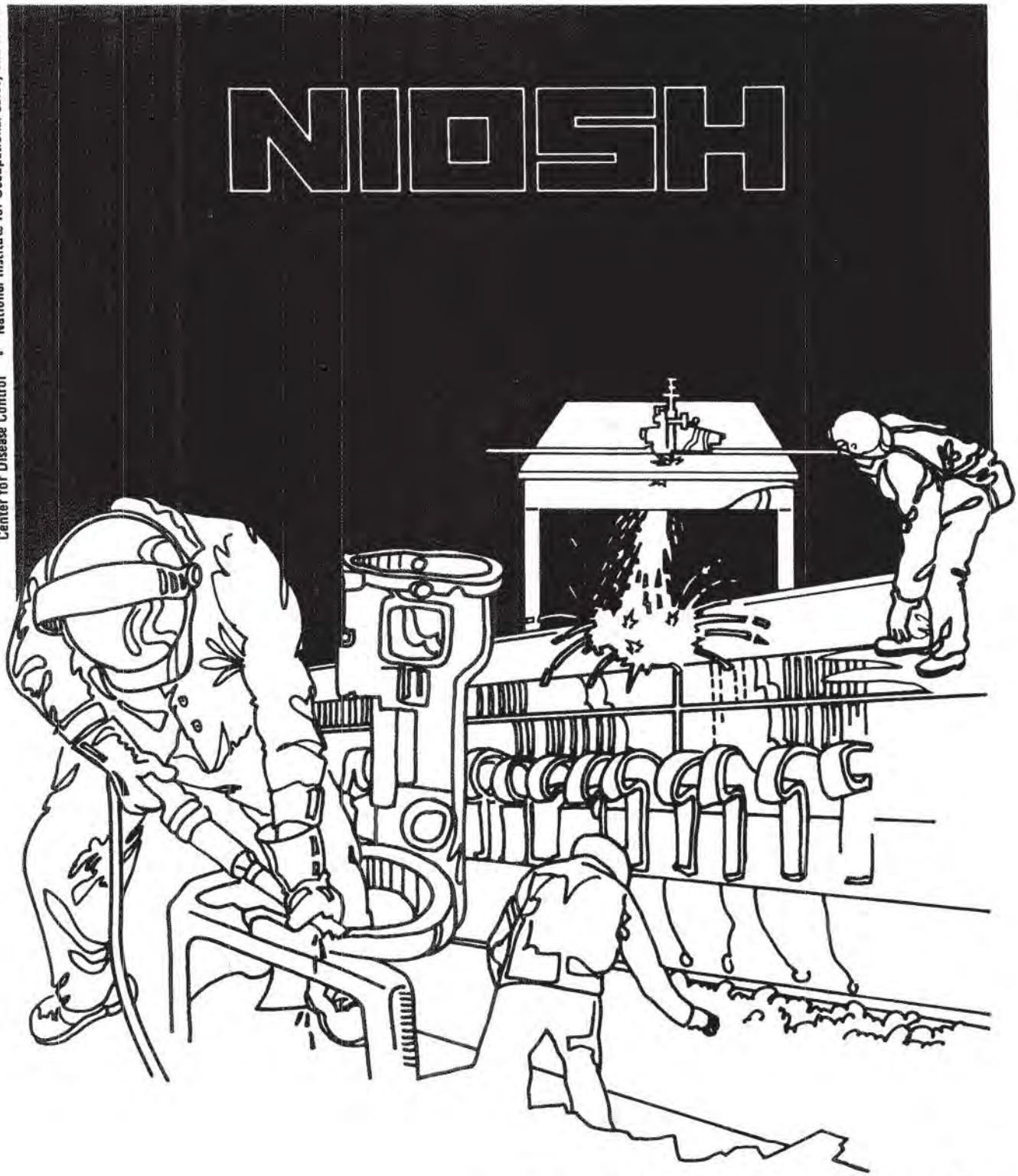
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service
Center for Disease Control • National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

80–159–752

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 699(a)(6), which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HE 80-159-752
October 1980
MOUNTAIN BELL
DENVER, COLORADO

NIOSH INVESTIGATORS:
Paul Pryor, IH

I. SUMMARY

In May 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from an employer representative to evaluate the potential exposure to ammonia at Central Staff Communications Laboratory (COM-LAB), Mountain Bell, Denver, Colorado. The ammonia (anhydrous) is used in duplicating machines and approximately 30 employees work in this area.

During August 1980 personal and area time-weighted average (TWA) exposures to ammonia were determined at various duplicating operations in the COM-LAB department.

Mountain Bell recently installed new exhaust ventilation systems in this department and this was evaluated to determine the systems' ability to remove the contaminant from the areas in question. Both personal and area samples were well below (1.0 - 5.5 parts per million - ppm) the NIOSH and OSHA evaluation criteria of 50 parts per million for ammonia.

On the basis of the data obtained in this evaluation, NIOSH determined that exposures to the duplicating operators, as well as the other employees in this department, were below applicable exposure criteria for ammonia. It was also determined that the exhaust ventilation systems in each of the areas evaluated were operating effectively. Finally, the safety and health procedures program developed by Mountain Bell is very complete and should provide adequate information to safeguard the health of those employees who work in this department against potential ammonia exposures.

KEYWORDS: SIC 7330 (Duplicating), duplicating machines, microfilm, microfiche, ammonia.

II. INTRODUCTION

In May 1980 NIOSH received a request pursuant to Section 20(a)(6) of the Occupational Safety and Health Act of 1970 from a representative of Mountain Bell, Denver, Colorado. The request was to evaluate the potential health hazard from exposure to ammonia from duplicating operations in a lab where microfilm and microfiche duplicating occurs. An environmental survey was conducted on August 18, 1980, to evaluate exposures to ammonia; also, a review of the exhaust ventilation systems and Mountain Bell's safety and health procedures for handling ammonia exposures was evaluated.

