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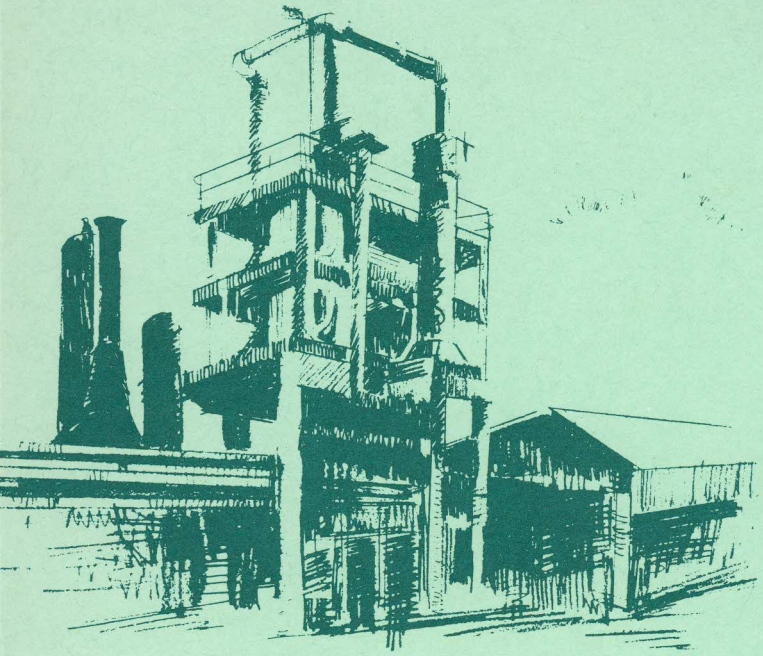
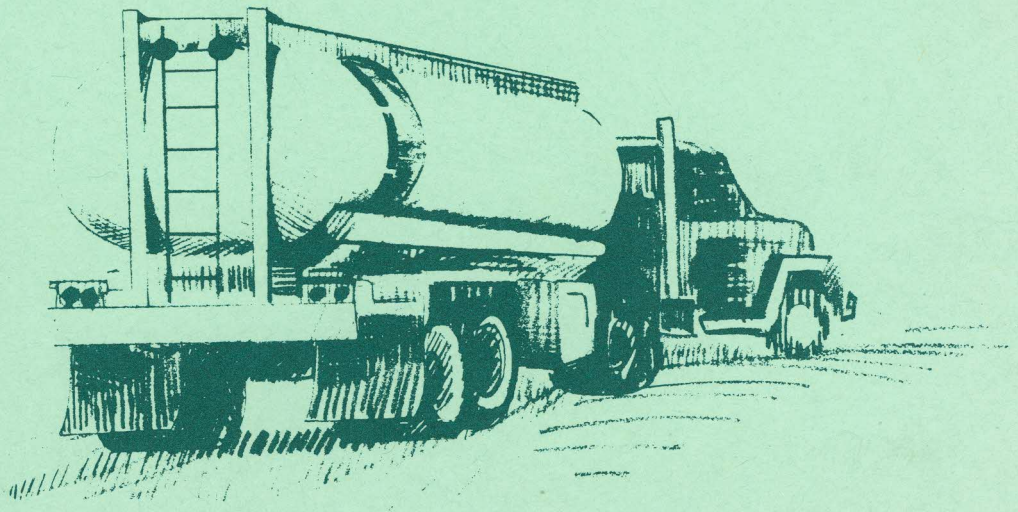


SELF-EVALUATION INSTRUMENT-- NITROGEN FERTILIZER INDUSTRY



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

SELF-EVALUATION INSTRUMENT--
NITROGEN FERTILIZER INDUSTRY

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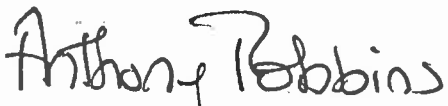
FOREWORD

This document, designed for the nitrogen fertilizer industry, is one of a series of industry self-evaluation instruments that provides an additional approach to promoting safety and health among employers and employees in industry.

The concept of voluntary self-evaluation is an adjunct to existing regulatory procedures and is intended to improve awareness of the need to develop comprehensive occupational safety and health programs.

The development of this concept in cooperation with the industry and employees involved is another means by which NIOSH attempts to fulfill its responsibilities under the Occupational Safety and Health Act of 1970.



Anthony Robbins, M.D.
Director, National Institute
for Occupational Safety
and Health

PREFACE

Good work practice or proper procedure, is the application of an accumulated body of knowledge which may be defined to include those tasks, skills, and instincts recognized by labor groups and industry as being practical and necessary to protect the safety and health of workers, where no standards exist or where they are desirable as a supplement to existing standards. Through voluntary self-evaluation, management and labor can participate in a coordinated procedure to accomplish the goal of a safe and healthful work environment.

This "Self-Evaluation Instrument (SEI) Nitrogen Fertilizer Industry" has been developed by professionals in occupational safety, industrial hygiene, and occupational medicine - persons well acquainted with the problems associated with the Nitrogen Fertilizer Industry. This instrument has been designed to deal with the operations, good work practices, proper procedures, and regulations within the fertilizer industry and to provide management with guidelines to be implemented in cooperation with their workers.

Good work practices also may be based upon industry policy and negotiated work agreements rather than any legal requirement. Many accepted proper procedures are implemented for the purpose of complying with the general duty portion (Sec. 5) of the OSH Act (PL 91-596).

Each section begins with a brief explanation of the potential occupational safety and health hazards that may exist as the result of the operations or procedures covered by that section.

Following these explanatory paragraphs, questions are presented to establish the existing status of specific activity in terms of its potential to produce injury or illness. A "Yes" answer indicates appropriate controls are in place. A "No" answer indicates changes may be necessary or that controls are absent or ineffective; or that a safe work practice is being violated. Because of the broad scope of this manual, some sections may not be applicable to a particular work environment.

The SEI is designed so that those persons most familiar with a specific operation or procedure will be able to respond to questions relating to that particular situation. Each section of the SEI should be reproduced and given to the person responsible for the work to which it applies. The supervisor and employees doing the work can then complete their particular section.

The results of completing the SEI should be made available to all of the workers, and their help enlisted in correcting detected deficiencies.

After the results of the first use of the SEI are evaluated and acted upon, periodically repeating the self-evaluation procedure will afford management and employees the opportunity to judge the effectiveness of existing controls and obtain a measure of assurance that their work environment continues to satisfy State and Federal OSHA standards.

The SEI is intended to be used with a companion publication, "Self-Evaluation of Occupational Safety and Health Programs" [DHEW(NIOSH) Publication No. 78-187] which will answer most of the questions that may arise in the process of completing the SEI. The publication presents a concept whereby management and labor can join together to recognize and prevent or control potential hazards. It presents a basic information core applicable to most industries, with a program for self-evaluation and steps needed for implementation.

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ABSTRACT

So that employers and employees within the nitrogen fertilizer industry can more readily recognize actual or potential occupational hazards, a series of comments and self-evaluation questions applicable to this industry has been prepared. This field-tested, systematic questionaire approach covers identifiable work areas and work situations within the nitrogen fertilizer industry.

After responsible workers complete a walk-through investigation and answer the questions, and after the condition of all work areas is further evaluated, those areas that need upgrading will become obvious. Because pertinent occupational safety and health standards for nitrogen fertilizer manufacturing are included, implementing corrective action should provide a measure of assurance that OSHA and MSHA standards are being met.

A companion document, "Self-Evaluation of Occupational Safety and Health Programs," gives basic information applicable to all industries and should be used with "Self-Evalution Instrument --Nitrogen Fertilizer Industry" to aid in implementing a comprehensive occupational safety and health program.

CONTENTS

CONTENTS (Continued)

ACKNOWLEDGMENTS

Self-evaluation is a new approach to a systematic identification of potential safety and health problems in a selected industry. NIOSH is very pleased to have been asked to work with The Fertilizer Institute (TFI) in the preparation of this document. That TFI is committed to providing a safe and healthful work environment is evidenced by the dedication and long hours volunteered by many responsible and highly competent individuals and their sponsoring companies. In addition, the authors are indebted to the following individuals and member companies of The Fertilizer Institute for their assistance in orientation to the industry and subsequent testing and review of the document:

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CHAPTER I - GENERAL

COMPRESSED GASES

There are several different compressed gases that are used and stored in most fertilizer plants. Because of the high pressures contained in these cylinders, there is a tremendous amount of stored energy that can reach catastrophic proportions if accidentally released. It is of utmost importance that the cylinders be handled, stored, and used correctly to prevent accidents.

Some of the gases have properties that are hazardous in other ways such as being flammable, toxic, or oxygen depleting. All such characteristics need to be recognized so they can be properly controlled. Unless otherwised indicated, the term cylinder refers to all cylinders, whether full or empty, whether in use or spare, in storage or in transit.

Read all of the questions in this section; discuss the questions with those people at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are compressed gas cylinders always secured to prevent upset? Yes ( ) No ( )

2. Are compressed gas cylinders individially chained? Yes ( ) No ( )

3. Are compressed gas cylinders always used and stored in an upright position? Yes ( ) No ( )

4. Are oxygen and fuel gas cylinders separated by at least 20 feet or is a 5-foot noncombustible barrier with a half-hour fire rating between them? Yes ( ) No ( )

5. Is oxygen kept far enough from welding and cutting operations so that sparks and slag cannot reach it? Yes ( ) No ( )

6. Is oxygen kept at least 20 feet from combustible materials (especially oil or grease)? Yes ( ) No ( )

7. Are valve-protection caps always kept on cylinders that are not in use? Yes ( ) No ( )

8. Are empty cylinders so marked and are their valves closed? Yes ( ) No ( )

9. Are "No Smoking" signs displayed near fuel gas and oxygen storage areas? Yes ( ) No ( )

10. Is a fire extinguisher kept in the vicinity of welding and cutting operations? Yes ( ) No ( )

11. Are employees prohibited from using oil or grease for lubricating valves, gauge connections, or other parts of an oxygen system? Yes ( ) No ( )

12. Are cylinder storage areas well ventilated? Yes ( ) No ( )

13. Are employees prohibited from using cylinders (even empties) as rollers? Yes ( ) No ( )

14. Are all cylinders approved, properly marked, and properly identified? Yes ( ) No ( )

15. Do all CO_2 cylinders, including those in an automatic fire extinguishing system, receive a hydrostatic test every 5 years? Yes ( ) No ( )

16. Are cylinders kept away from sources of heat? Yes ( ) No ( )

17. Is there an automatic CO_2 fire extinguishing system? (If not, go to question 18) Yes ( ) No ( )

Is there a predischarge alarm on the CO_2 extinguishing system? Yes ( ) No ( )
Is rescue equipment available for the immediate rescue of anyone trapped by a CO_2 discharge Yes ( ) No ( )
Are CO_2 cylinders inspected regularly? Yes ( ) No ( )

18. If hydrogen cylinders are used: (If not, go to page 3.)

Is the hydrogen storage 20 feet from flammable materials or oxidizing gases? Yes ( ) No ( )
Is the storage such that it will always be 25 feet from open fires and away from electrical equipment? Yes ( ) No ( )
Is the storage 50 feet away from other flammable gas storage? Yes ( ) No ( )
If stored outside are weeds and vegetation kept away from the area? Yes ( ) No ( )
Are nonsparking tools used in hydrogen areas? Yes ( ) No ( )

DUSTS, GASES AND ORGANIC SOLVENTS

The questions in this section of the Self-Evaluation Instrument are designed to identify potential health hazards to employees resulting from exposure to dusts, gases, and organic solvents and to evaluate the establishment's program to protect employees from these hazards. An effective program includes:

-- Regular monitoring of dust, gas, and organic solvent levels in the work environment.
-- Engineering and administrative controls to protect employees from excessive exposure.
-- The use of personal protective equipment by employees where controls have not sufficiently reduced exposure.
-- Precautions for the handling and storage of dusts, gases, and organic solvents.
-- Periodic medical evaluaton to assess the effect of exposure on individual employees.
-- Education and training of employees in the recognition and prevention of excessive exposure to dusts, gases, and organic solvents.

Dusts

There are many different dusts and many industrial processes that cause dust generation. Wherever a mineral is used as a raw material, excessive dust generation is possible. An important source of dust generation is the grinding or machining of products with mineral content. Each point at which dusts or materials are handled should be studied closely to detect points of possible dust generation. The following is a list of some dusts that may cause pneumoconiosis. (lung disease):

calcium	gypsum
clays	lime
coal	limestone
diatomaceous earth	silica

Although solid dust particles may have no liquid states and no flash point, when they reach ignition temperatures, (which depends upon moisture content) as by friction or otherwise, they produce flammable vapors, which can burn and explode. Dust particles, having more surface area, due to finely divided state are more potentially hazardous than their solids counterpart.

Gases

There are many sources and uses of gases in the industrial environment. It is important that the source of all gas generation be recognized and that appropriate measures be taken to prevent excessive exposure. The following are examples of some gases commonly found in industry:

- acetylene
- ammonia
- carbon dioxide
- carbon monoxide
- chlorine
- fluorine
- hydrogen
- hydrogen sulfide
- methane
- oxides of nitrogen
- propane

It must be remembered that a substance in the gas phase has the characteristic of being able to cause a fire and may be more flammable than when in the liquid state. In order of flammability are: cyclopropane, acetylene and methane. Flammable gases can burn without the application of heat thus flash points are meaningless. The potential for explosion must always be considered with gases under pressure, in the presence of an ignition source, when unstable, such as acetylene, when the container receives a severe blow, or when in the presence of oxygen.

Solvents

A solvent is any material used to dissolve another material. This section is concerned with industrial solvents containing carbon, i.e., aqueous organic solvents. Organic solvents can affect health, productivity, and efficiency.

If any employees at your establishment are exposed to dusts, gases, or organic solvents, this section should be completed. Often substances are identified by manufacturer trade names, making it possible that they are present at your establishment unknowingly. If you are uncertain, check with the manufacturer, a suitable reference book, or a person experienced in your operation who is trained to recognize potential hazards.

Read all of the questions in this section; discuss the questions with those people at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are environmental measurements of exposure to dusts, gases, and organic solvents made on a regular basis and are records kept? Yes ( ) No ( )

2. Are exposure records kept on all employees exposed to dusts, gases, or organic solvents? Yes ( ) No ( )

3. Have engineering controls been utilized at work areas where dusts, gases, or organic solvents are present? Yes ( ) No ( )

4. Are approved respirators available to all employees exposed to dusts, gases, or organic solvents? Yes ( ) No ( )

5. Are employees trained in the use of respirators? Yes ( ) No ( )

6. Are warning signs posted where dusts, gases, and organic solvents are generated, stored or occur? Yes ( ) No ( )

7. Is there an ongoing program to educate employees exposed to dusts, gases, or organic solvents about the following:

   Effects of these substances on health? Yes ( ) No ( )
   Danger levels of exposure to each of these substances? Yes ( ) No ( )
   Control of these substances? Yes ( ) No ( )
   Personal protection against these substances? Yes ( ) No ( )

8. Are the following administrative or engineering controls used to limit employee exposure to dusts:

   Moisture is added to settled dusts or dry processes have been changed to wet processes? Yes ( ) No ( )
   Wet vacuums are used instead of sweeping? Yes ( ) No ( )
   Operators of processes generating dust are rotated to limit exposure time? Yes ( ) No ( )

9. Are eye protectors available to employees exposed to organic solvents? Yes ( ) No ( )

10. Are protective gloves and clothing available, and required to be worn by employees exposed to organic solvents? Yes ( ) No ( )

DUSTS, GASES, AND ORGANIC SOLVENTS
(Medical)

Dusts, when inhaled, can cause lung problems. Some dusts, may cause pathologic changes, therefore, air concentrations of dusts should be identified and controlled.

Many different gases can be considered as industrial air contaminants. Some are directly manufactured and others are byproducts of other processes. Excessive exposure to contaminant gases can cause breathing problems, nosebleeds, hoarseness, chest pains, skin and eye irritation (or damage), insomnia, fatigue, nausea, stomach pains, asphyxiation, and even death. The presence of any contaminant gases in the workroom atmosphere should be investigated so that the potential health hazards can be recognized.

Organic solvents may exist in a liquid, mist, or vapor form. Some are highly toxic. They can cause skin and eye irritation (or damage) by contact, and can be absorbed into the bloodstream through the skin, by inhalation, or by ingestion. The hazard potential of a solvent depends upon its inherent toxicity, airborne concentration, and manner of use. Solvents with low vapor pressures exist mainly in liquid form. However, if the solvent is sprayed or heated, airborne concentrations will increase. Solvents with higher vapor pressures will have higher airborne concentrations. Excessive exposure to organic solvents can cause lung problems, irritation or itching of eyes, nose or throat, skin rash, headache, dizziness, nausea, fatigue, loss of consciousness, paralysis, and even death.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help. It is important that this section be completed by the physician. Ideally, the physician or full-time, on-site nurse and supervisor will conduct a walk-through survey when answering the questions.

1. Is there a screening program to identify the employee who has a health condition (e.g., asthma) that might make the employee more susceptible to having an adverse reaction to exposure to dust, gases, or organic solvents? Yes ( ) No ( )

2. Are the employees identified by the screening program:

Advised of their health condition?	Yes ( )	No ( )
Advised of the added risks in working in an environment where inorganic dusts are present?	Yes ( )	No ( )
Counseled in job selection to minimize their exposure to dust, gases, organic solvents?	Yes ( )	No ( )
Prevented from initially accepting a position where dusts, gases, or organic solvents are present?	Yes ( )	No ( )

3. Do medical histories of employees potentially exposed to excessive levels of dusts, gases, and organic solvents include the following:

Smoking and drinking habits?	Yes ( )	No ( )
Past and present exposure to silica, contaminant gases, and organic solvents?	Yes ( )	No ( )
Lung problems?	Yes ( )	No ( )
Cardiovascular (heart) problems?	Yes ( )	No ( )

4. Are medical records kept on all employees exposed to dust, gases, and organic solvents? Yes ( ) No ( )

5. Are the following medical tests or examinations given on a regular basis to employees exposed to dusts:

Pulmonary function - FEV_1/FVC (spirometry)?	Yes ( )	No ( )
Chest X-ray (PA)?	Yes ( )	No ( )
Complete physical?	Yes ( )	No ( )

6. Are the following medical tests or examinations given on a regular basis to employees exposed to gases:

Complete blood count (CBC)?	Yes ( )	No ( )
Chest X-ray (PA)?	Yes ( )	No ( )
Urinalysis?	Yes ( )	No ( )
Electrocardiogram (ECG)?	Yes ( )	No ( )
Pulmonary function - FEV_1/FVC (spirometry)?	Yes ( )	No ( )
Complete physical?	Yes ( )	No ( )

7. Are the following medical tests or examinations given on a regular basis to employees exposed to organic solvents:

Complete blood count (CBC)?	Yes ( )	No ( )
Urinalysis?	Yes ( )	No ( )
Liver function test (LFT)?	Yes ( )	No ( )
Breath analysis?	Yes ( )	No ( )
Complete physical?	Yes ( )	No ( )

ERGONOMICS: PHYSICAL DEMAND AND JOB ANALYSIS

By systematically evaluating the physical and psychological (mental) stress employees face on the job, methods and techniques for reducing or eliminating stresses often can be devised. Evaluating these stresses in your establishment means looking closely at the jobs employees do, what motions are required, how often they are performed, how physically and mentally difficult they are, how monotonous they are, etc. The questions asked are designed to identify potential safety and health hazards to employees resulting from physical and mental stress and to evaluate your establishment's program to deal with these hazards. An effective program includes:

-- An analysis of the physical and mental demands of each job.
-- An analysis of each employee's ability to meet the demands.
-- The use of personal protective equipment and engineering and administrative controls to reduce or eliminate employee stress.
-- A preventive medical program involving early diagnosis and treatement of the effects of stress.

Read all of the questions in this section; discuss the questions with those people at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help. It is important that this section be completed by the physician. Ideally, the physician or full-time, on-site nurse and supervisor will conduct a walk-through survey when answering these questions.

