Petroleum Institute | A trade organization representing petroleum producing companies |
| Amines | Class of chemical compounds with which acrylonitrile is incompatible *(see incompatibility)* |
| Ammonia | Used in manufacture of acrylonitrile |
| Amyl nitrite | Substance used in ampules to revive persons who have fainted or become unconscious. |
| AN | Synonym and abbreviation for acrylonitrile |
| API | *See American Petroleum Institute* |
| Area Monitoring | Measurement of the concentration for a chemical or chemicals in the work place at a specific location |
| Artificial Respiration | Also cardiopulmonary resuscitation; care provided by individual to revive person's respiration when person has stopped breathing |
| Autoignition Temperature | The temperature at which a chemical will spontaneously ignite; the autoignition temperature for acrylonitrile is 900oF (or 485oC) |
| Bases | Class of chemical compounds with which acrylonitrile is incompatible *(see incompatibility)* |
| Boiling Point | The temperature at which a chemical boils; acrylonitrile boils at a temperature of 171oF (77oC) |
| Bonded | Process by which a container is electrically grounded |
| Butyl Rubber | A material used in PPE that provides limited protection against acrylonitrile |
| Carbacryl | Synonym for acrylonitrile |
| CAS | *See Chemical Abstracts Services Registry* |

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| Centrifugal Pump | A type of pump that uses centrifugal (circular) motions for transfering liquid |
| Chemical Abstracts Services Registry | System for assigning specific identification number for chemicals; the Chemical Abstracts Services Registry for acrylonitrile is 107-13-1 |
| Chemical Flashover | The rapid ignition and burning of a chemical vapor cloud; chemical flashovers produce high radiant heat over a relatively short period of time |
| Chocks | Blocks used under the wheels of a truck to help prevent its unintentional movement |
| Confidence Level | Used in describing the precision associated with a particular measurement; usually provided as a percentage, e.g., a 95% confidence level is one which 19 out of 20 measurements will produce the same result. |
| Contaminated | Items which contain residual chemical |
| Cyanoethylene | Synonym for acrylonitrile |
| Decontamination | The process of removing chemical contamination from personnel protective equipment to allow safe exit of the wearer and for putting reusable personal protective equipment back into service |
| Derailer | A device on rail car intended to protect rail cars and plant property from runaway railcars |
| Dermatitis | Inflammation of the skin such as rash which is produced by contact with chemicals or other irritants |
| Dike | A earthen or concrete barrier around a storage tank designed to hold spilled liquid |
| Dip Tube | A tube at the top of a rail car or tank truck that permits access into the container, and extends to the bottom of the container |
| Direct Measuring Devices | Equipment which can determine the concentration of a chemical or chemicals in the workplace instantaneously |
| DOT | Department of Transportation – establishes regulations regarding shipping containers (tank trucks, rail cars, etc.) and other aspects of AN transport. |
| Dry Sweeping | The use of a broom or compressed air to remove liquid or dirt from a floor surface |
| Engineering Controls | Changes in a process or equipment which minimize hazards to employees |

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| Extinguishing Agent | Substance used to put out fires; water, foam, and carbon dioxide are examples of extinguishing agents |
| Eyewash Fountain | Emergency equipment designed to wash chemicals or other debris from a worker's eyes |
| Face and Eyewear | Items of personal protective equipment designed and configured to provide protection to the wearer's face and eyes from different hazards; face and eyewear include safety glasses, goggles, and faceshields |
| Facepiece | A tight fitting enclosure forming part of the respirator which fits around the breathing zone of the wearer; includes quarter, half, and full facepieces |
| Flammability Range | The range of a chemical concentration in air that will ignite in the presence of an ignition source |
| Flammable Liquid | U.S. Department of Transportation classification for acrylonitrile |
| Flash Cover | An accessory garment worn over chemical protective clothing to allow the wearer to safely escape chemical flashover situation |
| Flash Point | The temperature at which a chemical will give off sufficient vapors to ignite if a source of ignition is present; the flash point for acrylonitrile is 30oF (-1oC) |
| Freezing Point | The temperature at which a chemical freezes; acrylonitrile freezes at a temperature of -118oF (-84oC) |
| Full Body Garments | Protective clothing that covers the wearer's body, including at least the torso, arms, legs, and head (when a hood is attached) |
| Fumigrian | Synonym for acrylonitrile |
| Garlock | An asbestos material used in gaskets in chemical process piping which is relatively inert to chemical attack and stable at high temperatures |
| Gravity Discharge | A method of releasing liquid from a storage tank or vessel using gravity of the means for its release |
| Grounded cable | A wire used to connect the transfer vessel (i.e., tank truck or rail car) to ground for preventing the initiation of a spark |