III. BACKGROUND

The Central Staff COM-LAB is responsible for producing all the microfilm and microfiche materials used for the telephone directory and hard copy reference data for the Colorado and Wyoming Mountain Bell systems. The lab has approximately 30 employees who work different shifts over a 24 hour period. The work shifts are from 7:45 a.m. - 4:30 p.m., 4:15 p.m. - 12:15 a.m., and 12:00 Midnight - 8:00 a.m., and normally there are 10 employees working per shift.

There are three different models of duplicators used in this department, and each uses ammonia in the duplicating process. There is one 16 mm duplicator, two 35 mm duplicators, and nine fiche type duplicators. The 16 mm duplicator uses a liquid ammonia which comes in gallon size plastic containers. The ammonia is automatically fed into the process and this machine is used from one to two times per week for approximately two to three hours per operation. The gallon of ammonia in the 16 mm duplicator is replaced about every two months.

The two 35 mm duplicators use two pound ammonia cylinders for these machines and are considered to be a closed system. That is, the only potential exposure to the operator is during the changing of the cylinder or if there is a leak in the system. Both the 16 and 35 mm machines have recirculating exhaust systems which use absorber type units to remove the ammonia contaminants. The absorbers are maintained approximately every two months and this maintenance takes about 10-15 minutes to perform.

The ammonia used for the nine fiche duplicators is supplied to the individual units via pipes which run to 150 pound ammonia cylinders. These cylinders are in a special room located away from the employees which is designed to reduce exposures if a leak should occur.

The nine fiche-type duplicators were each recently fitted with two exhaust ventilation ducts which connect directly into the back of the machine. The flow rates for the exhaust ducts ranged from 1000-1500 feet per minute (fpm) which is more than sufficient, and thus, should provide adequate exhaust for each machine.

Therefore, the only potential direct exposure to an employee from ammonia, based on NIOSH's evaluation, would be changing the tanks or absorbers. Otherwise, the operators who work in this department have no other contact with ammonia, i.e., their daily activities do not require them to interact with the ammonia in any of the operations that were evaluated.

During the evaluation NIOSH was asked to review Mountain Bell's safety and health procedures for the employees who work in the Central Staff COM-LAB (refer to Appendix I). The following is a brief outline of the information discussed in Appendix I.

A. Anhydrous Ammonia-Safe Handling Procedures

1. Hazards
   - 1.1 Health Hazards
   - 1.1.1 Warning Properties
   - 1.2 Fire and Explosion Hazards

2. Engineering Control of Hazards
   - 2.1 Building Design
   - 2.2 Equipment Design
   - 2.3 Material of Design
   - 2.4 Ventilation
   - 2.5 Electrical Equipment

3. Employee Safety
   - 3.1 Employee Education and Training
   - 3.2 Personal Protective Equipment

4. Fire Protection

5. Handling and Storage
   - 5.1 General
   - 5.2 Cylinders
   - 5.3 Storage

6. Waste Disposal

7. Medical Management

8. First Aid

9. Safety

Additional Information Specific to the COM-LAB

A. General Effects of Ammonia (Toxicology and Personal Protection)

1. Physiological reactions to eyes, nose, throat, and lungs

2. Effects on the upper respiratory tract

3. Irritating symptoms to eyes

4. Effects of skin absorption

5. Reactions to respiratory tract and heart

6. Maintenance of machines and equipment

7-8. Personal protection

B. Use of Ammonia

1. 16 mm dulicator

2. 35 mm duplicators

3. Fiche duplicators

C. Use of Respirators

D. Emergency Shut-Offs for Ammonia Cylinders

The safety and health information presented in detail in Appendix I is given to new employees and is required to be reviewed annually by all the employees who work in this department.

IV. ENVIRONMENTAL DESIGN AND METHODS

Four ammonia breathing zone and six general room air samples were collected on long-term sampling tubes at a flow rate of 20 cubic centimeters (cc) per minute with vacuum pumps. The ammonia indication is based on the color reaction (in micro liters - μl) of ammonia present in the environment with bromophenol blue and acid in the long term detector tube. The following is the calculation used to determine the amount of ammonia present in ppm:

$$\text{ppm } NH_3 = \frac{\text{Indication in } \mu\text{l } NH_3}{\text{Air volume through tube in liters}}$$

V. EVALUATION CRITERIA

A. Environmental

Two sources of criteria were used to assess the workroom concentrations: (1) NIOSH criteria for recommended standards, and (2) Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910), January 1979. These standards are established at levels designed to protect individuals occupationally exposed to toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

Substance	Permissible Exposure Limits 8-Hour Time-Weighted Average
Ammonia.....	50 ppm (NIOSH and OSHA)

ppm - parts of substance per million parts of air.

B. Toxicological

Ammonia -- Ammonia is an eye, nose, and throat irritant, and if ingested ammonia can cause dyspnea (shortness of breath), bronchial spasm, chest pain, pulmonary edema, and a pink frothy sputum. Skin contact can produce burns and vesiculations (blisters).

VI. ENVIRONMENTAL RESULTS

A total of four personal (breathing zone) and six area samples were taken during the sampling period. Each of the personal samples was well below the evaluation criteria of 50 ppm (refer to Table 1). All the area samples taken found less than a tenth of the standard.

Each of the exhaust ventilation systems on the fiche duplicators was operating above (1000-1500 fpm) the 100 fpm required to exhaust ammonia contaminants at the source, i.e., internal dust measurements.