1. Are any employees engaged in heavy physical labor? Yes ( ) No ( )

2. Are employees with back problems screened before being assigned to jobs requiring heavy work? Yes ( ) No ( )

3. Are medical records kept for employees engaged in heavy or medium physical work? Yes ( ) No ( )

4. Is there a limit on the maximum weight a worker is required to lift alone without the help of lifting equipment? Yes ( ) No ( )

5. Are employees instructed in the proper manner of lifting heavy objects? Yes ( ) No ( )

6. Are employees at risk given Posterior-Anterior and Lateral chest X-rays for base line determinations? Yes ( ) No ( )

7. Are back X-rays taken of workers who will be doing heavy lifting in preplacement screening? Yes ( ) No ( )

In placing employees, are questions similar to the following considered:

8. Are workers placed on equipment that can be adjusted in accordance with the ability of the operator? Yes ( ) No ( )

9. Are normal verbal communications possible with the existing noise level? Yes ( ) No ( )

10. Are the needs for precise hand movements considered in placing employees? Yes ( ) No ( )

EXITS

Every building or structure, new or old, designed for human occupancy must be provided with exits sufficient to permit the prompt escape of occupants in case of fire or other emergency. The design of exits and other safeguards must be such that, in case of fire or other emergency, the lives of the occupants will not depend solely upon any single safeguard.

Read all of the questions in this section; discuss the questions with those people at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Is more than one regular exit provided? Yes ( ) No ( )

2. Can all employees exit from an area or building without the use of keys? Yes ( ) No ( )

3. Are all doors that must be passed through to reach an exit, or way to an exit, always free to access so that there is no possibility of a person being locked inside? Yes ( ) No ( )

4. Are all exit routes always kept free of obstructions? Yes ( ) No ( )

5. Are all hazardous products kept away from access to exits? Yes ( ) No ( )

6. Are exit doors side-hinged? Yes ( ) No ( )

7. Are all exits marked with an exit sign and illuminated by a reliable light source? Yes ( ) No ( )

8. Is the direction to exits, when not immediately apparent, marked with visible signs? Yes ( ) No ( )

9. Are doors or other passageways, that are neither exits nor access to an exit and located where they may be mistaken for exits, appropriately marked "NOT AN EXIT," "TO BASEMENT," "STORE ROOM," etc.? Yes ( ) No ( )

10. Are all paths to exits and employees' aisles kept sufficiently illuminated whenever employees are present? Yes ( ) No ( )

FIRE PREVENTION - FIRE PROTECTION

The potential for loss of life and the extremely great dollar value of a plant should make it imperative that fires be prevented. Therefore, employees must be thoroughly familiar with all fire prevention measures and must be capable of effectively fighting a fire if one should start. All protection equipment must be readily accessible at all times and in a ready-to-use condition.

An effective program for the prevention and control of fire in fertilizer plants includes:

-- Periodic training of employees in proper methods of fire prevention and use of fire-fighting equipment.
-- Proper storage and handling of combustible and flammable materials.
-- Proper temporary storage and prompt disposal of flammable materials.
-- Good housekeeping practices.
-- Electrical facilities suitable for hazard areas.
-- A plan of action in case of a fire.
-- Regular inspection and maintenance of fire-fighting equipment, systems, and protective gear.

Read all of the questions in this section; discuss the questions with those people at your establishment who know the most about the areas covered; and while conducting a survey complete this section with their help.

1. Are fire extinguishers easily accessible in all work areas? Yes ( ) No ( )

2. Are the fire extinguishers maintained in a fully charged and operable condition? Yes ( ) No ( )

3. Are maintenance records of fire extinguishers kept? Yes ( ) No ( )

4. Are fire extinguishers kept at their designated locations when not in use? Yes ( ) No ( )

5. Are fire extinguishers mounted near the hazard they are designated to protect? Yes ( ) No ( )

6. If located in an area of visual obstruction, are extinguisher locations designated by signs or other markings? Yes ( ) No ( )

7. Are the appropriate extinguishers available for the various hazards present? Yes ( ) No ( )

8. Are employees given instructions on how to choose the right type of extinguisher for a particular fire? Yes ( ) No ( )

9. Are employees given instructions on how to use a fire extinguisher? Yes ( ) No ( )

10. Is the sprinkler system properly maintained and regularly inspected? Yes ( ) No ( )

11. Are sprinkler system maintenance records kept? Yes ( ) No ( )

12. Are standpipe hoses available for immediate use? Yes ( ) No ( )

13. If there is a fixed CO_2 extinguishing system: (If not, go to question 14.)

    Are there provisions to ensure prompt evacuation of all employees in the CO_2 discharge areas? Yes ( ) No ( )

    Are there provisions to carry out the prompt rescue of employees trapped by CO_2 discharge? Yes ( ) No ( )

    Is the CO_2 system thoroughly inspected and tested annually? Yes ( ) No ( )

    Are inspection records kept? Yes ( ) No ( )

14. If there is a fixed dry chemical extinguishing system: (If not, go to question 15.)

    Is the system inspected at least once a year? Yes ( ) No ( )

    Are the controls tested at least once a year? Yes ( ) No ( )

    Are inspection and testing records kept? Yes ( ) No ( )

15. Is there a local fire-alarm signaling system? Yes ( ) No ( )

16. Is the maximum traveling distance to an alarm box 200 feet or less? Yes ( ) No ( )

17. Are alarm boxes located in the normal path of exit travel? Yes ( ) No ( )

18. Are the alarm boxes well marked and readily visible? Yes ( ) No ( )

19. Is the alarm system properly maintained? Yes ( ) No ( )

20. Is the alarm system tested regularly? Yes ( ) No ( )

21. Is more than one person assigned the responsibility of notifying the fire department during emergencies (even when an automatic fire alarm system is installed)? Yes ( ) No ( )

22. Are there selected personnel to investigate and possibly begin fire-fighting operations before the fire department arrives? Yes ( ) No ( )

23. Are there selected personnel to safely direct firemen to the fire location and inform them of any other hazards in the vicinity that might develop due to the fire? Yes ( ) No ( )

24. Is there a means of notifying all employees that there is a fire and giving them necessary evacuation instructions? Yes ( ) No ( )

25. Are periodic fire drills held? Yes ( ) No ( )

26. Are all appropriate employees informed of the results of fire drills? Yes ( ) No ( )

27. Is corrective action taken with respect to the adverse reports of fire drills? Yes ( ) No ( )

28. Does the plant have a written disaster plan? Yes ( ) No ( )

29. Are the following disasters considered and provided for in the disaster plan:

Fire?	Yes ( )	No ( )
Explosion?	Yes ( )	No ( )
Chemical exposure?	Yes ( )	No ( )
Radiation?	Yes ( )	No ( )
Biological exposure?	Yes ( )	No ( )
Natural disasters - windstorms, floods, earthquakes, etc.?	Yes ( )	No ( )

FLAMMABLE AND COMBUSTIBLE LIQUIDS

Improper storage, handling, and use of flammable and combustible liquids have resulted in numerous expensive industrial fires and many serious injuries and deaths. Proper storage must be provided for these materials and employees must be trained in approved methods for handling and using such liquids. Management must also institute controls to ensure that safe procedures and facilities are always used.

There are so many kinds of flammable and combustible liquids in widespread use that many persons are unfamiliar with the varying properties of these liquids. Employees should be encouraged to read the labels on all containers and to make sure that each container is properly identified and labeled.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. If flammable or combustible liquids are kept in an outside storage room or area: (If not, go to question 2.)

Are all containers in a secure position to prevent tipping or spilling?	Yes ( )	No ( )
Is proper drainage provided?	Yes ( )	No ( )
Are weeds and other rank vegetation kept clear of the area?	Yes ( )	No ( )

2. If flammable or combustible liquids are kept in an inside storage room: (If not, go to question 3.)

Are all containers and drums properly grounded?	Yes ( )	No ( )
Are containers of over 30-gallon capacity stacked no more than two high?	Yes ( )	No ( )
Is all dispensing from drums done by transfer pump or self-closing valves?	Yes ( )	No ( )
Is fire protection provided?	Yes ( )	No ( )
Are "No Smoking" signs exhibited?	Yes ( )	No ( )

3. Are safety cans used for dispensing liquids at the point of use? Yes ( ) No ( )

4. Are all dispensing containers properly labeled? Yes ( ) No ( )

5. Are flammable or combustible liquids that are not in safety cans stored in an approved cabinet? Yes ( ) No ( )

6. Are flammable or combustible paints, etc., which are stored for more than 30 days, kept in approved cabinets? Yes ( ) No ( )

7. Are large containers of oil (such as turbine oil) diked or curbed so as to direct liquid leakage and fire protection water to a safe location? Yes ( ) No ( )

8. Is drainage controlled to such an extent that the proper environmental rules are being compiled with? Yes ( ) No ( )

9. Is grounding/bounding required between containers during transfer of liquids? Yes ( ) No ( )

HAND AND PORTABLE TOOLS

This section of the Self-Evaluation Instrument is intended to evaluate the effectiveness of your small tool program. Included in this section are:

-- Hand tools (nonpowered screwdrivers, hammers, chisels, knives, picks, axes, cutters, etc.).
-- Portable power tools (electric, gasoline, pneumatic, and hydraulic).

Since accidents can occur while using hand and portable tools, special consideration should be given to the condition and use of these tools. Employers are responsible for maintaing the safe condition of both employer-owned and employee-owned tools. Hand and portable tools are often abused by being improperly stored and by being used for a job for which they are not designed. An effective small tool program includes:

-- Inspection and preventive maintenance procedures for the tools being used.
-- Training the users in the proper use and storage of each type of hand and portable tool.
-- Safeguarding the rotating or moving parts (points of operation).
-- Use of personal protective equipment as needed.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Do employees using hand tools receive instructions in their safe usage? Yes ( ) No ( )

2. Is there a program for periodic inspection and maintenance of hand and power tools? Yes ( ) No ( )

3. Are records kept of hand and power tool inspections? Yes ( ) No ( )

4. Are poorly maintained or damaged tools taken out of service and tagged at the time of inspection? Yes ( ) No ( )

5. Are there designated tool storage facilities? Yes ( ) No ( )

6. Is eye protection required when persons use tools on materials producing flying chips or dust? Yes ( ) No ( )

7. Is the practice of carrying tools with unprotected sharp edges or points in pockets prohibited? Yes ( ) No ( )

8. Are the points or sharp edges of tools sheathed or protected when not in use? Yes ( ) No ( )

9. When portable electric power tools are used in severe grounding hazard locations, is power provided from an approved isolated power source or a 12-volt system? Yes ( ) No ( )

10. Is there an established testing program for the isolated power supply equipment? Yes ( ) No ( )

11. Are records maintained of the isolated power supply tests? Yes ( ) No ( )

12. Is the integrity of the grounding conductor on portable electric tools tested, and are ground fault circuit interrupters used when necessary? Yes ( ) No ( )

13. Is personal protective equipment, such as safety glasses with side panels, approved dust respirators, coverall goggles, gloves, and earmuffs, provided and required to be used when working with power tools? Yes ( ) No ( )

14. Are electrical tools equipped with a switch that requires constant operator pressure for operation (or with a lock-on control that will turn off power with a single motion of the trigger finger): Yes ( ) No ( )

15. Are portable abrasive wheel grinders equipped with:

Throat guards or spark arrestors used to protect against pieces of broken wheel? Yes ( ) No ( )

Are these guards adjusted to within 1/4 inch of the wheel? Yes ( ) No ( )

16. If jacks are used: (If they are not, go to question 17)

Is the load rating marked on jacks?	Yes ( )	No ( )
Are jacks operated within their rated design limits?	Yes ( )	No ( )
After a load has been raised by a jack is it cribbed or blocked in position at once if someone is to get under the load?	Yes ( )	No ( )
Are jacks properly lubricated at frequent intervals?	Yes ( )	No ( )

17. If abrasive blast-cleaning nozzles are used: (If they are not, go to question 18)

Are the operating valves of the nozzles equipped with a deadman control?	Yes ( )	No ( )
Are NIOSH-certified or MSHA-approved respirators used?	Yes ( )	No ( )

18. If pneumatic-powered tools and hoses are used: (If they are not, go to question 19)

Is a retainer provided if the tool might be ejected from the hose?	Yes ( )	No ( )
Before disconnecting the air hose from the line, is the air cut off and the pressure in the line released?	Yes ( )	No ( )
Are non-sparking tools used in areas where explosive compounds may be present?	Yes ( )	No ( )
Is compressed air used for job cleaning purposes reduced to less than 30 p.s.i.?	Yes ( )	No ( )
When used with pneumatic tools, is the moisture accumulator drained daily?	Yes ( )	No ( )

19. If gasoline powered tools are used, is the gasoline dispensed from and stored in approved safety cans? Yes ( ) No ( )

HEAT (TEMPERATURE)

This section is designed to identify potential health hazards to employees resulting from exposure to excessive heat and humidity and to evaluate your establishment's program to protect employees from these hazards. An effective program includes:

-- Regular monitoring of temperature and humidity levels in the work environment.
-- Engineering and administrative controls to protect employees from excessive exposure.
-- The use of personal protective equipment by employees where controls have not sufficiently reduced exposure.
-- Periodic medical evaluation to assess the effect of excessive heat exposure on individual employees.
-- Education and training of employees.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are complaints of excessive temperature (hot or cold) promptly investigated? Yes ( ) No ( )

2. Have measurements been made to evaluate temperature stress? Yes ( ) No ( )

3. Are exposure record kept on any excessive heat exposed employees Yes ( ) No ( )

4. Are measurements of exposure regularly scheduled? Yes ( ) No ( )

5. Are the following administrative controls used to minimize individual exposure: Yes ( ) No ( )
   Rotation of workers? Yes ( ) No ( )
   Frequent rest periods? Yes ( ) No ( )
   Heaviest work done during mildest periods? Yes ( ) No ( )
   Only essential work done in excessive heat areas? Yes ( ) No ( )

HEAT STRESS (MEDICAL)

The effects of heat in producing emotional or physical stress and strain are quite complex and cannot be evaluated by measuring the level of heat exposure alone. It is often difficult to determine accurately whether continued exposure will merely make employees uncomfortable or whether it will actually produce significant ill-effects. Upward changes of three degress or more or downward changes of two degress or more in workers' body temperature will impair their performances. Moreover, exceeding this 5-degree range presents a hazard to health. Some of the symptoms of heat stress are headache, weakness, dizziness, chills, muscle cramps, nausea, and irritability. In many establishments, climatic heat during summer months significantly contributes to the heat stress experienced from hot industrial processes. This heat, plus metabolic heat generated by the worker, can be substantial and can be directly related to a number of heat induced ill-effects. Heat exposure in the occupational environment can cause heat strain, cramps, exhaustion, or stroke, and can result in decreased job performance and a noticeable increase in job-related accidents. Workers may experience fatigue and irritable sensations that can affect other workers and their own home life.

The human body exhanges heat with the environment in one of four ways:

Conduction -- direct heat transfer between the body and a hot or cold object.
Convection -- transfer of heat due to the movement of air past the body.
Radiation -- the transfer of thermal energy betwen individuals and their surroundings where surface temperatures differ from skin temperatures. (The terms infrared, radiated heat, and radiant heat are often used synonumously).
Evaporation --transfer of heat by evaporation of moisture (sweat) from the skin.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help. It is important that this secton be completed with a physician. Ideally, the physician, or full-time on-site nurse and supervisor will conduct a walk-through survey when answering the questions.

1. Do you have a screening program to identify the employee who has a health condition (e.g. heart disease, pulmonary problems) that might make the employee more susceptible to having an adverse reaction to heat? (If no, go to question 3.) Yes ( ) No ( )

2. Are the employees who are identified by the screening program:

   Advised of their health condition? Yes ( ) No ( )
   Advised of the added risks in working in a hot environment? Yes ( ) No ( )
   Counseled in job selection to minimize their exposure to heat? Yes ( ) No ( )
   Prevented from initially accepting a position in a hot environment? Yes ( ) No ( )

3. Is there a program of acclimatization or gradual introduction of employees to hot environment? Yes ( ) No ( )

4. Is drinking water available at hot work sites? Yes ( ) No ( )

5. Are the following medical tests or examinations given on a regular basis to employees exposed to heat:

   Pulse rate? Yes ( ) No ( )
   Blood pressure? Yes ( ) No ( )
   Electrocardiogram (ECG)? Yes ( ) No ( )
   Physical examination? Yes ( ) No ( )

6. Are medical records kept on employees exposed to heat? Yes ( ) No ( )

7. Is there an ongoing program to educate employees exposed to heat in the following:

   Effects of heat on health? Yes ( ) No ( )
   Means to overcome heat stress? Yes ( ) No ( )
   Emergency treatment of heat stress? Yes ( ) No ( )

8. Are employees who are potentially exposed to excessive levels of heat protected from:

Infectious agents?	Yes ( ) No ( )
Acids?	Yes ( ) No ( )
Alkalies?	Yes ( ) No ( )
Gases?	Yes ( ) No ( )
Inorganic and organic dusts?	Yes ( ) No ( )
Organic solvents?	Yes ( ) No ( )
Pesticides?	Yes ( ) No ( )
Sudden Cold?	Yes ( ) No ( )
Ionizing radiation?	Yes ( ) No ( )
Noise, vibration, or nonionizing radiation?	Yes ( ) No ( )

JOB PLANNING -- JOB BRIEFING

Safety and health planning meetings should be conducted with the personnel involved when beginning new jobs such as construction or large-scale maintainence work involving more than one area or department. The responsible supervisor from each affected area should be required to attend these meetings. On-site job briefing is as equally important to safety as job training. Each employee should understand the general purpose of the job and their particular work assignment.

Read all the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Does each immediate supervisor conduct a briefing session before beginning all jobs for all crew members under his supervision? Yes ( ) No ( )

2. Does the supervisor stop any other activity during this time so that all crew members are able to hear and participate in the briefing session? Yes ( ) No ( )

3. During these sessions are efforts made to ensure that each employee understands:

   Exactly what work is to be done? Yes ( ) No ( )
   Why the work is necessary? Yes ( ) No ( )
   The existing hazards and proper methods to overcome these? Yes ( ) No ( )
   A step-by-step procedures for completion of the job? Yes ( ) No ( )
   His/Her own job and what others will be doing? Yes ( ) No ( )

4. If there is any change in the original work plan, are all crew members advised of the change and any additional hazards that might arise as a result of the change? Yes ( ) No ( )

5. Are crew members encouraged to ask questions and make comments during these meetings? Yes ( ) No ( )

MACHINERY AND MACHINE GUARDING

The potential for personal injury is inherent in the use of almost any piece of powered machinery or equipment. Therefore, it is necessary to develop and follow safe procedures to control the potential hazards. An effective safety program for machine operation in fertilizer plants includes:

-- Adequate guarding of the moving parts of all machines.
-- Periodic inspection and formal preventive maintenance of each machine.
-- Formal training for machine operators and maintenance personnel.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Is there a regular program of safety inspections of machinery and equipment? Yes ( ) No ( )

2. Are records kept of safety inspections? Yes ( ) No ( )

3. Is there a training program to instruct employees in safe methods of machine operations? Yes ( ) No ( )

4. Is there adequate supervision to ensure that safe operating procedures are being followed? Yes ( ) No ( )

5. Is adequate clearance provided between machines for machine operation, materials, and wastes without blocking traffic or interfering with machine operations? Yes ( ) No ( )

6. Is equipment and machinery securely placed and anchored, if necessary, to prevent tipping or other movement that could result in personal injury? Yes ( ) No ( )

7. Is there a power shut-off switch within reach of the operator's position at each machine? Yes ( ) No ( )

8. Can electric power to each machine be locked out for maintenance, repair, or security? Yes ( ) No ( )

9. Are the noncurrent-carrying metal parts of each machine electrically grounded? Yes ( ) No ( )

10. Are manually operated valves and switches controlling the operation of equipment and machines clearly identified and readily accessible? Yes ( ) No ( )

11. Are all pulleys and belts that are within 7 feet of the floor or working level properly guarded? Yes ( ) No ( )
(Also see 1910.219 (e)(2)(ii))

12. Are all moving chains and gears properly guarded? Yes ( ) No ( )

13. Are safety glasses, face shields, or other eye-protective equipment provided and required to be used by machine operators? Yes ( ) No ( )

14. Are splash guards mounted, on machines that use coolant, to prevent the coolant from reaching employees? Yes ( ) No ( )

15. Are methods provided to protect the operator and other employees in the machine area from hazards created at the point of operation, ingoing nip points, rotating parts, flying chips, and sparks? Yes ( ) No ( )

16. Is the guard secured and does it offer no accident hazard in itself? Yes ( ) No ( )

17. If special handtools are used for placing and removing material, do they protect the operator's hands? Yes ( ) No ( )

18. Are machines driven by belts and shafting equipped with a licking-type belt shifter or equivalent positive device? Yes ( ) No ( )

19. Is provision made to prevent machines from automatically starting when power is restored after a power failure? Yes ( ) No ( )

20. Are brazed joints in bandsaws and band resaws the same thickness as the saw blade? Yes ( ) No ( )

21. With respect to training:

Is operator training required on all machines? Yes ( ) No ( )
Is adequate supervision provided? Yes ( ) No ( )
Is unauthorized personnel operation restricted? Yes ( ) No ( )

MATERIAL HANDLING AND STORAGE

Material is moved, either by hand or mechanical means, in every business and industry. Accidents from material handling account for 20% to 25% of all occupational injuries. The questions in this section are designed to identify potential hazards to employees resulting from methods of handling and storing materials and to evaluate the establishment's program to protect employees from these hazards. An effective material handling and storage program includes:

-- Training in safe work practices.
-- Proper use of equipment, tools, and protective equipment so as to reduce personal injury.