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| Hand Brakes | Special brakes used to prevent the unintentional movement of a rail car |
| Hydrogen Cyanide | Toxic gas evolved from burning acrylonitrile |
| Hydrostatic Pressure Testing | The use of liquid (usually water) under pressure to test the integrity (or leak-tightness) of a vessel or container designed to hold pressure |
| IARC | *See International Agency for Research on Cancer* |
| Incineration | The destruction of chemical at a high temperature such as in a thermal oxidizer or flare |
| Ingestion | Route of chemical exposure; process by which a person eats or drinks foods or liquids contaminated with chemical |
| Inhalation | Route of chemical exposure; process by which a person breathes in contaminated air or chemical vapors |
| Inhibition | Process by which a substance is added to a chemical to keep it from polymerizing *(see polymerization)* |
| International Agency for Research on Cancer | An international organization which studies cancer-causing compounds and prepares guidelines on the classification of specific substances |
| Intrinsically Safe | Devices which are safe to use in flammable or hazardous environments in that they have been determined not to produce sparks or open flame capable of igniting a flammable environment |
| Material Safety Data Sheet | Comprehensive summary of chemical/physical property data, hazards, and safety information for a specific chemical prepared by the manufacturer |
| Maximum Allowable Work Pressure | The highest pressure that a hose can be subjected to during use |
| Medical Surveillance | The practice of conducting regular medical examinations with the specific focus on symptoms or effects caused by exposure to chemicals |
| Methylethyl-hydroquinone | Chemical used for the inhibition of acrylonitrile |
| Molecular Weight | Sum of atomic weights for a molecule; related to size of molecule; the molecular weight for acrylonitrile is 53. |
| MSDS | *See Material Safety Data Sheet* |
| National Fire Protection Association | Private organization that writes standards related to fire protection and chemical safety; provides rating system for chemical health, flammability, and reactivity hazards |

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| National Institute for Occupational Safety and Health | Organization within the U.S. government which certifies and approves respirators |
| National Response Center | An organization to which spills are reported within the United States |
| Neoprene | A material used in PPE that provides limited dermal protection against acrylonitrile |
| NFPA | *See National Fire Protection Association* |
| NIOSH | *See National Institute for Occupational Safety and Health* |
| Nitrogen Blanketing | The displacement of oxygen in the space above liquid in a storage tank or vessel with nitrogen to reduce the possibility of a flammable vapor being formed |
| NRC | *See National Response Center* |
| Occupational Safety and Health Administration | *OSHA.* Organization within U.S. government responsible for safety regulations; OSHA 29 CFR 1910.1045 applies to acrylonitrile |
| Odor Threshold Level | The concentration at which an individual can detect a chemical by smelling it |
| OSHA | *See Occupational Safety and Health Administration* |
| Oxides of Nitrogen | Toxic gas evolved from burning acrylonitrile |
| Oxidizers | Class of chemical compounds with which acrylonitrile is incompatible *(see incompatibility)* |
| Parts Per Million | Measure of concentration of a chemical in air |
| PEL | *See Permissible Exposure Limit* |
| Permissible Exposure Limit | *PEL.* Maximum average concentration of a chemical in air set by OSHA to which a worker may be exposed during an8 hour workday (i.e. 8-hr time-weighted average (TWA). The PEL for acrylonitrile is currently 2 ppm (8hr TWA) based on OSHA regulation 29 CFR 1910.1045. |
| Personal Monitoring | The use of a device on a worker which is able to record or measure the concentration of a chemical or chemicals in the work place |
| Personal Protective Equipment | *PPE.* Items of clothing and equipment used to protect individuals from chemicals and other hazards |
| Placard | A label that is affixed to cargo tanks with warnings and identifying information |
| Poison | U.S. Department of Transportation classification for acrylonitrile |
| Polymerization | Process by which chemical reacts with itself to form long |