VII. DISCUSSIONS AND RESULTS

During this evaluation it was determined that no health hazard existed to those employees who perform duplicating operations in the COM-LAB at Mountain Bell. This conclusion is based on the air samples taken, evaluation of the work processes and exhaust ventilation systems, as well as a review of the toxicological information. NIOSH also determined that the present safety and health procedures written up by the company are an accurate description of the issues that should be addressed in a training manual on educating the worker about ammonia.

VIII. RECOMMENDATIONS

In view of the findings of NIOSH's environmental study, as well as personal communications with the COM-LAB supervisors and staff, the only recommendation that can be made at this time is that the existing concern, as outlined in the health and safety manual on ammonia, should be maintained and altered only as deemed necessary. That is, as processes change in the COM-LAB the engineering controls and personal protection, as outlined in the health procedures manual, should change according to the needs and safety concerns of the employees in this department. Also, the annual review of this program should be continued.

IX. REFERENCES

1. Industrial Hygiene and Toxicology, second edition, Frank Patty (editor), Interscience Publishers, 1967, Vol. II.

2. Industrial Toxicology, third edition, Hamilton and Hardy, Publishing Service Group, Inc., 1974.

3. "Threshold Limit Values for Chemical Substances in Workman Air", American Conference of Governmental Industrial Hygienists, (1979).

4. Encyclopedia of Occupational Health and Safety, International Labor Office, McGraw-Hill Book Company, New York.

5. Industrial Ventilation, A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists, 14th edition (1976).

6. U.S. Department of Health, Education, and Welfare. Occupational Diseases, A Guide to Their Recognition, Public Health Service Publication (NIOSH) No. 77-181.

X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:	Paul Pryor, M.S. Regional Industrial Hygienist NIOSH - Region VIII Denver, Colorado
Originating Office:	Hazard Evaluations and Technical Assistance Branch (HETAB) Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) NIOSH - Cincinnati, Ohio
Report Typed By:	Marilyn K. Schulenberg NIOSH - Region VIII Denver, Colorado

XI. DISTRIBUTION AND AVAILABILITY

Copies of this determination report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Mountain Bell.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado Department of Health.
5. State Designated Agency.

For the purpose of informing the 30 affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1

BREATHING ZONE AND GENERAL ROOM AREA SAMPLING
FOR AMMONIA

Mountain Bell
Denver, Colorado

August 28, 1980

Job/Area Description	Sample Number	Type Sample	Sampling Time (minutes)	Ammonia (ppm)
GAF Operator	1	BZ	240	5.5
GAF Room	2	GR	240	2.5
Microfiche Machine - L	3	GR	240	1.0
Microfiche Machine - F	4	GR	240	3.0
Microfiche Machine - G	5	GR	240	3.0
Computer Attendant	6	BZ	120	1.0
Microfiche Machine - H	7	GR	120	1.0
Microfiche Operator	8	BZ	120	1.0
K and E Room	9	GR	120	1.0
K and E Operator	10	BZ	120	2.0
EVALUATION CRITERIA				50 ppm

ppm = parts of contaminant per million parts of air
BZ = breathing zone sample
GR = general room sample

ANHYDROUS AMMONIA
SAFE HANDLING

The following material is copied, by permission, from chemical safety data sheet SD-8 entitled "Properties and essential information for safe handling and use of Anhydrous Ammonia", as revised in 1960, and as published under copyright by Manufacturing Chemists' Association, Inc., 1825 Connecticut Avenue, N.W. Washington 9, D.C. Information has been copied, by permission, from pamphlet G-2 entitled "Anhydrous Ammonia", fifth edition: 1962 as published and copyrighted by Compressed Gas Association, Inc., 500 Fifth Avenue, New York, New York 15036.

1. HAZARDS

1.1 Health Hazards

Anhydrous Ammonia either as liquid or vapor is a strong skin, eye and respiratory tract irritant. Direct exposure by contact can cause severe burns.

1.1.1 Warning Properties

Ammonia has a penetrating, intensely pungent, suffocating odor, and is strongly irritant, so that there is little likelihood that anyone will voluntarily remain in a seriously contaminated atmosphere.

1.2 Fire and Explosion Hazards

Ammonia is capable of forming flammable mixtures with air within certain limits (16 to 25% by volume).

The presence of oil, or a mixture of ammonia with other combustible materials, will increase the fire hazard.

The explosive range of ammonia is broadened by a mixture of oxygen replacing air, and by temperature and pressure higher than atmospheric. Contact of ammonia with certain other chemicals, including Mercury, Chlorine, Iodine, Bromide, Calcium, Silver Oxide, or Hypochlorite can form explosive compounds. Mercury instruments employed in Anhydrous Ammonia service should never be connected in such a manner as to permit contact of the mercury with liquid or gaseous Anhydrous Ammonia.

2. ENGINEERING CONTROL OF HAZARDS

2.1 Building Design

Where bulk quantities of Anhydrous Ammonia are stored or handled in buildings, such areas must be cut off from other occupancies and the building protected with automatic sprinklers, vapor tight electrical equipment, effective ventilation, and good floor drainage.

2.1 Building Design Continued

Pressure relief valves are required on storage tanks and may be arranged on a 3-way valve so that one is always open to the tank. Valves should discharge to a safe location outside the building.

Ammonia tanks inside buildings should not be located in the vicinity of tanks containing flammable liquids.

Areas in which ammonia hazards exist should have an adequate number of well-marked exits through which personnel can escape quickly in case of emergency. Doors should be provided with panic bars. They should open outwards and lead to outside galleries or platforms, fire escapes, or other unobstructed passageways.