A portion of this self-evaluation instrument is intended to determine the effectiveness of the powered industrial truck safety program. Powered industrial trucks are those powered trucks (other than vehicles used on the road), designed to be controlled by a riding operator, and motorized hand trucks, designed to be controlled by a walking operator.

An effective safety program includes:

-- Systematic inspection and formal preventive maintenance program for each powered industrial truck.
-- Formal training of operators and maintenance personnel.
-- Adequate refueling and charging areas.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Is there a limit on the maximum weight a worker is permitted to lift by himself without equipment? Yes ( ) No ( )

2. Is the weight marked on objects to be lifted or carried manually? Yes ( ) No ( )

3. Are workers employed in manual materials handling trained in proper lifting techniques? Yes ( ) No ( )

4. Is there preplacement screening of workers applying for manual material handling jobs? Yes ( ) No ( )

5. Is machinery available for lifting? Yes ( ) No ( )

6.	Do workers actually use the equipment for lifting when loads are heavy?	Yes ( ) No ( )
7.	Is machinery available for pulling and carrying heavy loads?	Yes ( ) No ( )
8.	Are special devices provided to employees when moving drums or barrels?	Yes ( ) No ( )
9.	Are two-wheeled hand trucks and wheelbarrows equipped with knuckle-guards to protect hands from jamming against door frames or other obstructions?	Yes ( ) No ( )
10.	Are two-wheeled trucks equipped with brakes?	Yes ( ) No ( )
11.	Are loads on hand trucks, dollies, and wheelbarrows secure from slipping or falling?	Yes ( ) No ( )
12.	Is all material storage stable and secure from collapse?	Yes ( ) No ( )
13.	Are derail or bumper blocks or both provided on all spur railroad tracks to prevent railway cars from entering a work area?	Yes ( ) No ( )
14.	Is all material kept at least 2 feet from a fire door?	Yes ( ) No ( )
15.	Is all stored material kept at least 3 feet from sprinkler heads?	Yes ( ) No ( )
16.	Are flammable and combustible materials stored separately from other storage?	Yes ( ) No ( )
17.	Are hazardous materials kept where they will not create a dangerous condition?	Yes ( ) No ( )
18.	Are all permanent aisleways properly marked?	Yes ( ) No ( )
19.	Are aisleways kept clear of materials?	Yes ( ) No ( )
20.	Are the proper types of fire extinguishers readily available for the different exposures?	Yes ( ) No ( )

21. Are flammable and combustible materials stored only in areas designed for their storage? Yes ( ) No ( )

22. Are storage areas, which are not on grade level, posted with maximum floor loading weight limits? Yes ( ) No ( )

23. Is all combustible waste kept in closed cover, metal containers? Yes ( ) No ( )

24. Are all persons except the operator prohibited from riding on industrial trucks (except where a passenger seat is provided)? Yes ( ) No ( )

25. Are high-lift trucks fitted with an overhead guard of sufficient strength to protect the operator from falling objects? Yes ( ) No ( )

26. Are backrest extensions provided to prevent loads from sliding toward the mast at maximum reward tilt? Yes) ( ) No( )

27. Are all industrial trucks equipped with a horn or other warning device? Yes ( ) No ( )

28. Are the brakes of highway trucks set, and chocks placed under (against) their rear wheels, while they are being loaded and unloaded? Yes ( ) No ( )

29. Is protection provided to prevent movement of railroad cars during loading and unloading operations? Yes ( ) No ( )

30. Are spinner knobs prohibited on steering wheels of trucks? Yes ( ) No ( )

31. Are the following precautions normally taken by operators before they leave their trucks unattended:

Load engaging or lifting mechanism fully lowered? Yes ( ) No ( )
All controls neutralized? Yes ( ) No ( )
Brakes set? Yes ( ) No ( )
All power shut off? Yes ( ) No ( )
Wheels blocked when parked on an incline? Yes ( ) No ( )
Other (specify) _____

32. Are trucks that are equipped with permanently mounted LP gas containers always required to be refueled outdoors? Yes ( ) No ( )

33. Are operators required to stop engines and leave the trucks during refueling? Yes ( ) No ( )

34. Are all fuel containers required to be handled carefully to avoid damage to container or valve assembly? Yes ( ) No ( )

35. Are no more than two LP gas containers used on an industrial truck? Yes ( ) No ( )

36. Is smoking prohibited and so posted in refueling and battery charging areas? Yes ( ) No ( )

37. Are there formal training programs for all truck operators? Yes ( ) No ( )

38. Is each operator's proficiency periodically reviewed? Yes ( ) No ( )

39. Are the following subjects covered during training and reviews:

Operation within rated load limits? Yes ( ) No ( )
Operation with only secure loads? Yes ( ) No ( )
Prohibit loads that cause wheels to be lifted off the ground? Yes ( ) No ( )
Safeguarding of personnel working or walking near this equipment? Yes ( ) No ( )
Proper placement of forks during various operations? Yes ( ) No ( )

40. Is there a systematic, periodic inspection program for all industrial trucks? Yes ( ) No ( )

41. Are inspection records kept? Yes ( ) No ( )

42. Is there a preventive maintenance program for all industrial trucks? Yes ( ) No ( )

43. Are preventive maintenance records kept? Yes ( ) No ( )

44. Is the manufacturer's written approval obtained before modifying any industrial truck? Yes ( ) No ( )

45. Are aisles and doorways wide enough for safe passage of trucks? Yes ( ) No ( )

46. Is storage of materials and equipment prohibited under energized buses, high power lines, or near energized equipment? Yes ( ) No ( )

47. Are employees instructed in the hazards of working around loads suspended by a crane, an A-frame, or similar equipment? Yes ( ) No ( )

MEDICAL AND FIRST AID

Although today's workers in the fertilizer industry readily accept preplacement medical examination as a condition of employment, they are less familiar with the need for periodic reexaminations. Management may not fully understand the economic reasons for either preplacement or periodic examinations. However, the high cost of workers' compensation, the expense of diminished or variable production schedules, and the cost both in money and in time of replacement training make medical surveillance and biological monitoring essential for worker placement and retention in a particular job or at a given worksite.

Medical staff can only recommend to management actions to be taken or not taken concerning worker and worksite safety and health. It is management's responsibility to recognize that medical recommendations are but an additional tool for evaluating their prospective workers. Medical recommendations provide knowledge of the conditions under which existing or prospective workers may function safely and effectively.

Medical recommendations must be appropriate for worksite conditions and potential hazards. They must also be consistent with the goals of management and the requirements of labor. Medical recommendations must not be so lax that the safety and health of workers are compromised, nor so stringent that employment and retention of an individual are unfairly limited.

The results of all medical examinations, including Medical History and Occupational Toxic Exposure History and reports of examination of all biological specimens, must be discussed with the worker. It is important to remember that although individual workers are entitled to know the results of examinations, biological monitoring, and medical surveillance, management is generally entitled only to a medical assessment written in appropriate language by the medical personnel. This assessment should include information from which management can make decisions regarding placement, type of activity, and conditions under which the workers may safely and effectively work.
Many companies also consider previous injuries and illnesses, revealed in the worker's medical and Occupational Toxic Exposure History, when making decisions about placement and retention.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help. It is important that this section be completed by the physician. Ideally, the physician or full-time, on-site nurse and supervisor will conduct a walk-through survey when answering the questions.

1. Is there a formalized medical program at this location? Yes ( ) No ( )

2. Is this program described in a readily available, written policy statement? Yes ( ) No ( )

3. Does the organization have provision for:

Health counseling and education?	Yes ( )	No ( )
Sight and hearing conservation?	Yes ( )	No ( )
Prevention of occupational dermatitis (e.g., solvent cleaner burns)?	Yes ( )	No ( )
Protection form exposure to harmful physical and chemical agents?	Yes ( )	No ( )
Personal hygiene?	Yes ( )	No ( )
Stress, resulting from a behavioral or situational type of problem?	Yes ( )	No ( )
Instruction in the proper use and fitting of personal protective equipment?	Yes ( )	No ( )
Immunizations?	Yes ( )	No ( )
Biological hazards (e.g., bites, stings, poisonous plants)?	Yes ( )	No ( )

4. Does the organization have written policies with regard to the following:

Alcoholism?	Yes ( )	No ( )
Mental illness?	Yes ( )	No ( )
Drug abuse?	Yes ( )	No ( )
Smoking hazards?	Yes ( )	No ( )
Obesity?	Yes ( )	No ( )
Cancer?	Yes ( )	No ( )
Pulmonary problems?	Yes ( )	No ( )
Hypertension?	Yes ( )	No ( )
Nutrition?	Yes ( )	No ( )
Family problems?	Yes ( )	No ( )

5. Are appropriate medical facilities available on-site or at a nearby location? Yes ( ) No ( )

6. Is an occupational nurse (RN, LPN) or nurse's aide available on-site or by agreement? Yes ( ) No ( )

7. Is an "on-call" physician available on-site or at a nearby location? Yes ( ) No ( )

8. Is the physician:

Qualified in occupational medicine?	Yes ( )	No ( )
Experienced in occupational medicine (3 years full time or equivalent)?	Yes ( )	No ( )

9. Is the physician consulted for possible medical effects of all new products or processes before proposed changes? Yes ( ) No ( )

10. Is the employee informed of the results of his medical examination or biological monitoring? Yes ( ) No ( )

11. Are the following medical tests and examinations normally given during preplacement and periodic examinations: Yes ( ) No ( )

Spirometry (pulmonary function - FEV_1/FVC?	Yes ( ) No ( )
Chest X-ray?	Yes ( ) No ( )
Back X-ray?	Yes ( ) No ( )
Complete blood counts (CBC)?	Yes ( ) No ( )
Neurologic examinations?	Yes ( ) No ( )
Visual acuity?	Yes ( ) No ( )
Color Blindness?	Yes ( ) No ( )
Appropriateness of corrective lenses?	Yes ( ) No ( )
Audiometric testing?	Yes ( ) No ( )

12. Is audiometric testing conducted periodically? Yes( ) No ( )

13. Is the assessment based on visual and audiometric testing made available to the:

Worker concerned?	Yes ( ) No ( )
Worker's supervisors?	Yes ( ) No ( )
Medical (physician) consultant?	Yes ( ) No ( )
Other (specify) _____	

14. Does the preplacement examination provide for an assessment of potential vertigo (dizziness)? Yes ( ) No ( )

15. Do preplacement and periodic medical examinations include an assessment of each worker's cardio-pulmonary function relative to his ability to use positive and negative pressure respirators without significant discomfort or harm? Yes ( ) No ( )

16. Does medical evaluation to assess the effects of exposure by individual employees to pesticides include:

Complete blood count?	Yes ( ) No ( )
Specific pesticide blood analysis?	Yes ( ) No ( )
Neurological (motor function) examination?	Yes ( ) No ( )
Urinalysis for pesticide metabolites?	Yes ( ) No ( )

17. Is eye and skin protection provided worker potentially exposed to pesticides? Yes ( ) No ( )

18. Are topics covered and attendance records kept at safety and health education meetings? Yes ( ) No ( )

19. Does the educational program include training in:

Recognition of warning signs and posters?	Yes ( )	No ( )
Understanding of safety manuals?	Yes ( )	No ( )
Good work practices?	Yes ( )	No ( )
Individual job training?	Yes ( )	No ( )
First aid?	Yes ( )	No ( )

20. Have the first-aiders in each section on each shift received training from the American Red Cross, or by equivalent means? Yes ( ) No ( )

21. Are the first-aid kits periodically inspected? Yes ( ) No ( )

22. Are consumable items in the first-aid kit replaced immediately after use? Yes ( ) No ( )

23. Are the names, addresses, and phone numbers of advisory physicians or alternate medical facilities posted for all supervisors and first-aiders to use? Yes ( ) No ( )

24. Is an eye-wash fountain (with sufficient water for 15 minutes of irrigation) available at all sites where substances may be splashed in the eye? Yes ( ) No ( )

25. Have employees been instructed in proper eye-flushing technique? Yes ( ) No ( )

26. Is drinking water replacement available for workers exposed to excessive heat stress? Yes ( ) No ( )

27. Are appropriate employees made aware of materials and processes likely to create potential health hazards. Yes ( ) No ( )

NOISE

The questions in this section of the Self-Evaluation Instrument are designed to identify potential health hazards to employees resulting from exposure to excessive noise, and to evaluate your establishment's program to protect employees from this hazard. An effective program includes:

-- Regular monitoring of noise levels in the work environment.
-- Engineering and administrative controls to protect employees from excessive exposure;
-- The use of hearing protective equipment (noise attenuating devices) by employees where controls have not sufficiently reduced exposure.
-- Periodic medical evaluation to assess the effect of exposure on individual employees.
-- Education and training of employees.

The ill-effects of noise in general, and industrial noise in particular, can be prevented by controlling noise at its source, or at least by protecting the employee against the effects of noise. Measurement, control, and protection from hazardous noise is a solvable technical problem. The identification of potentially hazardous noise sources is the first step. After identifying the sources of noise, the establishment can design a noise survey that will measure its intensity, frequency distribution, and duration. The results of the survey can then be used to define the appropriate mechanism for the control of the noise. In addition, the level of noise exposure that employees experience can be evaluated to determine the possible threat of noise-induced hearing loss as well as the other ill-effects resulting from noise exposure. This evaluation can be used to define the appropriate mechanism for protection of the employee against any noise-related ill-effects.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Have noise levels been measured? Yes ( ) No ( )

2. Are exposure records kept on all employee exposed to noise? Yes ( ) No ( )

3. Have engineering controls been used to reduce noise levels? Yes ( ) No ( )

4. Is a low noise requirement included in specifications for potentially noisy new equipment? Yes ( ) No ( )

5. Which of the following administrative controls have been used by this establishment to minimize individual employee exposure to noise:

Rotation of workers?	Yes ( )	No ( )
Frequent rest periods?	Yes ( )	No ( )
Cafeterias and rest areas located in quieter places?	Yes ( )	No ( )
Only essential work done in noisy area?	Yes ( )	No ( )

Other (specify) _____

NOISE STRESS
(MEDICAL)

Noise is defined as undesirable sound. Noise occurring in the occupational environment can cause: (1) noise-induced hearing loss; (2) stress-related illness (physiological or psychological); and (3) decreased job performance. Hearing loss, which is recognized as the most serious of these ill effects, is easily identified and measured. There are insufficient data at this time for determining clear cause and effect relationships between excessive exposure to noise and other problems. However, a hearing conservation program designed to eliminate noise-induced hearing loss should also reduce the risks of all noise-related ill-effects.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help. It is important that this section be completed by the physician. Ideally the physician or full-time on-site nurse and supervisor will conduct a walk-through survey when answering the questions.

1. Have employees exposed to noise received audiometric testing within the past 2 years? Yes ( ) No ( )

2. Does the medical and Occupational Toxic Exposure History of employees working with or exposed to noise include past and present exposure and results of audiometric testing? Yes ( ) No ( )

3. Are preplacement audiometric tests required? Yes ( ) No ( )

4. Are medical records (including results of audiometric testing) maintained on employees exposed to noise? Yes ( ) No ( )

5. Is there an ongoing preventive health program to educate employees in the following:

   Safe levels of noise exposure? Yes ( ) No ( )
   Personal protection against excessive noise exposure? Yes ( ) No ( )
   Effects of noise exposure on health? Yes ( ) No ( )

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment is required whenever toxic or other substances can do bodily harm through absorption, inhalation, or physical contact. Various processes, environments, chemicals, or mechianical irritants constitute hazards for which personal protective devices for the eyes, face, head, and extremities, as well as protective clothing and respiratory devices, are required.

All personal protective equipment must be properly designed and sufficiently well constructed to provide the protection for which it is intended. It must be maintained in a sanitary and reliable condition.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Do hard hats used by employees meet the requirements of American National Standards Institute (ANSI) standard Z89.1 - 1969 Industrial Protective Helmets? Yes ( ) No ( )

2. Are employees who require corrective lenses required to use industrial safety glasses or to wear protective goggles over their glasses? Yes ( ) No ( )

3. Is a medical assessment and a physical examination performed on personnel required to use self-contained respirators? Yes ( ) No ( )

4. Is there an established inspection program for respirators? Yes ( ) No ( )

5. Are records of respirator inspections maintained? Yes ( ) No ( )

6. Are the respirators used certified by the National Institute for Occupational Safety and Health (NIOSH)? Yes ( ) No ( )

7. Are employees who use respiratory equipment instructed in the proper methods and of use and required to clean, inspect, and sanitize respirators? Yes ( ) No ( )

8. Does all safety toe footwear conform to ANSI standard Z41.1(1967)? Yes ( ) No ( )

9. Is protective clothing available and required to be worn conforming to 29CFR1910.132 Yes ( ) No ( )

SANITATION

Sanitation and good housekeeping are essential parts of any effective occupational safety and health program. The questions in this section of the Self-Evaluation Instrument are designed to identify potential sources for the spread of infection and disease and to evaluate the establishment's program to prevent unsanitary conditions. An effective sanitation program includes:

-- Regular inspection of facilities to identify unsanitary conditions.
-- A frequent, regular program of housekeeping;
-- Review of records to determine if there is any connection between poor sanitation and employee illness or absence.
-- Education of employees in personal hygiene.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1.	Is housekeeping a regularly scheduled activity at this establishment?	Yes ( ) No ( )
2.	Are floors kept dry and clean?	Yes ( ) No ( )
3.	Are work areas kept clean?	Yes ( ) No ( )
4.	Are machines and equipment kept clean?	Yes ( ) No ( )
5.	Do work areas have a sufficient number of waste receptacles?	Yes ( ) No ( )
6.	Are waste receptacles leakproof?	Yes ( ) No ( )
7.	Are waste receptacles kept clean?	Yes ( ) No ( )
8.	Are waste receptacles emptied regularly?	Yes ( ) No ( )
9.	Are regular inspections made for insects, rodents, and vermin?	Yes ( ) No ( )
10.	Are drinking water dispensers kept clean and sanitary?	Yes ( ) No ( )
11.	Are all nonpotable water outlets clearly marked?	Yes ( ) No ( )

12. Are nonpotable water outlets separate (i.e., free from cross connections) from the potable systems? Yes ( ) No ( )

13. Are an adequate number of properly equipped toilet facilities provided? Yes ( ) No ( )

14. Is consuming or storing food and beverages in toilet rooms or near toxic materials prohibited? Yes ( ) No ( )

15. Are safety wash stations (shower, tank and/or eyewash) provided? Yes ( ) No ( )

VEHICLES AND CRANES

Employees should never be allowed to drive and operate specialized power equipment unless properly trained and authorized to do so.

Drivers and operators must learn to acquaint themselves with the overall height and width of the equipment when loaded as well as unloaded. They should be constantly alert to avoid striking overhead projections (underpasses, bridges, etc.).

It is the responsibility of all vehicle operators to know and obey all local, state, and Federal regulations and know and practice defensive driving.

The questions are intended to evaluate the effectiveness of your vehicle safety program. They concern motorized equipment that is used on the road, such as trucks, passenger cars, buses, motorcycles, and off-the-road equipment, such as bulldozers and road graders.