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| | chain molecules (polymers) |
| Polyvinyl Chloride | A material used in the construction of protective clothing and equipment which offers limited protection against acrylonitrile |
| Positive Pressure | Referring to a respirator in which the pressure inside the facepiece is kept positive at all time by action of the regulator |
| PPE | *See Personal Protection Equipment* |
| ppm | *See Parts Per Million* |
| Propenenitrile | Synonym for acrylonitrile |
| Propylene | Used in manufacture of acrylonitrile |
| Protective Clothing | Items of apparel designed and configured to provide protection to the wearer's skin from chemical and other hazards; protective clothing includes gloves, footwear, partial body garments, and full body garments |
| Protective Footwear | Protective clothing designed and configured to protect the wearer's feet and ankles |
| Protective Gloves | Protective clothing designed and configured to protect the wearer's hands and wrists |
| PVC | *See Polyvinyl Chloride* |
| Reactivity | Measure of how a chemical will react with itself or other substances |
| Reportable Quantity | The amount of spilled chemical, which by law, must be reported to the appropriate federal, state, or local agency |
| Respirators | Items of personal protective equipment designed and configured to provide protection to wearer's respiratory system from chemical inhalation hazards; may also provide protection from physical hazards |
| Safety Shower | An emergency device used to wash chemical spills off of workers' bodies |
| SCBA | *See Self-Contained Breathing Apparatus* |
| Scrubbing System | A system that is used to remove chemical from an air stream through absorption in a circulating liquid or adsorption onto a solid |

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| Self-Contained Breathing Apparatus | *SCBA.* A respirators in which the wearer has a portable supply of breathable air connected to a facepiece or loose fitting enclosure around the wearer's breathing zone |
| Self-Priming Pump | A pump that does not require to be pressurized with the transfer liquid before use |
| Skin Absorption | Route of chemical exposure; process by which a person has skin contact with a chemical (either as liquid or vapor) |
| Sodium Metabisulfite | A chemical compound used to neutralize chemical spills of acrylonitrile |
| Solubility | Indication of how well one chemical mixes with another; acrylonitrile readily mixes in all common organic solvents, but only partially mixes with water |
| Specific Gravity | Ratio of density of liquid to density of water; acrylonitrile has a specific gravity of 0.81 |
| Splash Suit | Type of full body protective garment which is two or more pieces and designed to protect the wearer's torso, arms, and legs |
| Substituted Allyl Nitrile | Chemical classification of acrylonitrile |
| Threshold Limit Value | Maximum average concentration of a chemical in air to which a worker may be exposed during an 8 hour workday set by ACGIH |
| TLV | *See Threshold Limit Value* |
| UN ID No. | *See United National Identification Number* |
| United National Identification Number | International number used for identifying specific chemicals; the United National Identification Number for acrylonitrile is 1093 |
| Vapor Control System | A system designed to limit the release of vapors into the atmosphere |
| Vapor Density | Ratio of chemical vapor density to air at a given temperature; acrylonitrile is heavier than air |
| Vapor Pressure | The pressure exerted by vapors coming off a liquid; indicates how easily a chemical creates vapors at a specific temperature; the vapor pressure for acrylonitrile at room temperature is 83 mm Hg |
| Ventilation | The practice of providing additional air flow in a work area to prevent the build-up of chemical vapors |
| Ventox | Synonym for acrylonitrile |