2.2 Equipment Design

2.2.1 Special Equipment and Design

The design of Anhydrous Ammonia piping and equipment is highly specialized because of the properties of the material. The technical problems of designing equipment, providing adequate ventilation and formulating operating procedures which insure maximum security and economy, can be handled best by experienced engineers and safety and fire protection specialists.

2.2.2

Piping should be installed so as to avoid any possibility of trapping liquid Anhydrous Ammonia between closed valves, unless the section is protected by pressure relief or liquid expansion device.

2.2.3 Totally Enclosed Systems

Totally enclosed systems are preferable for processes using Anhydrous Ammonia as a component. Opening equipment during the operation for addition or removal of materials should be avoided.

2.2.4 Open Containers

High concentrations of Hazardous vapors may be discharged from open or partially closed containers. Open equipment should be avoided.

2.3 Material of Design

Most common metals are not affected by Anhydrous Ammonia; however, when mixed with very little water or water vapor, both gaseous and liquid ammonia will attack vigorously, Copper, Silver, Zinc and all of their alloys. Iron or Steel will not react readily with either dry or moist ammonia and are normally used for pipes and fittings.

2.4 Ventilation

It is of primary importance that adequate ventilation be provided and maintained to keep the concentration of ammonia gas below 100 ppm by volume in air. Higher concentrations are dangerous for the unprotected worker.

Although special ventilating systems will not be found necessary in most processes, rooms into which ammonia might escape should have ventilating ducts leading to the outside, so that escaping gas will not contaminate adjoining areas or bar the escape of persons who may be working in them.

Ducts should be located at ceiling level and lead upwards.

Local exhaust ventilation is essential also in rooms or areas where ammonia is handled to prevent excessive concentration of ammonia in air and to avoid accumulation of flammable mixtures. If mechanical ventilation is used, spark-proof fans are desirable and electrical equipment should meet national electrical code requirements for hazardous locations.

2.5 Electrical Equipment

Lighting fixture and electrical equipment should be vapor proof, grounded, and should meet national electrical code and local requirements.

3. EMPLOYEE SAFETY

3.1 Employee Education and Training

Safety in handling ammonia depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision and the use of safe equipment.

The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervision. Workers should be thoroughly informed of the hazards that may result from improper handling of ammonia. Each employee should be fully informed as to what to do in an emergency.

In addition to the above, employee education and training should include the following:

(A) Instruction and periodic drill or quiz regarding the locations, purpose and use of respiratory protective devices and other personal protective equipment.

(B) Instruction and periodic drill or quiz regarding the locations of safety showers, eye baths, bubbler drinking fountains, or the closest source of water for use in emergencies.

(C) Instructions to avoid all unnecessary inhalation of vapors of ammonia and all direct contact with the liquid.

3.1 Employee Education and Training Continued

(D) Instruction and periodic drill or quiz regardi g the location, purpose and use of emergency fire fighting equipment.

(E) Instructions to report to the proper authority all equipment failures and/or any unusual odor of ammonia.

3.2 Personal Protective Equipment

3.2.1 Availability and Use

While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation and intelligent conduct on the part of employees working with ammonia, it is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area may be exposed to danger.

The correct usage of personal protective equipment requires the education of the worker in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazard.

3.2.2 Eye Protection

Gas-tight chemical goggles or full length protection should be worn when handling ammonia where leaks or spills may occur.

Water wash and water sprays should be available in areas where ammonia leaks, spills or splashes may be encountered.

3.2.3 Respiratory Protection

Severe exposure to ammonia may occur in tanks during equipment cleaning and repairs, when decontaminating areas following spills, or in case of failure of piping or equipment. Employees who may be subject to such exposures should be provided with proper respiratory protection and trained in its use and care. Available types are described below.

Note: Respiratory protective equipment must be carefully maintained, inspected, cleaned and sterilized at regular intervals, and always before and after use by another person.

5.2 Handling - General Continued

In handling or operating any type of ammoni system, always be sure that all valve connections and pipe lines are in proper order and condition before starting the operation. Keep compressors and motors clean and in good repair.

During cold weather keep all steam traps warm whether or not tanks are in service.

Never, under any circumstances, close all valves on a full line of liquid ammonia unless protected by pressure relief or liquid expansion device.

5.3 Cylinders

(A) Handling

Anhydrous Ammonia cylinders are of two types: The tube (horizontal) and the bottle (vertical).

Cylinders should never be subjected to rough handling or to abnormal mechnical shock such as dropping or bumping.

Do not use rope slings for unloading. When handling by crane or derrick, a suitable platform, cradle or boat should be used. Do not use hooks, tongs, or similar fastening devices.

Do not use electric magnets for unloading or handling.

Avoid dragging or sliding cylinders. It is safer to move the bottle type cylinders even short distances by using a suitable trunk rather than by tilting or rolling them on their bottom edges.

Use a rack or chain to hold cylinders in place when hooked up for discharging.

Do not place or handle cylinders where they might form part of an electrical circuit. Contact with third rails or trolley wires must be avoided.

Do not remove valve protection until ready to withdraw ammonia from the cylinder.

Do not tamper with numbers, markings, or test dates stamped into cylinders.

Cylinders for ammonia or any other compressed gas, whether full or empty, should never be used as rollers for moving heavy or bulky articles.

(B) Emptying

The tube type cylinder is normally used in the horizontal position. Two general types of valves are supplied. Depending on which type is involved, either the valve outlet or the valve stem is at an angle with the longitudinal axis of the cylinder. It is the position of this valve outlet or stem which determines whether liquid or gaseous ammonia will be discharged from the cylinder. When the valve outlet or stem is on top, the dip pipe on the inside of the cylinder is under the liquid, and therefore liquid anhydrous ammonia will be discharged. To discharges gaseous ammonia, the cylinder is turned so that the valve outlet or stem points downward. Follow instructions of ammonia manufacturer involved.