Since most motor vehicle accidents are due either to unsafe driving practices or to poor equipment maintenance, an effective vehicle safety program should include the following areas of concern:

-- Systematic inspection and formalized preventive maintenance of each vehicle.
-- Formal training and selection of operators and maintenance personnel.
-- Thorough investigation of each vehicle accident.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are tools boxes stored so as not to interfere with access or operation? Yes ( ) No ( )

2. Are bulldozer and scraper blades, end loaders, and dump-body vehicles required to be fully lowered or blocked when not in use? Yes ( ) No ( )

3. Are all dump-body vehicles equipped with a positive means of support that is permanently attached and capable of being locked in position to prevent accidental lowering of body during maintenance and inspection? Yes ( ) No ( )

4. Do all job-site vehicles having an obstructed view to the rear have reverse signal alarms audible above the surrounding noise levels, or else is an observer always present to signal the driver when it is safe to back? Yes ( ) No ( )

5. Do dump trucks that are loaded by front-end loaders or cranes have a cab shield adquate to protect the operator from shifting or falling materials? Yes ( ) No ( )

6. Is it required that a periodic safety check be made of all job site vehicles to ensure that all safety equipment and accessories are in safe operating condition? Yes ( ) No ( )

7. Are new drivers carefully selected on the basis of driving record and physical and mental health? Yes ( ) No ( )

8. Are new drivers properly trained for the particular equipment they will operate? Yes ( ) No ( )

9. Is the proficiency of all drivers periodically reviewed? Yes ( ) No ( )

10. Are all accidents reported to the supervisor whether or not property damage or injuries have occurred? Yes ( ) No ( )

11. Are written records kept of all accidents? Yes ( ) No ( )

12. Are all accidents investigated and actions instituted to prevent recurrence? Yes ( ) No ( )

13. Are accident repeaters retrained or removed from their job? Yes ( ) No ( )

14. Are drivers prohibited from drinking while driving? Yes ( ) No ( )

15. Are employees driving or riding in vehicles required to use safety belts all the time? Yes ( ) No ( )

16. Are the following required of drivers:

Inspect vehicle daily?	Yes ( ) No ( )
Report immediately items needing repair?	Yes ( ) No ( )
Verify load is secured?	Yes ( ) No ( )
Check to see that all doors are locked?	Yes ( ) No ( )
Other (specify) _____	

17. Are plant roads well-marked, with signs posted to keep traffic flowing safely at a reasonable speed? Yes ( ) No ( )

18. Are warning signs, barricades, and lights maintained in repair and construction areas, and promptly provided as dangerous conditions occur? Yes ( ) No ( )

19. Is there a regularly scheduled preventive maintenance program for each vehicle? Yes ( ) No ( )

20. Are written records kept of maintenance performed? Yes ( ) No ( )

21. If locomotives are used:

Are all locomotive operators trained in their use?	Yes ( ) No ( )
Are employees prohibited from riding locomotive footboards?	Yes ( ) No ( )

22. If mobile cranes are used:

Are mobile cranes equipped with fire extinguishers?	Yes ( ) No ( )
Are rated-load capacities and hazard warnings posted in view of the operator?	Yes ( ) No ( )
Is the equipment inspected by a competent person before each use?	Yes ( ) No ( )
Are mobile cranes inspected annually by a competent person?	Yes ( ) No ( )
Are records kept of annual inspections?	Yes ( ) No ( )

WALKING AND WORKING SURFACES

All places of employment, passage ways, storerooms, and service rooms must be kept clean and orderly and, as far as possible, in a dry condition. Where mechanical handling equipment is used, safe clearances must be allowed for aisles, at loading docks, through doorways, and wherever turns or passage must be made. Aisles and passageways must be kept clear and appropriately marked. Covers and guardrails must be provided to protect personnel from the hazards of open pits, tanks, floor or wall openings, elevated platforms, etc.

Scaffolds and manually propelled mobile ladder stands are elevated work platforms that support people and materials. The questions in this section of the Self-Evaluation Instrument are meant to evaluate the design, construction, use, and maintenance of different types of scaffolds that you may be using at your establishment.

The different types of scaffolds include:

-- Fixed scaffolds, such as those of tubular steel, are usually of a temporary nature and are generally dismantled when they are no longer needed.
-- Suspended scaffolds, often called swinging scaffolds, are light-duty, temporary units, suspended from overhead supports, and raised and lowered to the desired level by tackle or hoisting machines. These should not be confused with powered platforms, used for exterior building maintenance, which are permanent installations. These are covered in another section of this Self-Evaluation Instrument.
-- Mobile scaffold towers and ladder stands are equipped with wheels or casters and may be kept assembled and moved to new locations as necessary.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are all walkways provided with sufficient lighting to clearly distinguish the walking surfaces? Yes ( ) No ( )

2. Are aisles clearly defined and marked? Yes ( ) No ( )

3. Are all walkways and aisles free of protrusion, loose material, rock or any material that could cause a bumping, tripping, or falling hazard? Yes ( ) No ( )

4. Is workspace other than aisle space provided for all machine operators? Yes ( ) No ( )

5. Are all holes and openings provided with guardrails, or fitted with a flush cover of sufficient strength for the anticipated load? Yes ( ) No ( )

6. Are signs showing floor load capacity present? Yes ( ) No ( )

7. Are standard guardrails provided around all open pits? Yes ( ) No ( )

8. Are all platforms provided with toeboards and guardrails as required? Yes ( ) No ( )

9. If a wax is applied to floors, is it nonslip wax? Yes ( ) No ( )

10. Are walkways that are subject to water or other liquids provided with nonslip surfaces? Yes ( ) No ( )

11. Are mats provided inside entrance doors so people can wipe snow and ice from their shoes before walking onto a floor that is slippery when wet (e.g., terrazzo or varnished concrete)? Yes ( ) No ( )

12. Are there standard stair rails or handrails on all stairways having four or more risers? Yes ( ) No ( )

13. Are all stairs at least 22 inches wide? Yes ( ) No ( )

14. Are all stairs well illuminated? Yes ( ) No ( )

15. Do stairs angle no more than 50° and no less than 30°? Yes ( ) No ( )

16. If there are elevators at this establishment:

Are all elevators inspected regularly? Yes ( ) No ( )
Does this establishment have a current elevator inspection certificate for each elevator? Yes ( ) No ( )
Are all elevators in good working condition? Yes ( ) No ( )

17. Is only one person at a time permitted on ladders designed for one-man operations? Yes ( ) No ( )

18. Are the joints between ladder side rails and steps tight? Yes ( ) No ( )

19. Are ladders free from improvised repairs and from modifications to make them longer? Yes ( ) No ( )

20. Are ladders sturdy and strong enough for their intended use? Yes ( ) No ( )

21. If no cage, well, or ladder safety device is provided on a fixed ladder, is there a landing platform for each 20 feet or fraction thereof, or a ladder safety devise? Yes ( ) No ( )

22. Are rung spacings uniform for fixed ladders? Yes ( ) No ( )

23. Are clearances adquate for fixed ladders? Yes ( ) No ( )

24. Do fixed ladders have at least 3 feet of extension at the top of the landing? Yes ( ) No ( )

25. Is the distance between the centerline of rungs on a fixed ladder and the nearest permanent object in back of the ladder at least 7 inches or more? Yes ( ) No ( )

26. Do all fixed ladders have a preferred pitch of 75°-90°? Yes ( ) No ( )

27. If a portable ladder cannot be placed so as to prevent slipping, is it lashed or held in position by some other means? Yes ( ) No ( )

28. Are portable ladders free of cracks, splinter burrs, and bent rungs or frames? Yes ( ) No ( )

29. On two-section ladders, is height adjustment made only when user is at the bottom of the ladder? Yes ( ) No ( )

30. Is it prohibited to use the top of an ordinary step ladder as a step? Yes ( ) No ( )

31. Are guardrails and toeboards installed on all sides of scaffolds that are to be used at a height of 10 feet or more? Yes ( ) No ( )

32. Are guardrails 40 to 44 inches high? Yes ( ) No ( )

33. Are toeboards a minimum 4 inches high? Yes ( ) No ( )

34. Whenever there is danger of material falling off the scaffold onto persons below, is a wire mesh enclosure or equivalent provided between the guardrail and the toeboard? Yes ( ) No ( )

35. Are scaffolds erected on solid ground and fastened or anchored to prevent accidental movement? Yes ( ) No ( )

36. Are employees prohibited from altering or horizontally moving scaffolds? Yes ( ) No ( )

37. Has a licensed structural engineer approved in writing any scaffold over 50 feet high? Yes ( ) No ( )

38. Are scaffold planks cleated to prevent lateral movement? Yes ( ) No ( )

39. Do scaffold planks extend no more than 12 inches, nor less than 6 inches, from the end supports? Yes ( ) No ( )

WATER TREATMENT CHEMICALS

The chemicals used in water treatment processes can have toxic effects on employees and can cause irritation to the skin, eyes, throat, and lungs when high concentrations are present. The degree of danger to the employee depends upon the specific chemical, its concentration, and his/her exposure.

It is important to be aware of the properties of all the different chemicals used in a power plant so that proper safeguards can be established. Potential health hazards can also arise from chemical mist or dust. Exposure can be by skin contact, ingestion, or inhalation. The questions in this Self-Evaluation Instrument are designed to identify potential health and safety hazards to employees resulting from exposure to water treatement chemicals and to evaluate the establishment's program to protect employees from these hazards. An effective program includes:

-- Regular monitoring of chemicals in the work environment.
-- Engineering and administrative controls to protect employees from excessive exposure.
-- The use of personal protective equipment by employees where controls have not sufficiently reduced the exposure.
-- Precautions for the storage and handling of chemicals.
-- Periodic medical evaluation to assess the effect of exposure on individual employees.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are emergency showers and eye-wash fountains (with sufficient water to provide 15 minutes of continuous, copious irrigation) provided in all areas where acids and caustics are present, including battery locations? Yes ( ) No ( )

2. Are all large containers of acids and caustics diked or curbed to contain spills or leaks? Yes ( ) No ( )

3. Are acid and caustic tanks labeled as to type and concentration? Yes ( ) No ( )

4. Are acid and caustic filling pipes prominently labeled? Yes ( ) No ( )

5. Have any air concentrations of acids or caustics been measured at this establishment? Yes ( ) No ( )

6. Is protective clothing or equipment or both (body suit, boots, gloves, face shield, acid goggles, respirator, hard hat, apron) readily available at acid and caustic locations? Yes ( ) No ( )

7. Are employees required to use protective equipment when working with or around acids and caustics? Yes ( ) No ( )

8. Are employees who work with or are exposed to acids and caustics forbidden to wear contact lenses? Yes ( ) No ( )

9. Is acid protective equipment readily available at all battery locations? Yes ( ) No ( )

10. Are all chemical spills promptly cleaned up using approved methods? Yes ( ) No ( )

11. Are some employees trained in emergency and rescue work in the event of major chemical spills or leaks? Yes ( ) No ( )

12. Are all storage areas posted with appropriate warning signs? Yes ( ) No ( )

13. Are employees trained to understand the hazards associated with water treatment chemicals and proper procedures for working with them? Yes ( ) No ( )

14. Are any ventilation measures used in areas where water treatment chemicals are being handled? Yes ( ) No ( )

15. Are two units of approved self-contained breathing apparatus readily available at ammonia and chlorine locations? Yes ( ) No ( )

16. If dry chlorine is used, is it stored in an area where it will not be mixed or contaminated with anything but water? Yes ( ) No ( )

WELDING, CUTTING AND BRAZING

The use of welding, cutting, and brazing equipment, especially by occasional users, poses potentially hazardous problems. All persons authorized to use such equipment must be first trained in the proper safeguards.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

INSTALLATION AND OPERATION OF OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING

1. Are precautions taken to prevent the mixture of air or oxygen with flammable gases except at the burner or in a standard torch? Yes ( ) No ( )

2. Are precautions taken to prevent acetylene from being generated, piped (except in approved cylinder manifolds), or utilized at a pressure in excess of 15 p.s.i. gauge pressure or 30 p.s.i. absolute pressure? Yes ( ) No ( )

3. Is the use of liquid acetylene prohibited? Yes ( ) No ( )

4. Are flashback arrestors required to be used? Yes ( ) No ( )

5. Are only approved apparatus (torches, regulators, pressure-reducing valves, acetylene generators, manifolds) used? Yes ( ) No ( )

6. Are cylinders constructed, maintained and marked in accordance with the requirements of this standard (29 CFR 1910.251-252)? Yes ( ) No ( )

7. Are cylinders kept away from radiators and other sources of heat? Yes ( ) No ( )

8. When inside buildings, are cylinders stored in well-protected, well-ventilated, dry location at least 20 feet from highly combustible materials? Yes ( ) No ( )

9. Are cylinders kept away from elevators, stairs, or gangways? Yes ( ) No ( )

10. Are the valves of empty cylinders closed? Yes ( ) No ( )

11. Are signs reading: DANGER - NO SMOKING, MATCHES, OR OPEN LIGHT, or the equivalent posted? Yes ( ) No ( )

12. Are acetylene cylinders stored valve-end up? Yes ( ) No ( )

13. Are oxygen cylinders stored at a distance from highly combustible materials, reserve stocks of other cylinders, or any other substance likely to cause or accelerate fire? Yes ( ) No ( )

14. Are cylinders, cylinder valves, couplings, regulators hoses, and apparatus kept free from oily or greasy substances? Yes ( ) No ( )

15. Is care taken so that a jet of oxygen can never strike an oily surface, or greasy clothes, or enter a fuel oil or other storage tank? Yes ( ) No ( )

16. When transporting cylinders by crane or derrick, is a cradle, boat, or suitable platform used? Yes ( ) No ( )

17. Is care taken not to drop or strike cylinders? Yes ( ) No ( )

18. Is it prohibited to lift or pry up cylinders by valve-protection caps? Yes ( ) No ( )

19. Unless secured on special trucks, are regulators removed and valve-protection caps put in place before moving cylinders? Yes ( ) No ( )

20. Do cylinders without fixed hand wheels have keys, handles, or nonadjustable wrenches on stem valves when in service? Yes ( ) No ( )

21. Is it required that care be taken to avoid cylinders becoming part of an electrical circuit? Yes ( ) No ( )

22. Is it prohibited to use cylinders as rollers or supports? Yes ( ) No ( )

23. Is it prohibited to tamper with numbers and markings stamped on cylinders? Yes ( ) No ( )

24.	Is it prohibited to tamper with safety devices and valves?	Yes ( ) No ( )
25.	Is it prohibited to use hammers or wrenches to open cylinder valves?	Yes ( ) No ( )
26.	If trouble is experienced with a cylinder valve, is the supplier notified and are his instructions followed?	Yes ( ) No ( )
27.	Are fuel-gas cylinders placed with valve-end up when in use?	Yes ( ) No ( )
28.	Are liquefied gases stored and shipped valve-end up?	Yes ( ) No ( )
29.	Is rough handling of fuel-gas cylinders prohibited?	Yes ( ) No ( )
30.	Is it prohibited to crack a fuel-gas cylinder valve near sources of ignition?	Yes ( ) No ( )
31.	Before a regulator is removed, is the valve closed and gas released from the regulator?	Yes ( ) No ( )
32.	Are cylinders with leaky valves or fittings removed from sources of ignition and slowly emptied?	Yes ( ) No ( )
33.	Is a warning notice posted near cylinders with leaky valves or fittings before the supplier is notified?	Yes ( ) No ( )
34.	Is it prohibited to use fuel-gas from cylinders without reducing pressure via a regulator?	Yes ( ) No ( )
35.	Is the cylinder valve always opened slowly?	Yes ( ) No ( )
36.	Is it prohibited to open the acetylene cylinder valve more than 1-1/2 turns of the spindle?	Yes ( ) No ( )
37.	If a special wrench is required, is it left in position?	Yes ( ) No ( )

38. Are fuel-gas cylinders connected to one manifold inside a building limited to 300 pounds of liquefied petroleum gas or 3000 cubic feet of other fuel-gas? Yes ( ) No ( )

39. If more than one manifold is in the same room, are they at least 50 feet apart or separated by a barrier? Yes ( ) No ( )

40. Is installation of service piping systems in compliance with this standard (29 CFR 1910.251-252)? Yes ( ) No ( )

41. Are underground pipe and tubing and outdoor ferrous pipe and tubing covered or painted with a material suitable for protection against corrosion? Yes ( ) No ( )

42. Are aboveground piping systems marked in accordance with ANSI A13.1-1956, "Scheme for the Identification of Piping Systems"? Yes ( ) No ( )

43. Are station outlets marked to indicate the name of the gas? Yes ( ) No ( )

44. Are piping systems tested and proved gas tight at 1-1/2 times maximum operating pressure? Yes ( ) No ( )

45. Are piping systems thoroughly purged of air before being placed in service? Yes ( ) No ( )

46. When lines are being purged of gas or air, are sources of ignition removed from uncapped openings? Yes ( ) No ( )

47. Is only approved equipment installed, and is it used as recommended by the manufacturer? Yes ( ) No ( )

48. Are service piping systems protected by pressure relief devices? Yes ( ) No ( )

49. Does hose for oxy-fuel gas service comply with the Compressed Gas Association and Rubber Manufacturer's Association "Specification for Rubber Welding Hose, 1958"? Yes ( ) No ( )

Is red used to identify the acetylene (and other fuel-gas) hose, green for oxygen hose, and black for inert gas and air hose? Yes ( ) No ( )

When parallel lengths of hose are joined together, are no more than 4 inches out of every foot of hose covered by tape? Yes ( ) No ( )

Do hose connections comply with the Compressed Gas Association "Standard Hose Connection Specifications, 1957"? Yes ( ) No ( )

Will hose connections withstand twice normal pressure, and no less than 300 p.s.i.? Yes ( ) No ( )

Are hoses showing leaks, burns, worn places, or other defects repaired or replaced? Yes ( ) No ( )

50. With respect to pressure-reducing regulators:

Are pressure reducing regulators used only for the gas and pressures for which they are intended? Yes ( ) No ( )

Do connections comply with the Compressed Gas Association "Regulator Connection Standards, 1958"? Yes ( ) No ( )

Is repair work performed by skilled, properly instructed mechanics? Yes ( ) No ( )

Are gauges on oxygen regulators marked USE NO OIL? Yes ( ) No ( )

Are union nuts and connections on regulators inspected before use and damaged parts destroyed? Yes ( ) No ( )

APPLICATION, INSTALLATIONS, AND OPERATION OF ARC WELDING AND CUTTING EQUIPMENT

1. Does the apparatus comply with "Requirements for Electrical Arc-Welding Apparatus,"

   NEMA EW-1-1962, National Electrical Manufacturers Association, or with "Safety Standard for Transformer-Type Arc-Welding Machines," ANSI C33.2-1956, Underwriters' Laboratories? Yes ( ) No ( )

2. Is open circuit (No Load) voltage of arc welding and cutting machines as low as possible and not in excess of the recommended limits? Yes ( ) No ( )

3. Where higher voltages are required are precautions taken to protect the operator? Yes ( ) No ( )

4. Under wet conditions, are automatic controls for reducing no load voltage used? Yes ( ) No ( )

5. Is the installation of arc welding equipment in compliance with the recommended standard? Yes ( ) No ( )

6. Are workers assigned to operate or maintain arc welding equipment familiar with OSHA requirements? If doing gas shielded arc welding, with "Recommended Safe Practices for Gas-Shielded Arc Welding," A6.1-1966, American Welding Society? Yes ( ) No ( )

7. Are all connections checked before starting? Yes ( ) No ( )

8. Is welding cable spread out before use? Yes ( ) No ( )

9. Is grounding of the machine frame and safety ground connections of portable machines checked? Yes ( ) No ( )

10. Is equipment checked to make sure there are no leaks of cooling water, shielding gas, or engine fuel? Yes ( ) No ( )

11. Is proper switching equipment for shutting down the machine provided? Yes ( ) No ( )

12. Are manufacturer's printed rules and instructions strictly followed? Yes ( ) No ( )

13. Are electrodes removed from the holders when not in use? Yes ( ) No ( )

14. Is care taken that unused electrode holders cannot make electrial contact? Yes ( ) No ( )

15. Is the electric power to the machine shut off when no one is in attendance? Yes ( ) No ( )

16. Are portable or fixed shields or both used to protect others from injurious rays? Yes ( ) No ( )

17. Is it prohibited to use cables with splices within 10 feet of the holder? Yes ( ) No ( )

18. Are the welders forbidden to coil or loop welding electrode cable around his/her body? Yes ( ) No ( )

19. Is the use of defective equipment prohibited? Yes ( ) No ( )

20. Are wet machines thoroughly dried and tested before being used? Yes ( ) No ( )

21. Are work and electrode lead cables frequently inspected for wear and damage, and replaced when needed? Yes ( ) No ( )