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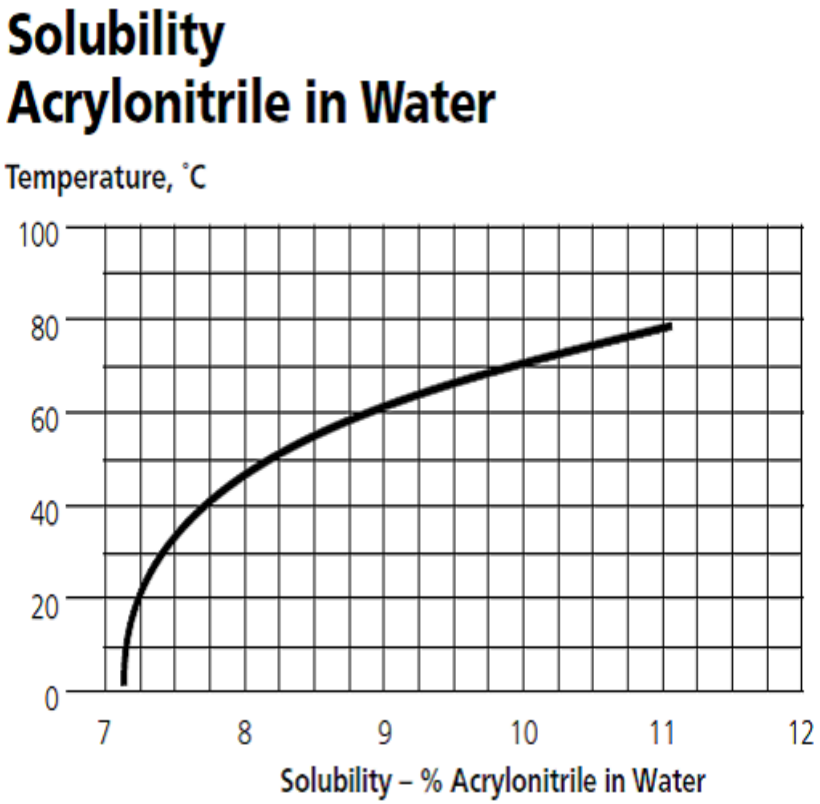
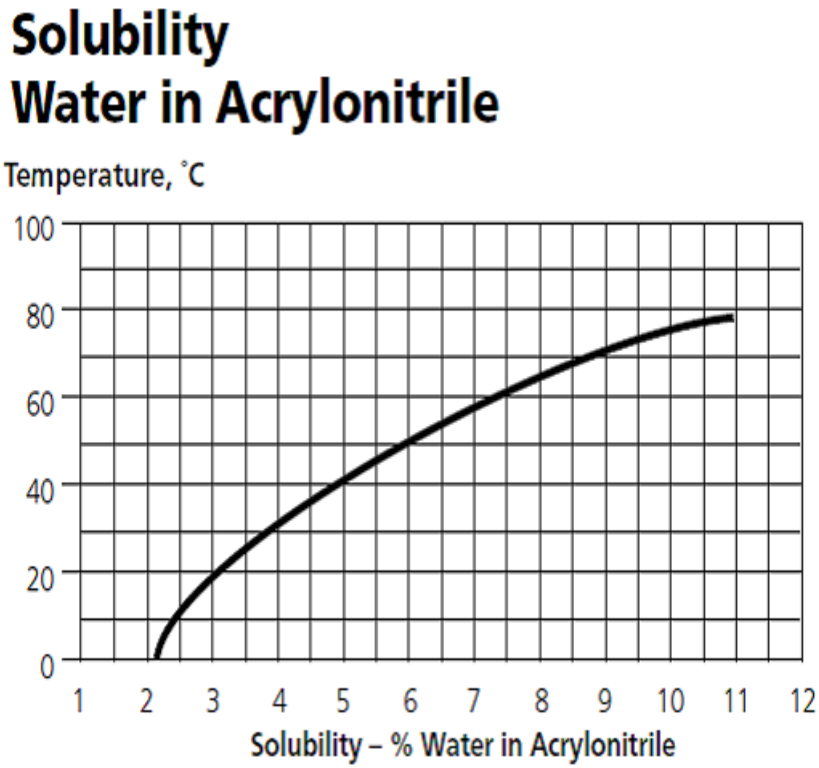
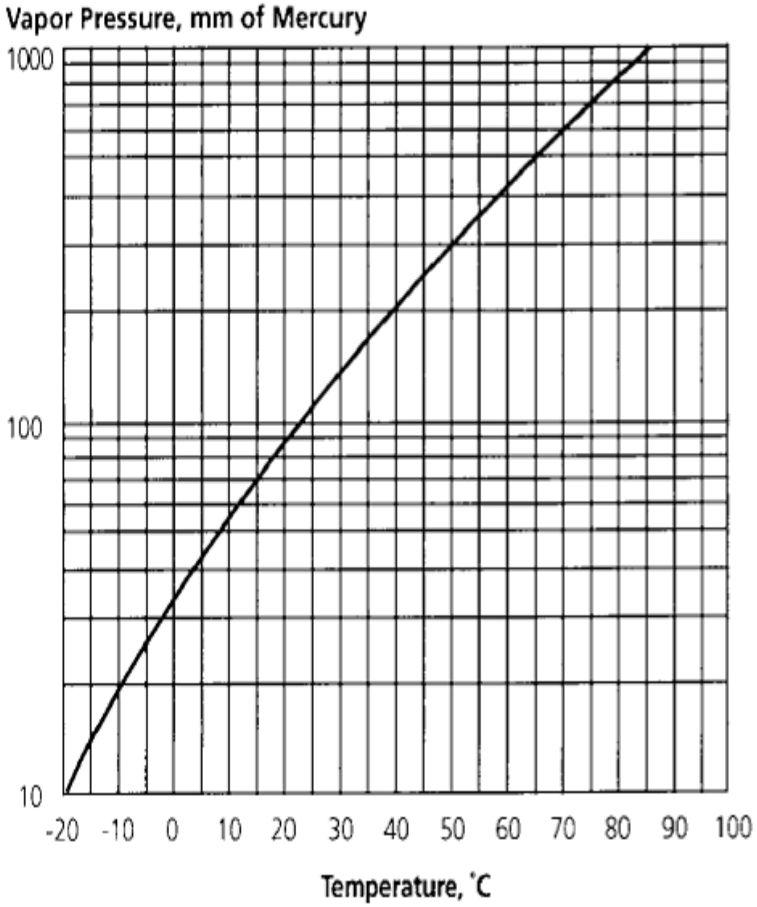
| Vinyl cyanide | Synonym for acrylonitrile |
| Water Fog | In extinguishing fires, the use of a fine water spray to dilute and raise the flash point of the mixture and to cool adjacent containers and equipment |