The Bottle Type, or Verticle Cylinder, will discharge ammonia as a gas when placed in an upright or vertical position. Due to liquid ammonia expansion, a bottle type cylinder may, under certain elevated temperature conditions, discharge a small amount of liquid when the valve is opened, and it is recommended that bottle type cylinders be allowed to reach room temperature before the valve is opened. To discharge liquid Anhydrous Ammonia, this type of cylinder must be placed in a horizontal position with the valve outlet pointed up.

The rate at which gaseous ammonia can be discharged from either type cylinder depends upon the temperature of the surrounding atmosphere and the surface area of the liquid ammonia.

Safety relief devices are not mandatory on ammonia cylinders of less than 165 pounds capacity. Do not heat an ammonia cylinder.

When the cylinder is empty, disconnect it, insert the valve plug and replace the cylinder protective cap.

If a bottle type cylinder has become frozen down during discharge, never use a pry under the valve end to loosen the cylinder. Use water to loosen the cylinder or wait for it to thaw out.

Store empty cylinders separate from filled cylinders and fasten an empty tag of cylinders immediately upon emptying. Close valve, replace plug or nut on valve outlet, and secure valve protecting cap snugly.

5.6 Storage

5.6.1 Indoor Storage

If Anhydrous Ammonia must be stored inside, store in a fire resistant structure, away from steam pipes and heating devices. Storage should be dry and cool. Avoid mechanical damage or overheating of storage tanks and cylinders.

5.6.1 Indoor Storage Continued

Ventilation should be provided through the structure in such a manner that full advantage of natural ventilation may be obtained. If natural ventilation is not sufficient, then storage area should be equipped with suitable type of mechanical ventilation.

Caution: Avoid pocketin of ammonia gas under floors, roofs, and similar structures.

Locations used for inside storage of Anhydrous Ammonia must be cut off from other occupancies and the building protected with automatic sprinklers, vapor tight electrical equipment, good natural ventilation, good floor drainage and adequate explosion venting.

5.6.2 Outdoor Storage

Outside storage tanks may be located at least 50 feet from buildings or adjacent to blank masonry building walls. The location should be away from any flammable liquid storage.

6. WASTE DISPOSAL

Waste disposal of ammonia and materials containing ammonia depends to a great extent upon local conditions. Be sure that all federal, state, and local regulations regarding health and polution are followed. The supplier will be able to furnish good advice.

If not prohibited, waste may be disposed of by diluting with large quantities of water and washing into sewers.

7. MEDICAL MANAGEMENT

7.1 Health Hazards

7.1.1 General

Anhydrous Ammonia is a strongly irritant chemical for the skin, eyes and respiratory tract. The liquid produces severe burns. The gas has a characteristic sharp penetrating odor. In sufficient concentrations it produces painful irritation.

Because of the unpleasant odor and prompt irritation, it is unlikely that anyone would voluntarily remain in an atmosphere seriously contaminated with ammonia. However, serious injury may result if escape is not possible.

7.1.2 Acute Toxicity

7.1.2.1 Systemic Effects

Ammonia is not a systemic poision.

7.1.2.2 Local Effects

Inhalation of high concentrations produces violent coughing due to its local action on the respiratory tract. If rapid escape is not possible, severe lung irritation, pulmonary edema and death can result. Lower concentrations cause eye irritation, laryngitis and bronchitis. See Table 1 for effects of various concentrations of gas in air.

Swallowing of the liquid results in severe corrosive action on the mouth, throat and stomach.

Exposure to high gas concentrations may cause temporary blindness and severe eye damage. Direct contact of the eyes with liquid Anhydrous Ammonia will produce serious eye burns.

Liquid Anhydrous Ammonia produces skin burns on contact.

7.1.3 Chronic Toxicity

Chronic irritation to the eyes, nose and upper respiratory tract may result from repeated exposure to the vapors. A threshold limit value of 50 in air has been set by some agencies as the maximum safe concentration for daily 8-hour exposure.

7.2 Preventive Health Measures

Employees should be carefully instructed and supervised in the proper methods of handling Anhydrous Ammonia in order to prevent direct contract with the liquid and exposure to the gas.

7.2.1 Personal Hygiene

Emergency showers and eye baths should be placed in convenient locations wherever Anhydrous Ammonia is used in quantity. Every employee should understand that direct contact with the chemical requires the instant application of large amounts of water to the affected area.

Skin, eye and respiratory protective equipment will often be necessary.

7.2.2.1 Preplacement Examinations

Most employees can be assigned to processes in which the use of Anhydrous Ammonia is carefully controlled. Under some circumstances the physician carrying out preplacement examinations may wish to exclude from exposure, people with the following condition:

(A) Those with only one functioning eye.

(B) Those with severe faulty vision.

(C) Those with chronic diseases of the nose, throat or lung.

7.2.2.2 Periodic Health Examinations

Usually periodic health examinations will not be conducted solely by reason of the employee exposure to ammonia.

7.3 Suggestions to Physicians

There is no specific treatment for overexposure to Anhydrous Ammonia vapors or direct local contact.

7.3.1 Oxygen Administration

Oxygen has been found useful in the treatment of inhalation exposures of many chemicals, especially those capable of causing either immediate or delayed harmful effects in the lungs.

In most exposures, administration of 100% oxygen at atmospheric pressures has been found to be adquate. This is best accomplished by use of a face mask having a reservoir bag of the non-rebreathing type.

Inhalation of 100% oxygen should not exceed one hour of continuous treatment. After each hour therapy may be interrupted. It may be reinstituted as the clinical condition indicates.