22. Do means for connecting cable lengths have adequate insulation? Yes ( ) No ( )

23. Is adequate operator training required? Yes ( ) No ( )

24. Is adequate supervision provided? Yes ( ) No ( )

FIRE PREVENTION - FIRE PROTECTION

1. If the object to be welded or cut cannot be moved, are movable fire hazards in the vicinity removed? Yes ( ) No ( )

2. If the object to be welded cannot be moved and fire hazards cannot be removed, are guards used to confine heat, sparks, and slag? Yes ( ) No ( )

3. Are precautions taken to prevent sparks from dropping through floor openings onto possibly combustible materials below? Yes ( ) No ( )

4. Is suitable fire extinguishing equipment available for instant use? Yes ( ) No ( )

5. Are fire watchers utilized when welding or cutting is performed in locations where a serious fire might develop? Yes ( ) No ( )

6. Are fire watchers instructed in their duties? Yes ( ) No ( )

7. Are floors in work areas swept clear for a radius of 35 feet? Yes ( ) No ( )

8. Are combustible floors kept wet, covered by damp sand, or protected by fire-resistant shields? Yes ( ) No ( )

9. When floors are wetted-down, are Personnel protected from shock? Yes ( ) No ( )

10. Is cutting or welding prohibited in the following situations:

In areas not authorized by management? Yes ( ) No ( )
In sprinkler-equipped buildings while such protection is impaired? Yes ( ) No ( )
In the presence of explosive atmospheres? Yes ( ) No ( )
Near readily ignitable materials? Yes ( ) No ( )

11. Are ducts and conveyor systems that might carry sparks protected or shut down? Yes ( ) No ( )

12. Are nearby combustible walls protected by fire-resistant shields or guards? Yes ( ) No ( )

13. When welding is done on metal walls, are precatutions taken to protect combustibles on the other side? Yes ( ) No ( )

14. Is welding prohibited on metal partitions, walls, ceilings, or roofs having combustible coverings, or on walls or partitions of combustible sandwich-type panel construction? Yes ( ) No ( )

15. Is cutting or welding prohibited on pipes or metal in contact with combustible walls, partitions, ceilings, or roofs? Yes ( ) No ( )

16. Has management:

Established areas for cutting and welding, and procedures for cutting and welding in other areas?	Yes ( ) No ( )
Designated a responsible individual for authorizing cutting and welding in areas not specifically designated for these operations?	Yes ( ) No ( )
Ensured that cutters and welders and their supervisors are suitably trained in safe operations?	Yes ( ) No ( )
Advised all contractors about flammable materials or hazardous conditions of which they may not be aware?	Yes ( ) No ( )

17. Before hot work is begun, are used drums, barrels, tanks, and other containers so thoroughly cleaned that no substances remain that could explode, ignite, or produce toxic vapors? Yes ( ) No ( )

18. Are hollow spaces vented before cutting or welding? Yes ( ) No ( )

19. Is a fire check made of the area 1/2 hour after completion of welding? Yes ( ) No ( )

20. When work is suspended for any appreciable period of time, are electrodes removed from holders, torch valves, closed, and fuel-gas and oxygen supply shut off at a point outside the confined area? Yes ( ) No ( )

21. Are torch valves closed and is the gas supply shut off when welding is suspended for any appreciable period of time, such as lunch or overnight? Yes ( ) No ( )

22. After welding operations are completed, is the hot metal marked to provide a warning to other workers? Yes ( ) No ( )

MISCELLANEOUS

1. Are welders and helpers working on platforms, scaffolds, or runways protected against falling? Yes ( ) No ( )

2. Is welding cable so placed that it is clear of passageways, ladders, and stairways? Yes ( ) No ( )

3. Does eye protection (helmets, hand shields, goggles) meet federal requirements? Yes ( ) No ( )

4. Are employees exposed to the hazards created by welding, cutting, or brazing operations protected with personal protective equipment and clothing, as required by 29 CFR 1910.132 and 29 CFR 1910.251-252? Yes ( ) No ( )

5. Is adequate ventilation provided in and where welding or cutting is performed? Yes ( ) No ( )

6. When working in confined places:

   Are environmental monitoring tests taken? Yes ( ) No ( )
   Are cylinders and welding machines left on the outside? Yes ( ) No ( )
   Is portable equipment on wheels securely blocked? Yes ( ) No ( )
   Are means provided for quick removal of welders in case of an emergency? Yes ( ) No ( )
   Is an attendant with a preplanned rescue procedure stationed outside? Yes ( ) No ( )

CHAPTER II

AMMONIA PLANT

The sections on NH_3 production are general in nature. However, the process flow and hazards involved should be somewhat similar in every NH_3 plant. Where temperatures and pressures are discussed these are approximate for a specific NH_3 installation.

Ammonia is a chemical component containing the elements nitrogen and hydrogen in a ratio of three parts hydrogen to every part of nitrogen. The process uses the raw materials air, steam and natural gas. Hydrogen is furnished by the natural gas and steam and the nitrogen is furnished by large volumes of compressed atmospheric air.

Ammonia production starts as steam as gas enters the primary reformer at a 3.5 - 4.0 steam to gas ratio. This steam comes in contact with a nickle oxide catalyst and is heated to approximately 1500 degrees F. Ninety percent of the methane (CH_4) is cracked (separation of the carbon and hydrogen) in this process. The process gas stream next enters the secondary reformer where air is combined with the gas stream and the remainder of the methane is cracked. The process gas stream then enters shift converters where it passes through a bed of iron oxide and copper oxide catalysts. Here, the steam and carbon monoxide components react to form hydrogen and carbon dioxide. The raw synthesis gas is then processed for carbon dioxide removal to yield a highly purified hydrogen/nitrogen gas. The next step is to remove the carbon dioxide gas and this is done by a solution containing monoethanolamine (MEA) or another absorbant chemical. The synthesis gas is then compressed to high pressure and enters a recycle loop passing through the ammonia converter. Only a portion of the hydrogen/nitrogen is converted to ammonia on eachpass. Recycling is necessary to convert all the gas to ammonia. The ammonia is cooled and condensed in a refrigeration process that lowers the liquid ammonia temperature to -26°F and is transferred to the large cryogenic storage tank where it is held at -28° F.

Primary health and safety hazards which one might expect to encounter in an ammonia plant arise from the following process conditions:

1. Explosive mixtures of hydrogen and methane in air.
2. High speed turbines.
3. Operations around pumps.
4. High and low temperatures generations.
5. Noise generation.
6. Gases and vapors monitoring.
7. Electronic and numerical process controls.
8. Start-up and turnaround procedures.
9. Exposure to high pressure equipment.

ANHYDROUS AMMONIA

Working with and around Anhydrous Ammonia (NH_3) can be performed safely when employees are knowledgeable of Anhydrous Ammonia's physicial and chemical characteristics. Accident prevention can be best achieved through initial and follow-up training on Anhydrous Ammonia and its effects. A complete personal protection equipment program and its enforcement are top priorities in a effective safety program for Anhydrous Ammonia processing plants.

Anhydrous Ammonia is a dry ammonia gas compressed and cooled by mechanical means to liquid form for convenience and economy in shipping, storing, and many processes. It is very irritating to the eyes, skin, and respiratory tract. The liquid produces severe burns. The gas has a sharp penetrating odor, detectable at about 50 ppm. Under certain conditions it can be a fire and explosion hazard. Flammable limits are approximately 16 to 25 percent by volume of ammonia in air. The vapors from Anhydrous Ammonia are slightly lighter than air and can pocket in high enclosed locations.

CARBON DIOXIDE

Carbon dioxide (CO_2) is a colorless and odorless gas which is generally regarded as a simple asphyxiant. Symptoms and signs of asphyxia (lack of oxygen in lungs); headache, dizziness, shortness of breath, and ringing in the ears may be observed when a person has experienced high concentrations where there is insufficient oxygen in the atmosphere to support life. Removal from exposure results in rapid recovery.

METHANE

Methane (CH_4) is the chief component of most natural gas. It is a major source of hydrogen for the manufacture of ammonia. It is a colorless, odorless, and tasteless gas. Fire and explosion hazards are ever present when exposed to heat or open flame. When controlling a methane fire, it is best to stop the flow of gas, and use carbon dioxide or dry chemical extinguishing agents. Signs and symptom of asphyxiation accompany overexposure to the gas. First aid involves removing the person to fresh air immediately.

HYDROGEN

Hydrogen (H) is a colorless, odorless, tasteless gas extracted from methane (marsh gas), when producing ammonia. It is an extremely flammable gas and exposure to heat and/or open flame causes highly dangerous fires or explosions. It reacts vigorously with oxidizing materials. Carbon dioxide and dry chemical agents are most effective in extinguishing a large hydrogen fire. Sometimes steam may also be used as a fire extinguishing material.

CARBON MONOXIDE

Carbon monoxide (CO) is a colorless, non-irritating and practically odorless gas. It usually results from uncontrolled burning of organic materials, as the oxygen concentration and availability for complete oxidation are rarely ideal.

Carbon monoxide is extremely dangerous in appreciable quantity and exposure to very low concentrations can be extremely hazardous. A person exposed to a 1.28 percent concentration of carbon monoxide in the air will become unconscious after two or three breaths and probably expire in one to three minutes.

Poisoning is entirely by inhalation of the gas and may come on practically without recognized symptoms in a person who is relatively quiet. As carbon monoxide has an affinity for hemglobin 210 times that of oxygen it combines with the hemoglobin and renders the red blood cells incapable of carrying oxygen to the tissues of the body. The effect on the body is one of asphyxia. Some of the early symptoms of carbon monoxide poisoning are shortness of breath, headache, fatigue and faulty judgment. Oxygen and air free from CO should be administered in order to eliminate the carbon monoxide through the lungs.

The presence of carbon monoxide can be detected only by scientific tests. TLV levels are 50 ppm and 55 Mg/M3, (PEL is 50 ppm).

DESULFURIZERS

Explosive mixture hazard potentials exist in an ammonia plant primarily from the presence of hydrogen in air and methane in air found around the desulfurizer, primary reformer, carbon dioxide absorber and methanator.

Natural gas flows through the desulfurizers passing through a bed of activated carbon which removes mercaptan sulfur or hydrogen sulfides from the feed gas. The desulfurizers can be operated in series or parallel service. There are valves and piping for taking either vessel off the line for steam regeneration while the process flow continues through the other.

Following a regeneration cycle of a desulfurizer through a system of valve changes, a desired amount of feed gas is allowed to flow through the bed and through the desulfurizers. It is extremely urgent that the operator be in constant contact with the control room any time the desulfurizers are taken out of, or put into service.

Samples of the gas leaving the desulfurizer which has been in service the longest are taken for sulfur analysis.

A check should be made to be sure that the regeneration valving is closed. This will prevent high pressure gas from getting into the stream system in the event a valve may not have sealed properly.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Have all personnel been instructed in explosive gases'
   - Dangers? Yes ( ) No ( )
   - Explosive limits? Yes ( ) No ( )

2. Have all personnel been instructed in the explosive range of methane mixtures? Yes ( ) No ( )

3. Are instruments available for testing CH_4? Yes ( ) No ( )

4. Are all employees trained in the use of these instruments? Yes ( ) No ( )

5. Are explosive meters used to detect possible concentrations of hydrogen (H)? Yes ( ) No ( )

6. Is equipment available for extinguishing a hydrogen fire? Yes ( ) No ( )

7. Are safety hot work permits required for welding in this area? Yes ( ) No ( )

PRIMARY REFORMING

After desulfurization, the gas is compressed and then preheated to approximately 750° F by flue gases in the reformer convection section.

The primary reformer is a fired furnace consisting of a number of rows of tubes, depending on the size of the plant. The tubes are packed with nickel oxide catalyst in the form of rings. Heat for the reaction is furnished by burners.

The basic primary reformer is divided into four parts, radiant section, convection section, auxiliary boiler and the combustion air-preheat section. The hot flue gases will be drawn through each of these sections by an induced draft fan and out a common stack.

Combustion air is furnished by the forced draft fan to the auxiliary boiler and the arc burners.

The reformer furnace is designed to attain maximum thermal efficiency by recovering heat from the flue gases withdrawn from the reformer radiant section. For firing the reformer furnace, the design is based on utilization of a mixture of natural gas and purge and flash gas from the ammonia synthesis. Coils are included for preheating the natural gas fuel to prevent burner plugging when purge gas is mixed with the natural gas fuel and for preheating the air used for fuel combustion.

The air supply for combustion in the secondary reformer is provided by a compressor. This compressor may also serve to supply air to the reformer furnace at plant start-up for heating the reforming catalyst.

The reaction in the primary reformer is endothermic and requires a continuous input of heat. In order to obtain tube outlet temperatures at 1450° F - 1500° F, a furnace radiant section temperature of 1850° F will be necessary. The firing of the furnace must be carefully regulated to avoid localized heating and cold kinks on the tubes. Furnace temperature should be monitored at each riser inlet tube bank.

The nickel oxide catalyst promotes an equilibrium reaction at a temperature of approximately 1450° F at 500 psi.

$$CH_4 + H_2O = CO + 3H_2$$
$$CO + H_2O = CO_2 + H_2$$

Temperatures - The overall effect of increasing reforming temperature on the effluent gas composition is to reduce the methane and carbon dioxide content. On decreasing reforming temperatures, the effects are reversed.

Pressure - The pressure of the system will vary with the plant rates, design and differential created within the system. Pressures should be maintained within the design limits of all components of the entire system including lines and vessels.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Do pump flanges, packing glands and valve stems have splash shields? Yes ( ) No ( )

2. Are pumps protected by adequately sized and properly located relief valves? Yes ( ) No ( )

3. When pump maintenance is required, are all of the following steps taken:

   Suction and discharge valves closed and tagged? Yes ( ) No ( )
   Drain and vent valves open and tagged? Yes ( ) No ( )
   Pump thoroughly flushed or purged? Yes ( ) No ( )
   Motor breaker open, locked and tagged? Yes ( ) No ( )
   Maintenance work permit required? Yes ( ) No ( )
   Blinds inserted, where necessary? Yes ( ) No ( )

4. Are pumps checked regularly for excessive heat and vibration levels when operating? Yes ( ) No ( )

5. Are pump seals and packing glands made of materials recommended for use in an ammonia plant? Yes ( ) No ( )

6. Are regular checks made of the area for leakage or other problems? Yes ( ) No ( )

7. Are regular checks made to assure that the process is being controlled? Yes ( ) No ( )

8. Are environmental measuring instruments calibrated before each test? Yes( ) No ( )

9. Is there a training program on all monitoring equipment in the plant? Yes ( ) No ( )

10. Is advanced technology reviewed as possible replacements for present techniques. Yes ( ) No ( )

11. Are fuel gas trips reset to establish enough draft? Yes ( ) No ( )

12. Is the fuel gas trip system and pilot light in the auxiliary boiler checked for firing in every other burner row during start-ups? Yes ( ) No ( )

13. On start-up are drains on furnace bottom headers blown out until dry? Yes ( ) No ( )

SECONDARY REFORMER

The Secondary Reformer is a vessel containing a bed of catalyst. Partially reformed gas and air are mixed in a chamber where combustion takes place to supply heat for the reforming action and provide nitrogen for hydrogen-nitrogen balance.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Have employees been trained in safe techniques of lighting the Secondary Reformer? Yes ( ) No ( )

2. Have employees been made aware of the rapid temperature changes that may be involved? Yes ( ) No ( )

3. Are temperature controlling instruments:

   Checked periodically? Yes ( ) No ( )
   Maintained on a routine basis? Yes ( ) No ( )

4. Is there a system for inspecting hot spots on the secondary reformer? Yes ( ) No ( )

5. Is the process air trip maintained in operative status? Yes ( ) No ( )

6. Are operators aware of the dangers of failure to remove air when loss of process gas occurs? Yes ( ) No ( )

PRIMARY AND SECONDARY SHIFT CONVERTORS

The gas/steam mixture is introduced into the top of the shift convertor, in which carbon monoxide (CO) is converted to carbon dioxide (CO_2) with an equivalent molar production of hydrogen, leaving approximately 0.3 percent of carbon monoxide (dry basis) in the effluent gas. This vessel contains two beds of catalyst in two sections; a primary section containing promoted-iron high-temperature shift (HTS) catalyst and a secondary section containing low-temperature shift (LTS) catalyst.

Flow of gas in the primary shift section is downward through the catalyst bed. In the primary section, carbon monoxide reacts with steam to form equivalent amounts of hydrogen (H) and carbon dioxide. The shift conversion reaction is a reversible one favored by low temperature The rate of reaction, however, is favored by high temperature. The design of the primary shift section is based on reducing carbon monoxide (equivalent to approximately 12.9 percent at the inlet) to a level of 3.1 percent on a dry basis. In passing through the catalyst bed in the primary section, the heat of reaction causes the gas temperature to rise approximately 100° F above the inlet gas temperature. The approximate outlet temperature of the gas bed is in the range of 800° F.

Process gas containing H_2, N_2 (nitrogen), H_2O (water vapor) and traces of CO and CH_4 (methane) leaves the low temperature shift convertor at approximately 450° F. The process gas passes through a demisting pad in the top of the raw gas separator drum and enters the bottom section of the CO_2 absorber.

Read all the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are appropriate fire extinguishers provided for various hazards present? Yes ( ) No ( )
   Are they clearly marked? Yes ( ) No ( )
   Are they kept at their designated location? Yes ( ) No ( )
   Are they mounted near the hazard point they are designed to protect? Yes ( ) No ( )

2. Are fire hydrants located in the area? Yes ( ) No ( )

3. Are operating personnel trained in the use of fire-fighting equipment? Yes ( ) No ( )

4. Are fire permits required for cutting, welding, and use of spark producing tools? Yes ( ) No ( )

5. Are checks made for combustible gases regularly and before all jobs requiring hot work permits? Yes ( ) No ( )

6. Are written hot work permits required before starting any hot work? Yes ( ) No ( )

7. Is there a re-check program for combustible gas after a job has been discontinued or vacated for a period of time? Yes ( ) No ( )

8. Are all employees instructed to block off the feed of combustible gases to areas where fire process or equipment? Yes ( ) No ( )

CARBON DIOXIDE REMOVAL

In the carbon dioxide (CO_2) absorber, raw synthesis gas is processed for the removal of the carbon dioxide to yield a highly purified hydrogen/ nitrogen (H/N) gas. The bulk of the carbon dioxide is removed by absorption using monoethanolamine (MEA) or other absorption chemicals.

Gas exits the raw gas separator and enters the carbon dioxide absorber at the bottom. Regenerated lean absorption solution (CO_2 free) flows via exchangers to suction at the circulating pumps from the carbon dioxide strippers. It is then introduced to the top tray of the carbon dioxide absorber. The down flowing absorption solution comes in contact with the up flowing synthesis gas thus absorbing the carbon dioxide from the gas.

The absorber is operated with the MEA or other absorption chemical level above the gas inlet, and the control of the liquid release from the bottom is by differential pressure developed by the liquid head. Operation in this manner forces gas bubbles through the liquid and achieves the best removal of carbon dioxide.

The essentially carbon dioxide free gas leaves the carbon dioxide absorber via a demisting pad in the top section where any entrained moisture is removed.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are pressure relief valves regularly checked and tested? Yes ( ) No ( )

2. Are block valves or blind flange provided where necessary for isolation of the absorber? Yes ( ) No ( )

3. Is there a temperature indicator to monitor the MEA or chemical absorption system? Yes ( ) No ( )

4. Are there indicators to check MEA or chemical absorption:

   Flow? Yes ( ) No ( )
   Levels? Yes ( ) No ( )

METHANATION
(CO CONVERSION)

Process gas from the carbon dioxide absorber flows to the methanator system. Prior to methanation, it is necessary to preheat the stream to approximately 600° F, the initiation temperature of the methanation reaction. Preheating is accomplished in exchangers through the use of process heat streams. A by-pass around the methanator feed preheater is provided to control the temperature of the feed to the methanator.

Following preheating of the carbon dioxide absorber overhead gas, the stream is delivered to the methanator, a vessel containing a bed of a high activity nickel-base catalyst that is very effective for reacting carbon monoxide (CO), carbon dioxide (CO_2), and even oxygen (O_2) with hydrogen (H) to form methane and water (CH_4 and H_2O). This reaction is exothermic and raises the effluent gas temperature to approximately 680° F.