**Appendix III: SELECT PHYSICAL PROPERTIES OF ACRYLONITRILE**

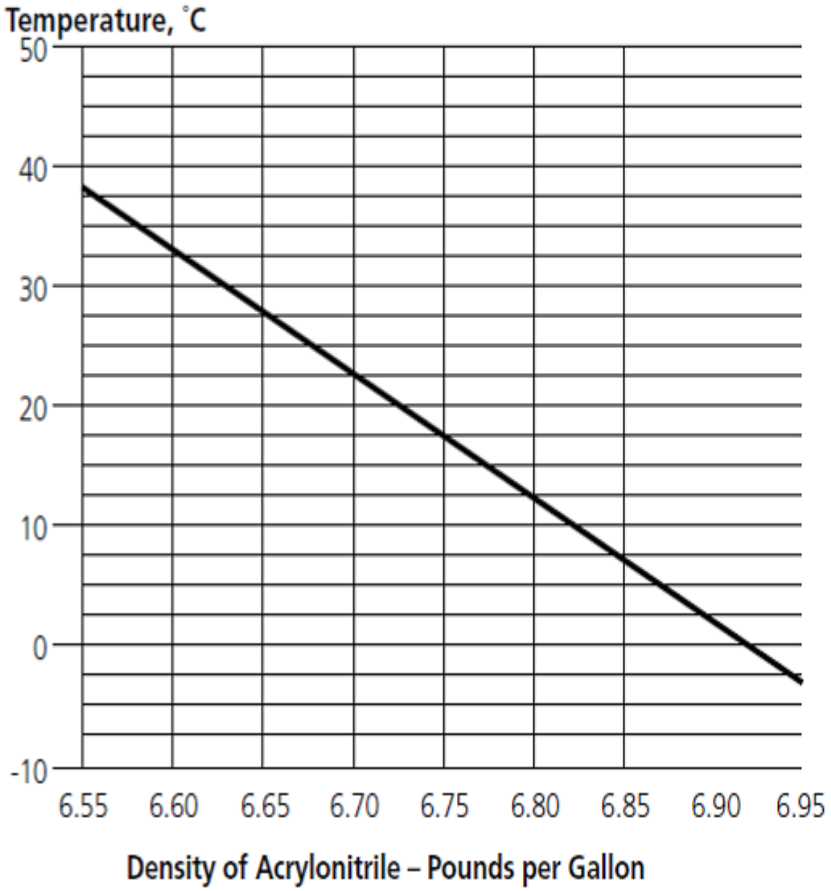


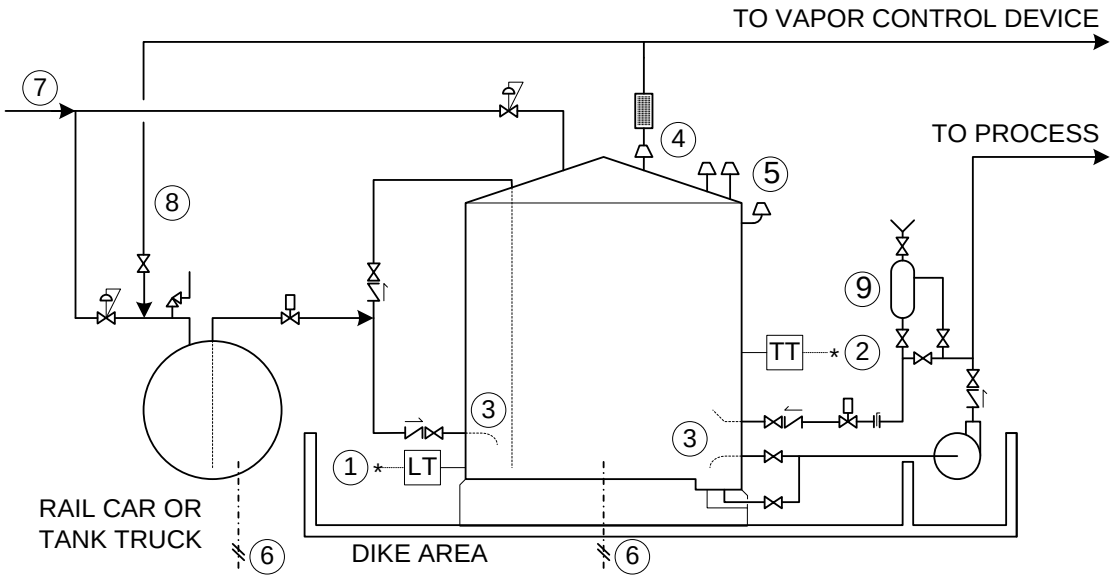
## Vapor Pressure




## Density of Acrylonitrile



## Appendix IV: DIAGRAM OF TYPICAL STORAGE TANK AND UNLOADING SYSTEM




1. Level transmitter(s) providing level indication in control room. High level alarm(s) and automated shutoff(s) of liquid feeds to prevent overfilling tank. Low level alarm(s) and automated shutoff(s) of liquid flow to internal mixing nozzle to prevent generation of static electricity due to spray above liquid surface. Separate transmitters may be required for level control and safety shutoff(s).

2. Temperature transmitter at bottom of tank providing temperature indication and high temperature alarm(s) in control room. Multiple measurements at different tank elevations may be needed for large tanks.

3. Typical options for liquid feeds with internal dip tubes and mixing nozzles.

4. Pressure control device and detonation arrestor in vent to control device.

5. Emergency vent(s), vacuum vent with flame arrestor, and overflow vent.

6. Grounding systems.

7. Dry nitrogen (preferred) or dry air supply for maintaining positive pressure in head space of tank.

8. Vapor return line from tank to shipping container.

9. Inhibitor addition tank.

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