Some believe that superior results are obtained when exposures to lung irritants are treated with oxygen under an exhalation pressure not exceeding 4 cm. water. Masks providing for such exhalation pressures are obtainable. A single treatment may suffice for minor exposure to irritants. It is believed by some observers that oxygen under pressure is useful as an aid in the prevention of pulmonary edema after breathing irritants.

7.3.1 Oxygen Administration Continued

In the event of an exposure causing symptoms or in the case of a history of severe exposure, the patient may be treated with oxygen under 4 cm. exhalation pressure for one-half hour periods out of every hour. Treatment may be continued in this way until symptoms subside or other clinical indications for interruption appear.

Caution: It may not be advisable to administer oxygen under positive pressure in the presence of impending or existing cardiovascular failure.

7.3.2 The patient should be kept comfortably warm, but not hot.

7.3.3 Stimulants will rarely be necessary where adequate oxygenation is maintained. Any such drugs for shock treatment should be given only by the attending physician. Never attempt to give anything by mouth to an unconscious patient.

8. FIRST AID

8.1 General Principles

After severe exposure to ammonia gas, it is important to move the patient from the contaminated area promptly. In case of contact of the liquid with the eyes or skin, immediate flushing with large quantities of running water is imperative. In all cases of severe injury, call a physician at once giving him a complete account of the accident.

8.2 Contact with Skin and Mucous Membranes

Speed in removing ammonia from contact with the patient and in moving the patient to an uncontaminated atmosphere is of primary importance. If skin contact is extensive and emergency showers available, the employee should get under the shower immediately. Contaminated clothing and shoes should be removed under the shower. In other instances flushing with large amounts of running water should be continued for at least 15 minutes.

Under no condition should salves or ointments be applied to the skin or mucous membrane burns during the 24-hour period following injury. Subsequent medical treatment is otherwise the same as for thermal burns.

8.3 Contact with the Eyes

If even small quantities of ammonia enter the eyes, they should be irrigated immediately and copiously with water for a minimum of 15 minutes. The eyelids should be held apart during the irrigation to insure the contact of water with all the tissues of the eye surfaces and lids. A physician should be called at the earliest possible moment. After the first 15 minute period of irrigation, if a physician is not available, the irrigation should continue for a second period of 15 minutes. It is then permissible as a first aid measure to instill 2 or 3 drops of 0.5% pontocaine solution or an equally effective aqueous topical anesthetic. No oils or oily ointment should be instilled unless ordered by a physician. The employee should be sent to a physician, preferably an eye specialist, as soon as possible.

8.4 Taken Internally

If liquid Anhydrous Ammonia has been swallowed, call a physician immediately. If the patient is conscious and able, he should drink large amounts of water to dilute the chemical. Do not induce vomiting if the patient is in shock, extreme pain or is unconscious. If vomiting begins, place the patient face down with head lower than hips, this prevent vomitus from entering the lungs and causing further injury.

8.5 Inhalation

Exposed persons should be removed at once to an uncontaminated area. If the exposure has been to minor concentrations for a limited time, usually no treatment will be required.

When there is severe exposure to higher concentrations, and if oxygen apparatus is available, oxygen can be administered but only by a person authorized for such duty by a physician. If the patient is not breathing, an effective means of artificial respiration should be initiated immediately. Call a physician.

The patient should be kept comfortably warn but not too hot and should be kept at rest.

Never attempt to give anything by mouth to an unconscious patient.

9. SAFETY

9.1 Physiological Effects

9.1.1 Ammonia vapor is not poisonous, but due to its high solubility in water, it does have a very irritating action on the mucous membrane of the eyes, nose, throat and lungs. Fortunately, since its sharp pungent odor serves as a warning signal, very small concentrations of ammonia in air are readily detected. Prolonged exposure to air containing 100 parts per million of ammonia is not harmful, but breathing air containing from 5,000 to 10,000 ppm of ammonia may cause sudden death from spsam or inflammation of the larynx. Concentrations

exceeding 700 ppm of ammonia vapor will cause irritation of the eyes and permanent injury may result if immediate remedial measures are not taken. Ammonia's high solubility in water causes it to irritate any skin surface where moisture has accumulated.

9.1.2 Table #2 The physiological r ponse to various concentrations of ammonia in air.

Table #2 - Physiological Effects of Ammonia
(Henderson And Haggard)

Parts of Ammonia Per Million Parts of Air (By Volume)	
Least Detectable Odor	53
Maximum Concentration Allowable For Prolonged Exposure	50
Maximum Concentration Allowable For Short Exposure (½ to 1 hour)	300-500
Least Amount Causing Immediate Irritation to the Throat	408
Least Amount Causing Immediate Irritation to the Eyes	698
Least Amount Causing Coughing	1720
Dangerous For Even Short Exposure (½ hour)	2500-4500
Rapidly Fatal For Short Exposure	5000-10000

9.1.3 Since liquid ammonia vaporizes readily and has a great affinity for water, it may cause severe injury to the skin by freezing the tissue and subjecting it to caustic action. The symptoms are practically the same as those of a burn.

9.2 Safety Equipment

9.2.1 Gas masks. This item of protective equipment should be of a type approved by the U.S. Bureau of Mines. It should be stored where it is easily accessible and where there is no danger of ammonia contaminating the atmophere.

9.2.2 Protective clothing. Personnel subject to exposure to ammonia should also be provided with a hat, gloves, suit and boots, all garments to be of rubber. Garments worn beneath the rubber outer clothing should be made of cotton. Some protection to the skin may be obtained by applying protecting oils. Approved eye goggles should be supplied if the eyes are not protected by a full face mask.