Read all of the questions in this section; discuss the questions with those workers at your extablishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are procedures established for switching of MEA or absorption solution pumps? Yes ( ) No ( )

2. Is there an overspeed and trip control on each turbine? Yes ( ) No ( )

3. Is the methanator equipped with high temperature alarms? Yes ( ) No ( )

4. Are solenoid valves and solenoid switches manually reset? Yes ( ) No ( )

5. Are pressure control valves downstream of the methanator feed heater rountinely checked for leakage? Yes ( ) No ( )

6. Are process vent valves routinely checked for leakage? Yes ( ) No ( )

COMPRESSION OF SYNTHESIS FEED GAS AND AMMONIA SYNTHESIS

Following cooling of the methanator effluent, the purified synthesis gas containing hydrogen (H) and nitrogen (N) in a volumetric ratio is compressed in a reciprocating or centrifugal compressor. Recycled gas from the synthesis section is returned to the compressor and recycled with synthesis loop fresh feed.

Through a series of heat exchangers and the ammonia converter, the conversion of the hydrogen and nitrogen to ammonia (NH_3) takes place at temperatures of approximately 700° to 900° F, then continues through more heat exchangers for cooling to a separator where the converted ammonia is separated as product ammonia. Non-converted hydrogen and nitrogen continues to be recycled.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are there written procedures for start-up of:

Compressors?	Yes ( ) No ( )
Synthesis loop system?	Yes ( ) No ( )

2. Are employees trained in these procedures? Yes ( ) No ( )

3. Are pressure relief valves regularly checked? Yes ( ) No ( )

4. Is the SYN (synthesis) gas compressor equipped with:

Relief valves?	Yes ( ) No ( )
Pressure indicators?	Yes ( ) No ( )
Flow indicators?	Yes ( ) No ( )
High temperature alarms?	Yes ( ) No ( )
Low temperature alarms?	Yes ( ) No ( )
Oil pressure gauges?	Yes ( ) No ( )

5. Is your SYN gas system protected with safety shutdowns? Yes ( ) No ( )

6. If a start-up heater is used, is it purged with steam during start-up before firing? Yes ( ) No ( )

7. Are all sections of the SYN gas loop pressure protected by relief valves? Yes ( ) No ( )

8. Is the ammonia synthesis section protected by:

Relief valves?	Yes ( ) No ( )
Temperature indicators?	Yes ( ) No ( )
Pressure gauges?	Yes ( ) No ( )
Level indicators?	Yes ( ) No ( )
Control valves?	Yes ( ) No ( )

9. Are the compressors and turbines provided with:

Auxiliary lube systems?	Yes ( ) No ( )
Auxiliary seal oil systems?	Yes ( ) No ( )

10. Are remote shutdowns provided for all compressors? Yes ( ) No ( )

11. Are high speed compressors and turbines continually monitored for:

Excessive vibration?	Yes ( ) No ( )
Axial deviation?	Yes ( ) No ( )
Bearing temperatures?	Yes ( ) No ( )

12. Is there a procedure for checking your overspeed trip? Yes ( ) No ( )

13. When the turbine is shutdown is it rolled periodically to eliminate shaft bow? Yes ( ) No ( )

14. Are low oil pressure alarms provided? Yes ( ) No ( )

15. Are low oil pressure trips provided? Yes ( ) No ( )

16. Are these systems backed by manual shutdowns? Yes ( ) No ( )

17. Is the compressor lubrication oil system backed up with an autostart spare? Yes ( ) No ( )

18. Are all critical speeds of compresssor sets posted near speed control device of turbine? Yes ( ) No ( )

GENERAL SAFETY GUIDELINES

The following questions are not all inclusive, but are some of the minimum safety practices that should be incorporated into an effective and meaningful loss prevention program in anhydrous ammonia manufacture.

1. Are employees trained in use of compressed air breathing apparatus? Yes ( ) No ( )

2. Is equipment available and required to be used for testing atmospheres for harmful or explosive gases? Yes ( ) No ( )

3. Do you have available breathing protection for harmful or dangerous gases? Yes ( ) No ( )

4. Are safety showers and eye wash stations located where any accidental contact with chemical may occur? Yes ( ) No ( )

5. Are designated employees trained in use of gas testing instruments? Yes ( ) No ( )

6. Are they fully aware of any limitations to these instruments:

   Carbon Dioxide (CO_2)? Yes ( ) No ( )
   Oxygen (O_2)? Yes ( ) No ( )

7. Are emergency plans established for extinguishing a hydrogen fire? Yes ( ) No ( )

8. Are safety instructions given to employees before starting any potentially hazardous job task? Yes ( ) No ( )

9. Has a complete noise level survey been made of the entire operations unit? Yes ( ) No ( )

10. Have high noise level areas been so designated and marked with "Hearing Protection Required" signs? Yes ( ) No ( )

11. Have noise barriers been installed around the compressor train? Yes ( ) No ( )

12. Have the high pressure steam vents been provided with silencers? Yes ( ) No ( )

13. Do air vents on the compressor discharge have silencers installed?

14. Are all personnel working near or in a moderately high noise level:

    Aware of permissible exposure times? Yes ( ) No ( )
    Adequately protected with prescribed ear plugs or muffs? Yes ( ) No ( )

15. Are safe entry permits required before entering any vessel? Yes ( ) No ( )

16. Is a designated watchman present before entering a vessel? Yes ( ) No ( )

17. Is an oxygen content check required to be made before entering a vessel or enclosure? Yes ( ) No ( )

SPECIAL GUIDELINES

1.	Is there a program to examine and test flexible ammonia (NH_3) hose?	Yes ( ) No ( )
2.	Are relief valves and other over pressure devices inspected periodically?	Yes ( ) No ( )
3.	Are periodic visual inspections made on anhydrous ammonia storage vessels and tanks?	Yes ( ) No ( )
4.	Do the plant furnaces have flame out controls to shut off gas in the event of loss of flame to prevent explosion?	Yes ( ) No ( )
5.	Is preventive maintenance performed on the flame out controls periodically?	Yes ( ) No ( )
6.	Is a hot work permit required before attempting to weld, cut, or braze in designated areas?	Yes ( ) No ( )
7.	Is there a procedure for purging vessels or lines that may contain flammable or dangerous substances before welding, cutting, or brazing?	Yes ( ) No ( )
8.	Is there a fire watch program?	Yes ( ) No ( )

MEDICAL AND FIRST AID

1.	Is a preplacement audiometric test performed?	Yes ( ) No ( )
2.	Is periodic audiometric testing done?	Yes ( ) No ( )
3.	Are employee medical records kept for the length of service plus time required by regulations or recommendations?	Yes ( ) No ( )
4.	Is health education provided for:	
	Vision conservation?	Yes ( ) No ( )
	Hearing conservation?	Yes ( ) No ( )
	Skin hygiene?	Yes ( ) No ( )
	Prompt and accurate reporting of accidents or injury?	Yes ( ) No ( )
	Use of protective equipment for:	
	Respiration?	Yes ( ) No ( )
	Vision?	Yes ( ) No ( )
	Hearing?	Yes ( ) No ( )
	Skin?	Yes ( ) No ( )
	Good work practices?	Yes ( ) No ( )
	Specific hazards?	Yes ( ) No ( )
	Toxicological and other harmful exposures?	Yes ( ) No ( )
	Personal hygiene, especially:	
	Smoking?	Yes ( ) No ( )
	Cleanliness?	Yes ( ) No ( )
5.	Are safety and health education meetings held on a regular basis?	Yes ( ) No ( )
6.	Are topics covered and attendance records kept of safety and health education meetings?	Yes ( ) No ( )
7.	Does the educational program include training in:	
	Recognition of warning signs and posters?	Yes ( ) No ( )
	Understanding of safety manuals?	Yes ( ) No ( )
	Good work practices?	Yes ( ) No ( )
	Individual job training?	Yes ( ) No ( )
	First aid?	Yes ( ) No ( )
8.	Have the first aiders in each section on each shift received training from the American Red Cross or equivalent training course?	Yes ( ) No ( )

9. Are first-aid kits inspected for completeness, appropriateness, and sanitation on a regular basis? Yes ( ) No ( )

10. Are the names, addresses, and phone numbers of advisory physicians or alternate medical facilities posted for all supervisors, workers, and first-aiders to use? Yes ( ) No ( )

HANDLING AND STORAGE

1. Are chlorine (Cl_2) cylinders required to be stored a safe distance away from ammonia? Yes ( ) No ( )

2. Are goggles required to be worn when handling chemicals that could be injurious to the eyes? Yes ( ) No ( )

3. Is the wearing of rubber gloves or other protective clothing when handling liquid ammonia? Yes ( ) No ( )

4. Are compressed flammable gases stored in designated areas? Yes ( ) No ( )

5. Are "No Smoking" signs posted in areas where vessels and tanks containing flammable products are located? Yes ( ) No ( )

6. Have employees been made aware that carbon dioxide (CO_2) can cause death by suffocation? Yes ( ) No ( )

7. Are employees aware that all gases lighter than air must be purged through the top of a vessel? Yes ( ) No ( )

8. Are hydrogen (H) cylinders stored away from oxygen (O_2) cylinders? Yes ( ) No ( )

9. Is breathing protection immediately available in ammonia loading, unloading, and sampling areas? Yes ( ) No ( )

10. Are employees instructed in the safe handling of compressed gas cylinders? Yes ( ) No ( )

CHAPTER III - NITRIC ACID

INTRODUCTION

The current methods of producing nitric acid involve oxidation reactions of ammonia (NH_3) with air (O_2) to give nitrogen oxide (NO) and nitrogen dioxide (NO_2), mainly, plus other nitrogen (N) oxides. Nitrogen dioxide is reacted with water (H_2O) in an absorber to give nitric acid plus nitrogen oxide which is reoxidized to nitrogen dioxide. This cycle continues in the absorption tower in a manner to give a 57-58 percent acid stream from the bottom and gases very low in nitrogen oxides from the top.

Major potential health and safety hazards which may be encounterd in any of the more common types of nitric acid plants might arise as follow:

From explosive mixtures (mainly between ammonia and air).
From pumping and handling of a strong acid such as nitric.
From generation of gases, some of which are toxic, such as some of those found in untreated stack gases.
From the generation and processing of high-pressure steam (since production of by-product steam is a desirable feature of the nitric acid manufacturing process).
From the use of high-voltage electric equipment such as that used for many of the motors driving centrifugal compressors.
From the operation of high-speed machinery.
From noise generated by operation of high-speed machinery.
From heat generation.

EXPLOSIVE MIXTURES

Explosive mixture hazard potentials exist in a nitric acid plant primarily from two major sources: from the ammonia-air mixture at the gauze and from the use of the hydrogen torch that is used to light the gauze.

It is imperative that a flame be maintained at the hydrogen torch at all times during the light-off so that hydrogen accumulation, which could subsequently be exploded, is not permitted.

It is also necessary that the vaporized ammonia be admitted to the air stream rather rapidly so that a minimum of ammonia is permitted to pass the catalyst gauze unreacted. An important judgment must be made by the person lighting the gauze. If the gauze does not light in a short time period, the ammonia should be shut off and the system purged with air to get rid of any possible explosive mixture.

The oxidation of ammonia with air is carried out only a few volume percentage points below the explosive range; therefore the necessity for properly trained personnel and well maintained control instruments.

There are some other, more subtle, potential instances for the formation of mixtures which could lead to explosions.

Nitrous gases can combine with ammonia to form ammonium nitrite and ammonium nitrate. The plant is especially vulnerable to nitrite formation during start-up. Care must be taken that these nitrite compounds are flushed from the system and not allowed to pocket in low points.

Instrument technicians must also be aware of the fact that ammonia and mercury are not allowed to contact each other as the azides, which could result, are highly explosive. In addition to mercury and ammonia, the use of glycerine-filled diaphragm gages or transmitters in or near nitric acid service could also result in explosive mixtures.

Management must carry on a continuing training program with operating and maintenance personnel to assure that all personnel are familiar with these hazard potentials and with the methods for preventing their occurences.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Is a record kept of those personnel that have been instructed in the explosive range of air/ammonia mixtures? Yes ( ) No ( )

2. Have all personnel been instructed in hydrogen-air mixture explosive limits? Yes ( ) No ( )

3. Is nitrate flushed from compressor wheels periodically? Yes ( ) No ( )

4. Are fire or burning permits required for welding? Yes ( ) No ( )

5. Is the discharge temperature of the air compressor below the auto-ignition point for air/oil mixtures? Yes ( ) No ( )

6. Are the plant or area rules enforced against smoking and using flame or sparking devices in areas where explosive mixtures might be present? Yes ( ) No ( )

PROCESS CONTROLS

There are two general types of process controls; electronic and pneumatic. In the modern plant, a combination of both is generally used.

These two types of controls can be further broken down into three main systems, i.e., compressor train controls, ammonia system control, and miscellaneous process critical system controls.

It is essential that the operator keep constant watch over all instruments to insure that any malfunction is observed immediately. Only in this way can unnecessary shutdowns be avoided and protection of the personnel and plant be assured.

A complete and automatic alarm and trip system should be provided to protect the plant and personnel should process variables reach points at which equipment could be damaged or fail. The alarm system should be set to sound at a point prior to which the automatic tripping system will activate to allow corrective action to be taken if possible.

If manual action fails (because of time or any other reason) to correct the situation, the trip system must automatically act to stop ammonia flow, to bring rotating machines to a safe stop, to relieve critical pressures, and to automatically take care of other critical factors.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are check valves examined at planned intervals to assure proper operation? Yes ( ) No ( )

2. Are all relief valves tested at planned intervals? Yes ( ) No ( )

3. Are low- and high-gauze temperature alarms and trips provided? Yes ( ) No ( )

4. Is a record kept of routine checks made on various alarms and interlocks? Yes ( ) No ( )

5. Does the plant fail-safe upon loss of electric power? Yes ( ) No ( )

6.	Are either vibration monitoring or vibration trip devices provided?	Yes ( ) No ( )
7.	Does centrifugal equipment have overspeed trip protection?	Yes ( ) No ( )
8.	Are records kept of planned periodic calibrations of temperature controllers?	Yes ( ) No ( )
9.	Is the process designed so that a warning is sounded when nitric acid leaks into the cooling water system?	Yes ( ) No ( )
10.	Are all operating personnel trained in the use of instruments provided?	Yes ( ) No ( )
11.	Does the plant fail-safe upon loss of instrument air?	Yes ( ) No ( )
12.	Is the reactor or converter protected from a spill-over of liquid ammonia?	Yes ( ) No ( )

HIGH SPEED TURBINE OPERATIONS

A dynamic multi-stage compressor is commonly used in nitric acid plants to compress air. Such compressors are generally driven by a combination of an electric motor and a power recovery gas expansion turbine, which latter may furnish up to 90% of the power requirements of the compressor.

Compressors commonly operate in the range of 7,000 to 15,000 rpm so it should be clear that attention must be focused on items such as selecting and maintaining the systems for supplying lubrication continuously to bearings, for monitoring vibration and speed, and for installing trip-out systems which will shut down such equipment if speed or vibration threaten to exceed those values beyond which personnel or the machine could be harmed.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are high-speed compressor and turbine sets monitored at planned intervals for:

Vibration?	Yes ( ) No ( )
Axial deviation?	Yes ( ) No ( )
Bearing temperatures?	Yes ( ) No ( )

2. Is the overspeed trip tested at periodic intervals? Yes ( ) No ( )

3. Does the turbine shut down automatically when excessive vibration occurs? Yes ( ) No ( )

4. When the turbine is shut down is it rolled-over periodically to eliminate shaft bow? Yes ( ) No ( )

5. Are low-oil pressure alarms and low-oil pressure trips provided? Yes ( ) No ( )

6. Are oil pressure alarm and trip systems backed by appropriate manual shut-off systems? Yes ( ) No ( )

7. Is the compressor lubrication oil system backed up with an auto-start spare? Yes ( ) No ( )

8. Are all critical speeds of compressor set posted near speed control devices on turbines? Yes ( ) No ( )

OPERATION AROUND PUMPS

In the nitric acid area, the nitric acid pumps are those which require the most attention in order to avoid potential injury to personnel. There are other pumps in the area but excluding the normal precautions which must be taken around rotating machinery (see GENERAL" Section), there is no need to discuss these here.

Materials of construction, system design, secondary defense against flange leaks (which could consist of flange guards), installation of relief valves, and appropriately designed operating monitoring checks are some of the areas of concern.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Do pump flanges, packing glands, and valve stems have splash shields or flange guards? Yes ( ) No ( )

2. Are pumps protected by adequate size relief valves located to conform to the plant's engineering codes? Yes ( ) No ( )

3. When pump maintenance is required, are all of the following steps required:

   Suction and discharge valves closed and tagged? Yes ( ) No ( )
   Drain and vent valves open and tagged? Yes ( ) No ( )
   Pump thoroughly flushed with water? Yes ( ) No ( )
   Necessary blinds inserted? Yes ( ) No ( )
   Motor breaker open, locked, and tagged? Yes ( ) No ( )
   Maintenance work permit required? Yes ( ) No ( )

4. Are pumps checked at planned intervals for increase in heat and vibration level when operating? Yes ( ) No ( )

5. Are start-stop switches of pumps located so that pump can be stopped even if packing or seal should fail? Yes ( ) No ( )

6. Are pump seals or packing glands confined to materials recommended for use in nitric acid? Yes ( ) No ( )

7. Are pumps located within a curbed area? Yes ( ) No ( )

HEAT GENERATION

Large quantities of heat are evolved in the oxidation of ammonia to produce nitrogen oxides. Much of this evolved heat is captured in a "waste heat" boiler and the steam produced is exported to units outside the nitric acid plant area. Additionally, heat is extracted from hot gases and used to do useful work in a gas expansion turbine.

Because of the equipment and lines used to produce and to utilize heat within the nitric acid process areas, insulation of such hot equipment and lines is of primary concern in order to avoid potential injury to personnel.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Is insulation provided and maintained on hot lines to protect personnel? Yes ( ) No ( )

2. Are high-temperature alarms and trips provided to protect equipment? Yes ( ) No ( )

3. Is an air conditioned control room provided? Yes ( ) No ( )

4. Are all temperatures and pressures of heat generating equipment monitored and findings recorded as necessary? Yes ( ) No ( )

5. Do vessels used with heat generating equipment meet the appropriate ASME Code? Yes ( ) No ( )

6. Do personnel operating ignition equipment have:

   Visual contact with the lighting of the catalyst? Yes ( ) No ( )
   Adequate means to stop the reaction or streams to the reactor? Yes ( ) No ( )

7. Are the safety devices used on heat generating equipment tested periodically? Yes ( ) No ( )

8. Are records kept of these tests? Yes ( ) No ( )

9. Have effective filters been installed to prevent contamination of the burning catalyst by oil or other foreign materials? Yes ( ) No ( )

GENERATION OF GASES AND VAPORS

The combustion of ammonia with oxygen (oxygen obtained from atmospheric air) via catalytic gauzes takes place according to two summary reactions (although a great many minor side reactions also occur):

1. $4\ NH_3(g) + 5\ O_2(g) = 4\ NO(g) + 6\ H_2O(g)$
2. $4\ NH_3(g) + 3\ O_2(g) = 2\ N_2(g) + 6\ H_2O(g)$

The combustion is controlled in a manner such that reaction "2" is kept as low as possible. Approximately 96% of the ammonia oxidizes according to reaction "1" and only some 4% according to reaction "2".

Nitric acid is produced by:

$$3\ NO_2 + H_2 = 2\ HNO_3 + NO$$

The toxic effect of nitric acid and the oxides differ somewhat. It is a combination of these compounds which is commonly encountered in industry since the oxides may be formed whenever nitric acid is used or produced and these may be mixed with nitric acid vapors.

Gaseous oxides of nitrogen consist of nitrogen oxide (NO), dinitrogen oxide (N_2O), dinitrogen trioxide (N_2O_3), nitrogen dioxide (NO_2), and dinitrogen tetroxide (N_2O_4). The chemical relationship of these compounds is so close that they seldom occur separately. Toxicologically the most important are dinitrogen tetroxide, (N_2O_4) (colorless), and nitrogen dioxide, (NO_2) (dark brown), both highly toxic. The color of a mixture of these gaseous oxides varies from colorless to chocolate brown, depending upon the percentage composition, which is largely a function of temperature. A toxic concentration of the gaseous oxides may therefore be dark brown or colorless. The intensity of the color is not an indication of the degree of danger.

Gaseous oxides are formed when nitric acid comes in contact with certain metals, e.g., copper, brass, zinc, or any organic material.