9.2.3 Safety showers. Since it is important to immediately flood with water the parts of the body exposed to ammonia, easily accessible showers should be provided, preferably of the treadle type. These showers should be capable of supplying large quantities of water. Bubbler type fountains for irrigation of the eyes should also be available.

9.3 Emergency Action

9.3.1 Leak Detection. A leak in the ammonia valve connections or feed lines is at once detected by odor. The exact location of the leak may be detected by allowing the fumes from an open bottle of hydrochloric acid (or from a squeeze bottle of sulfuric acid, or from an SO_2 aerosol container) to come in contact with the ammonia vapor, which produces a dense, white fog. Other means of leak detection can be obtained with moist phenolphthalein or litmus paper which will change color in ammonia vapor. Phenolphthale in paper may be obtained free of charge from ammonia manufacturers upon request. Sulphur tapers are not recommended.

9.3.2 Action in the Event of a Leak

9.3.2.1 Only an authorized person familiar with the plant should attempt to stop a leak, and if there is any question as to the seriousness of the leak, a gas mask of the type approved by the U.S. Bureau of Mines for use with ammonia should be worn. All persons not equipped with such masks should leave the affected area until the leak has been stopped.

9.3.2.2 If ammonia vapor is released, the irritating effect of the vapor will force personnel to leave the area before they have been long exposed to dangerous concentrations. To facilitiate their rapid evacuation there should be sufficient well-marked and easily accessible exits. If, despite all precautions a person should be trapped in an ammonia atmosphere, he should breathe as little as possilbe and open his eyes only when necessary if no gas mask is available, partial protection may be gained by holding a wet cloth over the nose and mouth. Since ammonia vapor in air will rise, a trapped person should remain close to the floor to tak advantage of the lower vapor concentrations at that level.

9.3.2.3 Although ammonia is flammable only within the narrow limits of 16 to 25% by volume, the mixture of oil with ammonia will broaden this range. Therefore, every precaution should be taken to keep sources of flame or sparks from ammonia areas. In the event that fire should break out in an area containing ammonia, every effort should be made to remove portable ammonia containers from the premises. If they cannot be removed, firemen should be informed of their location.

9.3.2.4 When a leak occurs in a congested area where atmospheric dissipation is not feasible, the ammonia should be absorbed in water. If liquid ammonia has been released, its high solubility in water may be utilized to control the escape of ammonia vapor. Application of a large volume of water from a fog or spray nozzle will lessen vaporization as

9.3.2.4 Continued

the vapor pressure of ammonia in water is much less than that of liquid ammonia. Liquid ammonia should not be neutralized with acid -- the heat generated by the reaction may increase the fumes.

9.3.3 Handling Leaking Cylinders

9.3.3.1 When there is a leak around an ammonia cylinder valve stem, it can usually be corrected by tightening the packing nut which has a left-handed thread. In case of serious cylinder leaks such as around the bottom of the valve:

(A) Discharge the ammonia to atmosphere, providing the location permits this to be done safely or,

(B) Discharge the ammonia through a hose or pipe into water (slowly) where it will be absorbed.

9.3.3.2 The leaking cylinders should immediately be removed from any building by at least two men wearing approved type gas masks.

9.4 First Aid Suggestions

9.4.1 General

9.4.1.1 Persons have chronic lung diseases or persons who have shown evidence of hypersensitivity to ammonia should not be employed where they will be exposed to it.

9.4.1.2 Any person who has been burned or overcome by ammonia should be placed under a physician's care immediately.

9.4.1.3 The patient should be removed to an area free from fumes, preferably a warm room (about 70 F.) and prevented from exercising for at least 24 hours.

9.4.1.4 Patient should be kept warm by the use of blankets or other covers if necessary.

Prior to the physician's arrival first aid measures should be taken. Those presented herein are based upon what is believed to be common practice in industry. Their adoption in any specific case should, of coarse, be subject to prior endorsement by a competent medical advisor.

9.4.2 Asphyxiation

9.4.2.1 Where breathing is weak, administer oxygen or mixtures of carbon dioxide and oxygen, containing not more than 5% carbon dioxide. It can be administered intermittently for periods of two minutes over a total time not to exceed fifteen minutes. (This mixture, already prepared and with necessary apparatus, can generally be obtained from local fire or police departments or hospitals.)

9.4.2.2 If breathing has ceased, start artificial respiration immediately.

9.4.2.3 Artificial repiration when administered by an inexperienced person is definitely hazardous following exposure to ammonia and should be avoided where possible. The use of a pulmotor is definitely not recommended as its more violent action will irritate and may severly injure the lungs However, a resuscitator used with oxygen and operated by a trained per on is recommended.

9.4.3 Eyes

9.4.3.1 Hold the lids open and pour clean water over the eyeball and lids (or use eye irrigation fountain). Wash thoroughly in this way for 15 minutes. A doctor, preferably an eye specialist, should be summoned immediately.

9.4.4 Skin

9.4.4.1 Speed is essential. Strip the ammonia-saturated clothing from the body immediately. Flood affected area continusuly with clean water for at least 15 minutes. Do not cover burns with cothing or dressings. Allow them to remain open to the air.

9.4.5 Nose and Throat

9.4.5.1 Irrigate nose and mouth with water continuously for 15 minutes. If the patient can swallow, encourage him to drink large quantities of ½% citric acid solution or lemonade. Summon physician immediately.

9.4.6 First Aid Supplies

9.4.6.1 It is recommended that ammonia users keep the following first aid supplies in addition to emergency protective equipment. These supplies should be stored in clean, accessible cabinets in a location that is not likely to be affected by an ammonia leak:

One quart bottle of ½% citric acid solution.

One pound sealed package of sterilized gauze.

AMMONIA

A. Effects of Ammonia:

1. Physiologically, ammonia causes intense irritation to the surface tissues of the eyes, nose, throat, and lungs. It should be impressed upon the worker that exposure to high concentrations of ammonia may burn, blind, strangle, and kill. Proper safety measures should therefore be observed in handling it.

2. The irritation of the upper respiratory tract is so rapid and violent that ammonia acts as its own warning agent. Concentrations of ammonia in air as low as 53 p.p.m. can be detected by the sharp, penetrating odor, although there is some indication that the minimum amount detectable may vary with the individual. Even though very low concentrations of ammonia can be breathed without harmful effects, higher concentrations will cause painful irritation, congestion, and swelling of the mucous membranes of the eyes, nose, and throat. Air containing 5,000 to 10,000 p.p.m. of ammonia may cause such intense irritation and swelling of the larynx that it closes the trachea (windpipe) causing sudden death through strangulation.

3. The first symptom of irritation to the eyes is an immediate burning and watering. Exposure of the corneal tissue of the eyes to higher concentrations of ammonia may cause deterioration of the tissue and even permanent blindness.

4. Ammonia is highly water-soluable and dissolves readily in the perspiration of the body. The effect of ammonia on the skin is that is a caustic burn, varying in severity with the concentration of ammonia and length of time of exposure. The skin becomes red and itches intensely, and these symptoms usually warn of injury to the exposed area before serious damage is done. The resistance of the skin to ammonia burns seems to vary with the individual, although in general a 2% concentration of ammonia is the maximum tolerated by the skin for more than a few seconds.

5. Changes in respiratory and heart action are produced as reflex actions resulting from the irritation of the respriatory tract.

6. Ammonia represents a possible panic hazard. Because of the discomfort resulting from even traces of ammonia in the air, care should be taken in setting up equipment and in keeping valve packing glands and union joints tight.

7. Goggles recommended for anhydrous ammonia service should be worn by all personnel dealing directly with anhydrous ammonia.

8. For users connecting and disconnecting ammonia cylinders regularly, an ammonia gas mask should be kept where it will be available in case of a leak.

AMMONIA

B. Use of Ammonia

1. 16mm Duplicator

   a. The duplicator uses a liquid ammonia which comes in a gallon size plastic bottl We should always wear rubber gloves and goggles when c anging bottles. Because of the liquid ammonia we also get a liquid waste. This should be emptied into a drain in the dark room.

   b. For the non-vent duplicator, the excess ammonia vapors are pumped into an absorber solution where they are chemically neutralized. It will turn a bluish tint when all the chemicals have been used. This should be emptied into a drain in the dark room.

2. 35mm Aperture Card Duplicators

   a. The K&E & 3M duplicators use 2 # anhydrous ammonia cylinders. When the pressure gauge is below 40-50 pounds per square inch the cylinder is empty. It is not normal for a cylinder to indicate 0 pressure & a supervisor should be notified if this happens. Some gas should always be left in the cylinder to prevent foreign materials entering it.

   b. Before a cylinder is changed the cylinder outlet valve should be turned tightly off and a number of old cards run through the machine to take pressure down to 10 pounds per square inch. Only when 10 # is reached is it safe to loosen the coupling that joins the flexible hose to the cylinder outlet. Careful and slow loosening of the coupling when the pressure is reduced will prevent a sudden rush of ammonia from entering the room or coming into contact with the skin. The part affected should immediately be flooded with water. The small amount of ammonia gas released in the air in this process will rapidly disperse.

B. Use of Ammonia continued:

3. Fiche Duplicators

a. Anhydrous ammonia is piped to all duplicators through a line under the floor from 150 # cylinder tanks.

b. Behind each machine is a yellow box. Inside this box is a shut-off valve for the ammonia. If a machine is having an ammonia leak, shut off the valve immediately.

c. When the ammonia supply runs out, a pressure light on the duplicator will come on. The 150 # ammonia tanks are located in the back room.

d. The following procedures should be used in changing the tanks:

a. Put on the gas masks.
b. Turn the 2 red handles (under gauges) to OFF position.
c. Use wrench and close valve tightly on top of the tank.
d. Slowly release pressure on the connectors. Only a slight (psst) release of pressure should be heard. (If the release of pressure continues, the valve on top of tank has not been completely closed.)
e. Repeat with the other tank.
f. Remove tanks from position & replace with full tanks.
g. Replace white washer on the connector before connecting.
h. Place connector on tank and tighten.
i. Slowly open valve -- listen for any release of pressure (psst). If none, continue to complete open valve. If it is leaking, tighten the connector on the tank again.
j. Use special ammonia detector tabs to verify there are no ammonia leaks.
k. Turn the 2 red handles to ON position.

C. Masks

1. Masks are provided at various locations in both Source & Com. Prior to changing any ammonia tanks these masks must be put on. No exceptions to this rule.

2. The mask will protect the eyes and give some breathing protection. The masks are not intended for use for a long period of time in an ammonia filled room. They are intended to be used only for a short period while changing bottles or in case of emergency to grab a mask and leave the room immediately. If there isn't time to put the gas mask on, hold it close to your face. The masks have cannisters and they will be replaced once a year.

3. More information for the masks is given on the following page.

D. Emer; ncy Shut-Off

1. There are 2 emergency Shut-Offs. They are the red buttons located at the door of B72 and the door to the room where the 150 # ammonia tanks are located.

2. n case of an emergency, leave the room immediately and hit ıhe Shut-Off button on the way out. Pick up nearest red telephone and notify the Building Fire Warden.

E. Additional Ammonia Information:

1. Additional ammonia information, given to us by the Bruning Corporation follows on the next pages.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396