Evidence of damage to the lungs following exposure to the oxides of nitrogen characteristically appears after a delay of 4-30 hours. This is in the form of pulmonary edema (accumulation of water-like fluid in the lungs), and may be severe and sometimes fatal.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are all acid plant personnel trained to be aware of the toxic effects of nitric acid vapors and gaseous oxides of nitrogen? Yes ( ) No ( )

2. Are personnel who work in the unit provided with proper respirator equipment in the event of a sudden leak or rupture? Yes ( ) No ( )

3. Is a record kept of all personnel that have been trained in the of use of various types of respiratory equipment? Yes ( ) No ( )

4. Is the air in the nitric acid plant monitored for nitric oxides? Yes ( ) No ( )

5. Do relief valves and/or rupture discs which might expel toxic vapors vent to a safe location? Yes ( ) No ( )

6. Do all flammable gas vents have flame arrestors? Yes ( ) No ( )

7. Are all enclosed areas properly ventilated? Yes ( ) No ( )

8. Is there an approved Nitrogen oxide (NO) detector available for use at the unit? Yes ( ) No ( )

HANDLING AND STORAGE OF PRODUCT

The product, "58 percent nitric acid," is corrosive. Fumes from this product are composed of acid mists; NO_2 and N_2O_4, and are potentially harmful to personnel.

The storage tank(s) should be located (if possible) in an area remote from operating areas and conservents should be installed. Vents from the tank should be located with the exit at some place designed to do no harm to personnel.

Acid lines should be drained and then flushed with water (after draining) to prevent burns to personnel who will be doing maintenance work on such lines. Since nitric acid can cause severe burns to skin, this point should be made forcefully in engineering guidelines bearing on providing line-runs, sampling stations, and other equipment in the storage area.

Read all of the questions in this section, discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey; complete this section with their help.

1. Is the storage tank vent located so that any escaping vapors cannot contaminate an operating area? Yes ( ) No ( )

2. Are acid sampling points adequately designed to prevent splashing of acid onto personnel using the apparatus? Yes ( ) No ( )

3. In the event of a spill or a rupture of the nitric storage tank, will its contents be contained by some secondary measure? Yes ( ) No ( )

4. Are combustible materials kept away from contact with nitric acid? Yes ( ) No ( )

5. Are storage tanks erected on a corrosive resistant foundation? Yes ( ) No ( )

6. Are precautions taken to insure that acid lines are drained and cleaned before maintenance work is performed? Yes ( ) No ( )

PERSONAL AND AREA PROTECTIVE EQUIPMENT

Protective equipment necessary to any operating unit depends upon the potential hazards that exist. Since the primary function of the plant is the oxidation of ammonia with air, there is always the danger of ammonia escaping from inside or from near the unit. The best available protection is to provide an isolation valve for the ammonia supply.

The nitric acid area must have a system of fire protection, ideally both a sprinkler system and portable equipment. Due to high temperatures generated in a nitric acid plant, insulation is mandatory on all vessels or piping which contain hot fluids, for the protection of personnel as well as equipment.

Other area protective equipment should include safety showers and eye washes (sufficient to supply a continuous, copious, 15-minute supply of water), and self-contained breathing equipment. Some plants may require an air sampling and monitoring system. Other area protective equipment may be needed depending on the location or situation of the nitric acid unit within a plant complex. Process Control Equipment, already described, is a special form of Area Protective Equipment.

While the "General" Section treats both Personal and Area Protective Equipment, some particularly pertinent questions also appear in this section.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Is special eye protection required and supplied In nitric acid area:

   Chemical goggles? Yes ( ) No ( )
   Face Shields? Yes ( ) No ( )

2. Is self-contained breathing equipment readily available? Yes ( ) No ( )

3. Are canister type gas masks readily available? Yes ( ) No ( )

4. Are masks issued and fitted on an individual basis? Yes ( ) No ( )

5. Is there a written record of replacement of canisters prior to expiration date? Yes ( ) No ( )

6. Do employees receive periodical training in use of:

   Hearing protectors? Yes ( ) No ( )
   Gas masks? Yes ( ) No ( )
   Self-contained breathing apparatus? Yes ( ) No ( )

7. Is the following protective clothing available:

   Rubber rain suits? Yes ( ) No ( )
   Full acid suit? Yes ( ) No ( )
   Acid-resistant rubber gloves? Yes ( ) No ( )
   Protective footwear? Yes ( ) No ( )

8. Are eye wash fountains and emergency showers (sufficient to provide a copious supply of water for 15 minutes) provided in the area? Yes ( ) No ( )

9. Do the operators in the area have communication equipment adequate to allow summoning of help in the event of an emergency? Yes ( ) No ( )

CHAPTER IV - UREA

Urea has the chemical formula NH_2CONH_2 and ranks as one of the top three nitrogen containing fertilizers used world wide. Urea has the highest nitrogen content (45 percent) of any solid nitrogen fertilizer.

When dissolved in water, urea hydrolizes very slowly to ammonium carbamate, which in turn eventually decomposes to ammonia and carbon dioxode. It is this slow decomposition process which is the basis for using urea as a fertilizer.

Urea is produced by the reaction of ammonia with carbon dioxide. Carbon dioxide is a waste product from the manufacturing of anhydrous ammonia. Therefore, urea plants are usually constructed in close proximity to an ammonia plant to convert waste carbon dioxide to urea.

There are three basic processes for converting ammonia and carbon dioxide to urea:

1. Once Through Process.

2. Partial Recycle Process.

3. Total Recycle Process.

The extent of the recycling of the ammonia and carbon dioxide back to the reactor determines the type of process for that plant. In the Once Through Process, none of the by-products (NH_3 and CO_2) forming the process are recycled, while a portion of the ammonia is recycled in the Partial Recycle Process. For the Total Recycle Process, all of the ammonia and a portion of the carbon dioxide are recycled either separately or in the form of a liquid ammonium carbamate solution. In all of the urea processes, the initial reaction involves the combining of ammonia and carbon dioxide at high pressures (2,000 to 5,000 psi) and at high temperatures (300 to 500° F) to form a hot molten urea solution. Caution should be taken in the plant to prevent accidental exposure.

The hot molten urea solution, normally obtained from the plant synthesis reaction, is a 70-75 percent by weight aqueous solution. This solution is either processed to solid urea or mixed with other materials, such as ammonium nitrate in an aqueous solution, to make nonpressure liquid fertilizers. Urea-melt is formed in one of two routes; evaporation or crystallization, with crystal remelts. The molten urea is them sprayed and solidified into small special particles called prills. Urea is also granulated by spraying urea melt onto a cascading bed or recycling fines in a rotating granulator.

The problems associated with urea bulk storage are primarily related to urea itself being hygroscopic. If the ambient humidity is over 60%, urea readily absorbs water from the atmosphere. This condition can cause serious pile setting and caking problems. If contamination of urea with other fertilizer materials takes place, particularly with ammonium nitrate or phosphatic fertilizers, the hygroscopic nature of urea is sharply increased.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered, and, while conducting a survey, complete this section with their help.

1. Are employees instructed in the proper procedures for storage and handling of urea? Yes ( ) No ( )

2. Is a program of pump maintenance and inspection carried out to prevent pump seals and shafts handling solutions containing urea from running hot and dry? Yes ( ) No ( )

3. Is entry to hopper cars or bulk trucks loaded with liquid or solid urea prohibited until any ammonia vapor accumulations have been removed and proper ventilation assured? Yes ( ) No ( )

4. Are work areas containing molten or hot urea liquids equipped with water flushing facilities? Yes ( ) No ( )

5. Are employees potentially exposed to molten or hot urea liquids provided with appropriate personal protective equipment? Yes ( ) No ( )

6. Are fresh air masks available within the urea plant for emergency use? Yes ( ) No ( )

7. Have employees been instructed concerning the operations of the equipment in the high pressure and temperature areas? Yes ( ) No ( )

8. Are safety relief valves (especially in high pressure service) periodically checked and maintained to prevent corrosion and product build-up in the valves. Yes ( ) No ( )

9. Are there remote start/stop switches for the high pressure compressors and pumps in the event of an emergency? Yes ( ) No ( )

10. Are alarms provided on the major process equipment for:

High temperature conditions?	Yes ( ) No ( )
High pressure conditions?	Yes ( ) No ( )

11. Are personnel instructed in the explosive range of air/ammonia mixtures? Yes ( ) No ( )

12. Do relief valves and rupture discs vent to safe locations? Yes ( ) No ( )

13. Are high noise areas identified and marked? Yes ( ) No ( )

NEUTRALIZATION PROCESS TO PRODUCE 83% AMMONIUM NITRATE SOLUTION

INTRODUCTION

In this process anhydrous ammonia vapor and aqueous nitric acid solution are reacted (generally in the presence of a solution of about 80 percent ammonium nitrate and water) to produce an ammonium nitrate-water solution.

The heat of the reaction is generally sufficient (with some preheating of the ammonia vapors) to allow evaporation of reaction water formed to establish a remaining equilibrium mixture of about 83 percent by weight of ammonium nitrate in water.

Control of the reaction can be difficult at times and eruptions of liquid from the reaction vessel are not uncommon when one or the other of the reactants builds up to an excess and the situation is reversed, resulting in a greater than normal reaction rate with a consequential increase in evolution of heat, vapors, and pressure.

Cautions must be observed in handling the 83 percent ammonium nitrate solutions which must be kept at about 180° F in order to prevent solidification.

Depending on the type of pollution abatement facilities which have been installed, emissions of ammonia and oxides of nitrogen from the reaction vessel could be quite large.

The following are some of the potential health and safety hazards which may arise in the operation of this type of plant:

-- Exposure to concentrated acid.
-- Exposure to anhydrous ammonia.
-- Exposure to hot 83 percent ammonium nitrate solutions.
-- Exposure to high-pressure steam.
-- Exposure to liquid and vapor eruptions from the reaction vessel.
-- Possible generation of explosive mixtures.
-- Exposure to harmful vapors emitted from the reaction vessel stack.
-- Rapid decomposition or explosion of ammonium nitrate.

DETONATION POTENTIALS

Uncontaminated ammonium nitrate (AN) is a stable compound. However, when heated above 410° F, AN can decompose with increasing heat liberated by the decomposition. Impurities such as heavy metals (mercury, zinc, copper, etc.), chlorides, and free acid (low pH) will lower the temperature at which AN starts to decompose.

Since AN is an oxidizing agent, organic material (wood, oil, urea, paper, etc.) mixed with AN at higher temperatures might tend to produce fires. AN contains internal oxygen to sustain combustion of organics and smothering will not necessarily extinguish a fire; flooding with water helps to control an AN fire by cooling the mixture below the temperature necessary to sustain the reaction.

To prevent conditions which would favor a dangerous chemical reaction of an AN melt:

-- Limit the impurities to keep the decomposition temperature high.
-- Prevent contamination by organic material.
-- Prevent the AN melt from reaching dangerous temperatures.
-- Provide for unrestricted release of any gaseous decomposition products.
-- Provide a water quench for emergency temperature control.

Read all of the questions in this section; discuss the question with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are temperature controls set to keep material below the decomposition temperature? Yes ( ) No ( )

2. Are written procedures required to be followed to prevent pressure build up? Yes ( ) No ( )

3. Are specialized precautions taken to preclude contamination of nitrate by organic materials? Yes ( ) No ( )

4. Is good housekeeping practiced? Yes ( ) No ( )

5. Is the area kept free of carbonaceous materials? Yes ( ) No ( )

6. Is adequate water available? Yes ( ) No ( )

7. Have all personnel been made aware of the hazards of contaminating ammonium nitrate? Yes ( ) No ( )

8. Has the process been engineered in an attempt to eliminate possibilities for confining hot, molten nitrate between closed valves, between impellers and closed valves, and in other, similar locations? Yes ( ) No ( )

9. Are appropriate alarms located at a central panel to indicate that pressures or temperatures have exceeded acceptable limits? Yes ( ) No ( )

PROCESS CONTROLS

While there are differences in the types of equipment used to manufacture 83% Ammonium Nitrate (AN 83), a system to control and monitor the reaction exists that is basic throughout the industry.

Depending on the process design, the neutralizer used to react Nitric Acid with Anhydrous Ammonia will operate at atmospheric conditions or under a slight pressure. The final AN 83 may be slightly on the free acid or free ammonia side, depending on operating parameters. The source of vaporized ammonia may be off-gas from a Once Through urea plant or vaporized virgin ammonia. The concentration and temperature of the nitric acid will vary and will help to determine the final concentration of the AN solution and the temperature of the neutralization reaction.

Process controls will include instrumentation that can operate (automatic/manual; remote/local) to control the feed rates and temperatures of the reactants (Ammonia, Nitric Acid) and to control the final pH of the AN 83 solution. A monitoring system will include equipment to detect and record the process variables. The controls and monitoring systems should be centralized to maximize operator efficiency and provide for operator safety.

Included in the process controls will be emergency equipment to control an upset condition in the neutralizer, such as safety reliefs for excessive pressure and a water system to quench the reaction.

The achievement of proper performance in a neutralizing plant requires very close process control. The unit should be controlled to maintain steady operation and as optimum conditions as the control equipment, indicating devices, and chemical testing procedures will permit. The operator should become thoroughly familiar with the purpose of each instrument, know its location, know its normal reading and know what to do if the reading is above or below normal. Every operator should be sufficiently familiar with the process so that he can formulate his own course of action should conditions demand it.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are relief valves provided to protect equipment and piping from pressure build up? Yes ( ) No ( )

2. Are all relief valves checked at planned intervals? Yes ( ) No ( )

3. Are all relief valves in 83% AN service protected against salt out? Yes ( ) No ( )

4. Is the pH of the AN solution coming from the neutralizer continuously monitored and recorded? Yes ( ) No ( )

5. Are alarms provided for high temperatures? Yes ( ) No ( )

6. Are alarms provided for high pressure? Yes ( ) No ( )

7. Are all thermometers re-calibrated at planned intervals? Yes ( ) No ( )

8. Is there a continuous monitoring and recording system on the following temperatures:

   The vaporized ammonia? Yes ( ) No ( )
   The nitric acid? Yes ( ) No ( )
   The reaction solution? Yes ( ) No ( )

9. Is an operator stationed in the control room to constantly monitor the system? Yes ( ) No ( )

10. Are all pressure gauges and pressure indicators protected against salt-out? Yes ( ) No ( )

11. Are all operating personnel initially trained and periodically retrained in the use of instruments that are provided? Yes ( ) No ( )

12. Is there a water system provided which can be used to quench the reaction? Yes ( ) No ( )

13. Are all pressure gauges and pressure indicators calibrated at planned intervals? Yes ( ) No ( )

14. Is there a check made to assure that the results from parameters monitored in the control room agree with the field readings? Yes ( ) No ( )

15. Are equipment running lights provided? Yes ( ) No ( )

16. Is the control system centrally located? Yes ( ) No ( )

OPERATION OF PUMPS

There are many different type pumps which can be located in the 83% ammonium nitrate solution producing facility but those used for two purposes provide the primary concerns for potential hazards to personnel.

Nitric acid pumps should be selected with regard for the material of construction and the pumping system should be designed to minimize hazard to personnel (for example, overhead lines should be welded and flange guards should be provided around flanges to prevent spraying in the event of gasket failure).

Eighty-three percent solution pumps must also be selected with regard to materials of construction and systems should be engineered also with attention to potential hazard to personnel in mind. Generally 83% solutions will be maintained at a temperature of about 180° F for transporting or storage, because at temperatures much lower than this, the material will salt-out. Provisions should be made, particularly around pumps, so that hot water or steam may be admitted and drained through the pump in the event of a salt-out in this system.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are materials used in packing and seals of types that will not sensitize ammonium nitrate? Yes ( ) No ( )

2. Are low-flow alarms provided on 83% pumps? Yes ( ) No ( )

3. Are low-flow shutdown switches provided on 83% pumps? Yes ( ) No ( )

4. Is there a low-amperage cut-off feature for motors in AN service? Yes ( ) No ( )

5. Is there a remote start/stop station for each pump in AN service? Yes ( ) No ( )

6. When maintenance is required are:

   Suction and discharge valves closed and tagged? Yes ( ) No ( )
   Drain and vent valves open and tagged? Yes ( ) No ( )
   Necessary blinds inserted? Yes ( ) No ( )
   Motor breaker open, locked, and tagged? Yes ( ) No ( )
   Pump thoroughly flushed with steam and water? Yes ( ) No ( )

7. Are pumps checked regularly for noise, vibration and overheating? Yes ( ) No ( )

8. Is there an audible alarm or a light indication in the control room if a pump in AN service has stopped? Yes ( ) No ( )

9. When pumps are shut down for extended periods are they drained and flushed well with water? Yes ( ) No ( )

10. Is the area around acid pumps curbed or are the pumps located in sumps to prevent spread of acid in the event of leaks? Yes ( ) No ( )

HEAT GENERATION

Heat is evolved in the production of 83% ammonium nitrate solution when nitric acid reacts with ammonia. The heat which is liberated vaporizes water from the reaction mixture and most of this steam, containing impurities not removed by a pollution abatement system, emits from a stack.

Some of the emitted steam may be used to vaporize ammonia which in turn, is fed into the neutralizer.

Read all of the questions in this section; discuss the question with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Is a high-temperature alarm provided on the neutralizer? Yes ( ) No ( )

2. Is adequate insulation provided for protection of personnel and equipment? Yes ( ) No ( )

3. Is there a quench system to stop the reaction and, thus, to stop generation of heat? Yes ( ) No ( )

4. Are key temperature indicators calibrated at planned intervals? Yes ( ) No ( )

7. Can both ammonia and acid flows be blocked at locations remote from the neutralizer? Yes ( ) No ( )

GENERATION OF VAPORS

Vapors, fumes, and mists may be generated or be contained in vessels during the production of 83% AN. The following presents the types, location, and sources of hazardous vapors about the 83% AN Plant.

TYPE	LOCATION	SOURCE
Nitric acid mist	Storage tanks	Atmospheric breathing through vent
	Neutralizer vent	Low neutralizing pH Acid sparger breakage Acid preheater tube failure Decomposition of AN Low scrubber pH
	Pumps and Piping	Mechanical seal leaks flange leaks
NO, NO_2, through vent and other gases	Acid storage tank	Atmospheric breathing
	Neutralizer vent	Dissolved HNO_3 driven off by heat of reaction Decomposition of AN
NH_3 Gas	Vaporizer	Relief valves Pipe and flange leakage
	Neutralizer vent	High neutralizer pH Ammonia sparger breakage Blending or refrigeration peaks Vaporizer blowdown
AN Mist	Neutralizer vent	High neutralizer temperature Separator failure
Steam	Neutralizer vent	Normal heat of reaction
CO_2 and Air	Neutralizer vent	Inerts from urea plant off gas Decomposition of organics

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Does the neutralizer vent discharge to a location generally remote, which could be regarded as providing little risk to personnel? Yes ( ) No ( )

2. Do 83% process tanks and run tanks have atmospheric vents? Yes ( ) No ( )

3. Is the liquid ammonia supply free of any dissolved gases other than water? Yes ( ) No ( )

4. Are regular checks made to see if there is any visible leakage from pumps, piping, and equipment in the processing area? Yes ( ) No ( )

5. Do off-gases from the neutralizer pass through an emission abatement control device before discharging to atmosphere? Yes ( ) No ( )

6. Is a physical inspection made at planned intervals to see that the neutralizer internals (such as the sparger) are not severly corroded or loose and are in sufficiently good condition to last until the next planned inspection? Yes ( ) No ( )

7. Are concentrations of vapors, such as ammonia and nitric acid, in the air in the operating area measured? Yes ( ) No ( )

HANDLING AND STORAGE OF PRODUCT

A potential hazard to personnel in the handling and storage of the 83% ammonium nitrate solution is in getting hot solution on the body or in the eye.

Such mishaps can occur during eruption from the neutralizing vessel, during sampling of product from either the storage tank or from the 83% hold tank, or from spray from a broken line or broken flange.

Since the 83% solution must be maintained at a temperature of about 180° F, there is a potential hazard to personnel if all hot lines and equipment are not insulated.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help

1. Does the 83% AN storage vessel have a reliable gauging device? Yes ( ) No ( )

2. Do the neutralizer and 83% process tank have reliable gauging devices? Yes ( ) No ( )

3. Are all 83% AN lines heated and insulated to the degree necessary to protect personnel and to prevent salt-out? Yes ( ) No ( )

4. Is the 83% AN in storage monitored for temperature changes on a regular basis? Yes ( ) No ( )

5. In the event of a rupture of the 83% AN storage tank would the contents be contained by some secondary measure? Yes ( ) No ( )

6. Are 83% AN storage tanks vented to prevent pressure variations? Yes ( ) No ( )

PERSONAL AND AREA PROTECTIVE EQUIPMENT

Protective equipment is a necessary part of any safety program. The primary areas of concern are individual and equipment safety.

Fire protection equipment should be displayed prominently, and employees should be trained in its proper use. While an AN fire must only be quenched with water, ABC type extinguishers should be located conspicuously to contain small fires (electrical, wooden pallets, bags, etc.) before they get out of hand.

Some examples of area protective equipment and devices are:

-- Flange bonnets to prevent acid or molten AN from spraying if gaskets fail.
-- Water safety showers and eye wash stations.
-- Clearly marked safety signs.
-- Relief vents
-- Area alarms and personnel calling devices.
-- Non-skid surfacing of walk areas.
-- Grating on elevated walk areas
-- Kick plates and guard rails.
-- Ladder guards

While requirements for Personal Protective Equipment is covered under "General", it might be well to record here that since ammonia and nitric acid are handled in the area, personal protective equipment appropriate for use in such areas (such as goggles, face shields, gas masks, air paks, etc.) should be readily available in the area.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are all hot tanks and lines insulated for personnel protection? Yes ( ) No ( )

2. Are flange guards or splash shields required? Yes ( ) No ( )

3. Are safety showers (with water supplies sufficient to provide a copious supply for 15 minutes) available in the area? Yes ( ) No ( )

4. Are eye wash stations provided in the area with water supply sufficient to provide a copious irrigation for 15 minutes? Yes ( ) No ( )

5. Are fire drills conducted periodically? Yes ( ) No ( )

6. Are employees trained in the use of fire fighting equipment? Yes ( ) No ( )

7. Has the communications systems been analyzed to determine if it is adequate for summoning help in the event of an emergency? Yes ( ) No ( )

8. Is the list of personal protective equipment available for use in the area reviewed at planned intervals to assure that such equipment is always consistent with current missions and safety practices? Yes ( ) No ( )

CHAPTER VI - SOLID AMMONIUM NITRATE MANUFACTURE

INTRODUCTION

Most agricultural ammonium nitrate is produced today by evaporation (generally falling film) of 83% ammonium nitrate solutions to a 95.0 to 99.8 percent ammonium nitrate solution and solidification of this resulting material (which must be held at about 350° F for 99.8% material to prevent solidification) through help of control devices such as prill plates, pan granulators, and Sandvik belts.

Beside the thermal burn hazards inherent in handling of any 350° F material, there is a special hazard in handling ammonium nitrate which begins to decompose at temperatures in this range. However, such mild decomposition would be accelerated greatly by the addition of carbon-containing materials, by the addition of certain metals, and by confinement. Therefore, special precautions are necessary to keep the ammonium nitrate in either molten or solid state free from contamination by carbonaceous materials and to keep the possibility of confinement such as in bearings, pump packings, between closed valves, etc. from occurring.

Major potential health and safety hazards, particular to ammonium nitrate production operations arise from:

-- Hot molten ammonium nitrate at 350° F.
-- High-pressure steam.
-- Conditions of contamination and confinement that could, in turn, lead to a dangerous build-up of the products of decompostion.
-- Emissions that, in turn, might cause significant environmental problems in surface or underground waters.
-- Dusts generated in prilling, conveying, and loading operations.

DETONATION POTENTIALS

Ammonium nitrate is a powerful oxidizing agent supportive of combustion and under certain conditions is capable of exploding. Ammonium nitrate must be kept free from contaminants, particularly organics, chlorides, and certain other metals. Confinement of ammonium nitrate must be avoided and adequate ventilation provided.

The decomposition of the molten salt is accelerated by acidic conditions (low pH), so it is important to avoid excess acidity and to minimize residence time in the molten state. The manufacturing plant and storage area must be designed and operated as a low fire risk area. The presence of explosives on the site must be prohibited.

In the evaporation and pumping steps commonly used to produce solid AN, molten AN may become trapped in seals and dead-end pipelines due to salting-out of the product. Heat may be applied to the confined AN due to the friction of a rotating pump, causing dangerous pressure build-up. For this reason, pumps without mechanical seals or packing glands must be specified.

During storage and distribution of Ammonium Nitrate, the product may be handled by people unfamiliar with its properties. It will be treated as any other fertilizer by such people and therefore, must be produced and distributed in a form such that it can be handled in this manner.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Is contaminated ammonium nitrate effectively prevented from being fed to an evaporator? Yes ( ) No ( )

2. Is a maximum temperature limit for the processing of ammonium nitrate set and enforced? Yes ( ) No ( )

3. Are there visual audible alarms to indicate dangerous high-temperature readings at manufacturing processing points? Yes ( ) No ( )

4. Is burning or welding on contaminated AN piping or plate prohibited and enforced? Yes ( ) No ( )

5. Is waste lubrication prevented from entering the AN system? Yes ( ) No ( )

6. Are materials which might be added to hot AN melt checked periodically for carbon content? Yes ( ) No ( )

7. Is the pH of the hot melt controlled? Yes ( ) No ( )

8. Has the plant been engineered in an attempt to prevent confinement of hot melt between "dead-end" points? Yes ( ) No ( )

PROCESS CONTROLS

Proper operation of an ammonium nitrate plant requires close process control. The unit should be operated to maintain steady conditions using the best control equipment, indicators, and chemical testing procedures available.

It must always be kept in mind that ammonium nitrate which is impure, overheated, confined, and excessively acidic might, under certain conditions, detonate. The operator must be alert to notice any abnormal conditions. The operators should be provided with necessary information for controlling the process, for using the indicating devices as guides, and interpreting the chemical analyses. From this information, the operator must be able to adjust the control equipment to obtain optimum and safe operating conditions.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey; complete this section with their help.

1.	Is melt and pH monitored and controlled?	Yes ( ) No ( )
2.	Are melt temperatures monitored and controlled?	Yes ( ) No ( )
3.	Are high-temperatures alarms provided from critical process locations?	Yes ( ) No ( )
4.	Are running operating lights provided on all equipment?	Yes ( ) No ( )
5.	Are all instruments, gauges, and indicators calibrated at planned intervals?	Yes ( ) No ( )
6.	Are manual by-passes provided around control valves?	Yes ( ) No ( )
7.	Are all relief valves tested at planned intervals?	Yes ( ) No ( )
8.	Are evaporator level indicators calibrated periodically?	Yes ( ) No ( )
9.	Is the pressure of steam on jacketed lines controlled?	Yes ( ) No ( )

10. Is all conveyor belting in AN prill service fire resistant? Yes ( ) No ( )

11. Are visual and audible alarm systems inspected on a planned schedule? Yes ( ) No ( )

OPERATION AROUND PUMPS

Although some of the potential hazards encountered around pumps are the same as those encountered around any machinery with rotating parts, there are some hazards specific to pumps used to transport hot molten ammonium nitrate.

Pumps without mechanical seals and packings must be specified and pump materials should be compatible with AN melt such that it will not corrode or cause an increase in the decomposition rate of the AN. Moreover, the pump should be chosen and its system designed in a manner such that ammonium nitrate cannot be confined and pressure not be allowed to increase above that point sufficient to do the process job; i.e., not above the pressure necessary to transport the melt to the top of the prill tower and through the prilling plate.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are pumps on molten nitrate provided with low-flow shut-down devices? Yes ( ) No ( )

2. Are pumps checked frequently for noise, overheating, and excessive vibration? Yes ( ) No ( )

3. Are pumps specified that do not depend on mechanical seals and packing? Yes ( ) No ( )

4. Are written procedures in effect to prevent dead heading of ammonium nitrate pumps? Yes ( ) No ( )

5. When maintenance is required are:

   Suction and discharge valves closed and tagged? Yes ( ) No ( )
   Drain and vent valves open? Yes ( ) No ( )
   Necessary blinds inserted? Yes ( ) No ( )
   Motor breaker open, locked, and tagged? Yes ( ) No ( )
   Pump thoroughly flushed with steam and water? Yes ( ) No ( )

6. Are AN melt pump systems designed for steam and/or hot water exit and drain points to be used for flushing in the event of salt-out? Yes ( ) No ( )

7. Are pumps used in hot AN melt service appropriately located away from high-density operation traffic areas? Yes ( ) No ( )

8. Have the pump systems been engineered to limit pressures which can be developed to only those necessary for the process requirements? Yes ( ) No ( )

HEAT GENERATION

A large quantity of steam is used in concentrating liquid 83% ammonium nitrate to the strength required for prilling of ammonium nitrate. Once the prill is formed, the concern is to avoid any external sources of heating sufficiently high to cause decompostion. Since decomposition temperature is lowered if the prills are too acidic (low pH), this condition, also, should be avoided, as should confinment.

1. Is product temperature in the bulk warehouse limited? Yes ( ) No ( )

2. Is the melt temperature controlled after leaving the evaporator? Yes ( ) No ( )

3. Is the quantity of hot AN melt in the system surge tank(s) limited to the minimum believed necessary for proper operation of the process? Yes ( ) No ( )

4. Is the melt surge tank(s) provided with a cooling or quench system? Yes ( ) No ( )

5. Is pH controlled in the melt surge tank? Yes ( ) No ( )

6. Is steam pressure to the melt surge tank and to jackets on lines containing melt controlled? Yes ( ) No ( )

7. Is oil or other carbonaceous material prevented from entering the hot AN melt system? Yes ( ) No ( )

8. Is there an established temperature above which material is not bagged? Yes ( ) No ( )

SOURCES AND ELIMINATION OF DUST

The major sources of dust generated in the production and handling of solid ammonium nitrate are generally covered by the following:

Particulate emission from evaporators in systems without pollution abatement equipment.

Emission of particulates from roof or stack vents through entrainment of dust or micro-prills by the cooling air and from generation of particulates through the combination of ammonia with with nitric acid, both released from mild decomposition of hot molten ammonium nitrate.

Physical abrasion in drying and cooling equipment with subsequent release of particulates from those systems without pollution abatement through the cooling air stream vent.

Physical breakdown of "shellies" and prills in handling and loading systems.

Release of coating agents, particularly in those systems where internal additives are not used. Most of the emissions of dust and particulates can be avoided by design of equipment, installation of proper process controls, with or without proper installation of pollution abatement equipment at appropriate locations.

Read all of the quesions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Does the external coating agent area include a dust collector? Yes ( ) No ( )

2. Are dust collectors on bagging machines periodically inspected? Yes ( ) No ( )

3. Are sizing screens hooded, with exhaust to a dust collector? Yes ( ) No ( )

4. Does the prill tower have an emissions abatement system? Yes ( ) No ( )

5. Does the cooler or dryer/cooler have an emissions abatement system? Yes ( ) No ( )

6. Is respirator equipment readily available for use by those working in dusty areas such as warehouses? Yes ( ) No ( )

7. Is the dust abatement program reviewed at planned intervals? Yes ( ) No ( )

8. Are all employees made aware of the fire and explosion potential of dusty environments? Yes ( ) No ( )

HANDLING AND STORAGE OF PRODUCT

Most ammonium nitrate in the United States is stored in bulk at the manufacturing site, although many producing sites also have provisions for bagged storage.

Beside problems associated with dust, the possibility of fire, with its concomitant effects, and potential injuries which could arise through carelessness or lack of instruction in lifting or in handling many types of mechanical equipment are of concern.

Care must be exercised to avoid contaminating ammonium nitrate with oil, grease, gasoline and other carbonaceous contaminants because addition of carbon to ammonium nitrate increase its sensitivity to detonation. To this end, mobile equipment should not be left unattended for long periods in AN bulk warehouses because of the possibilities of leaking gasoline or oil on to the product.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are fire retardant transport belts periodically inspected? Yes ( ) No ( )

2. Are carbonaceous materials kept out of the product warehouse? Yes ( ) No ( )

3. Are spills cleaned up immediately? Yes ( ) No ( )

4. When product loading is completed, is the system emptied? Yes ( ) No ( )

5. Is the product storage area protected by an automatic sprinkler system? Yes ( ) No ( )

6. Are the main fire aisles in bagged storage at least four feet in width? Yes ( ) No ( )

7. Is a dust collection system provided for internal or external additive unloading and storage? Yes ( ) No ( )

8. When not in use, is mobile equipment kept outside the bulk AN warehouse? Yes ( ) No ( )

9. Are oil or grease spills in bulk AN warehouse storage area cleaned up (together with contaminated product) and removed from the warehouse as soon as such spills have been noted? Yes ( ) No ( )

PERSONAL AND AREA PROTECTIVE EQUIPMENT

Due to the large amount of mechanical equipment in a solid ammonium nitrate manufacturing plant (some of which is massive), care must be taken to see that all rotating and moving equipment has proper guards installed. Pinch-points must also be guarded. Free and clear access for ladders, stairs, and platforms that meet OSHA requirements should be provided. All hot lines and vessels should be insulated for personnel protection. Safety showers and eye washes (that provide a copious water supply for 15 minutes) should be provided as well as adequate fire fighting equipment. It is imperative that an adequate water supply is available in the event of a fire. Break-up nozzles that provide more efficient cooling should be available. An alternate power supply should also be available in case of an electric failure.

Personal protective needs are described under the "General" Section but it is well to emphasize that respirators should be provided for use in work areas and that face shields should be made available for use when molten AN is being sampled.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Is non-skid material provided in the unit to prevent slipping? Yes ( ) No ( )
2. Is all rotating equipment properly guarded? Yes ( ) No ( )
3. Are periodic safety inspections made of the area? Yes ( ) No ( )
4. Is all safety equipment checked at planned intervals? Yes ( ) No ( )
5. Are respirators provided in dusty areas? Yes ( ) No ( )
6. Are face shields provided for use when hot melt is sampled? Yes ( ) No ( )

CHAPTER VII - NITROGEN SOLUTIONS

The process of producing high-pressure ammonia/ammonium nitrate solutions is primarily one of ammoniating ammonium nitrate liquor with anhydrous ammonia. The end product is a pressurized ammonia/ammonium nitrate solution. The anhydrous ammonia is introduced in a closed system by submerged distribution pipes (spargers) or other devices into the mix tank containing ammonium nitrate liquor. As a result of the chemical reaction a great deal of heat is generated. The partially ammoniated liquor is circulated through coolers (heat exchangers) to control the temperature of the tank mass. When the mixture in the tank is properly ammoniated and adjusted for nitrogen content, it is pumped into a holding tank for use or shipment.

The main process potential hazards are:

-- Inhalation of ammonia.
-- Direct skin contact with liquid ammonia.
-- Thermal burns.

Exposure to leaking ammonia lines and valves can cause severe injury to any part of the body, particularly the eyes. Once the ammonia is sparged into the ammonium nitrate liquor, there is possible danger from contact with the hot solution or from inhalation of a large amount of ammonia in the event of system upsets or failures. In order to avoid accidents all hoses, pipes, valves, pumps, tanks, and reactors must be effectively inspected and maintained.

Non-pressure nitrogen solutions are composed of urea and ammonium nitrate solutions. The percentage of nitrogen usually varies from 26 to 32 percent. The manufacturing process is essentially one of blending urea solution with ammonium nitrate liquor to attain the required mixture. Some heat is created requiring recirculation through a heat exchanger (cooler) during the blending process. When the desired mix is attained, the finished product, non-pressure nitrogen solution, is pumped to a storage tank or vehicle.

There is little danger from contact with the solution before, during, or after mixing except for the possibility of thermal burns.

Pumping operations and pump maintenance are critical areas in the handling of non pressure nitrogen solutions. A positive program of pump seal maintenance and effectively supervised pump operation should be established to prevent overheating of pumps.

Aqua ammonia (NH_4OH) is a clear solution of water and anhydrous ammonia (NH_3). Many industrial grades of aqua ammonia range up to 30 percent while fertilizer grade averages 20-25 percent. Since the boiling point of aqua ammonia ranges down to below 100° F, depending on strength, the vapor pressure must be taken into consideration when stored in non-pressure tanks.

Aqua ammonia is a strong corrosive irritant and can cause injury to the eyes, skin, and mucous membranes. Fumes can be damaging to the lungs. Although exposure to high concentrations of ammonia can cause blindness and death, there is no evidence that exposure to low concentrations (below permissible exposure limits) is hazardous nor that there is any harmful accumulation.

Aqua ammonia is corrosive to copper, copper alloys, aluminum alloys, and galvanized surfaces. The is no significant corrosive effect on carbon steel, which is commonly used for storage tanks, pipelines and pumps.

Since aqua ammonia reacts violently with most acids producing much heat, mixing should only be done after careful planning and preparation has been carried out.

An emergency response plan should be developed and kept readily available. All employees should be made aware of their specific assignments.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Are all workers trained in the nature and characteristics of the products being used and produced? Yes ( ) No ( )

2. Are all workers trained to understand the heat generation that accompanies mixing ammonium nitrate liquor and ammonia? Yes ( ) No ( )

3. Are all reaction vessels equipped with pressure and temperature indicators and controls? Yes ( ) No ( )

4. Are emergency exits:

   Clearly defined and marked? Yes ( ) No ( )
   Kept clean for rapid egress? Yes ( ) No ( )

5. Are potentially hot pipelines and vessels guarded or insulated to prevent thermal burns? Yes ( ) No ( )

6. Are anhydrous ammonia and ammonium nitrate liquor pipes and process equipment labeled showing:

Chemicals contained?	Yes ( ) No ( )
Direction of flow?	Yes ( ) No ( )

7. Are all pumps provided with pressure by-passes or other relief from hydraulic hammer and deadending? Yes ( ) No ( )

8. Are overhead devices such as chain wheel valves checked at regular intervals for mechanical integrity? Yes ( ) No ( )

9. Are relief valves:

Inspected at regular intervals?	Yes ( ) No ( )
Located so that discharge will be vented to a safe area?	Yes ( ) No ( )
Are relief pipes adequately supported and anchored to prevent whipping during discharge?	Yes ( ) No ( )

10. Are all storage tanks equipped with:

High level alarm or other backup system?	Yes ( ) No ( )
Fill indicator device?	Yes ( ) No ( )
Overflow protection to safe discharge?	Yes ( ) No ( )

11. Is there a regular inspection, servicing, and maintenance program for:

Pumps and seals?	Yes ( ) No ( )
Pump mounting frames?	Yes ( ) No ( )
Lines and valves?	Yes ( ) No ( )

12. Are nitrogen pressure solution hoses:

Inspected regularly?	Yes ( ) No ( )
Replaced promptly when found to be damaged?	Yes ( ) No ( )

13. Are employees instructed not to stand or walk on tank cars or tank surfaces outside of walkways? Yes ( ) No ( )

14. Is there a procedure established for completely emptying loading pipes or hoses before uncoupling from receiving rail tank car or tank truck? Yes ( ) No ( )

15. Is there a procedure whereby rail cars and/or trucks that appear unsound are not loaded? Yes ( ) No ( )

16. Is the following personal protective equipment required to be used when working with pressurized solutions:

Impervious gloves while loading and unloading? Yes ( ) No ( )

Complete eye protection when working around pumps, loading racks, or in any situation where a squirt from pressurized lines and vessels could occur? Yes ( ) No ( )

17. Is an emergency response plan available outlining specific assignments? Yes ( ) No ( )

18. Is all electrical equipment corrosion resistant or protected from contact with these highly corrosion raw materials and finished products? Yes ( ) No ( )

19. Are all workers trained in the importance of preventing contamination and sensitizing of ammonium nitrate? Yes ( ) No ( )

20. Is there an enforced rule to prohibit hot work (cutting and welding) on any pipes or vessels containing ammonia, or ammonium nitrate? Yes ( ) No ( )

21. Are special precautions taken to break flanged pipelines by first unscrewing bolts on opposite side from the worker to prevent eye injury? Yes ( ) No ( )

22. Where needed, is provision made for non-vocal communications? Yes ( ) No ( )

23. Are tank cars and tank trucks always checked before being loaded to make sure that:

The tank is structurally sound? Yes ( ) No ( )

All valves and fittings are in good operating condition? Yes ( ) No ( )

24. Are liquid hoses:

Inspected regularly? Yes ( ) No ( )

Replaced promptly when found to be damaged? Yes ( ) No ( )

25. Are liquid loading hoses secured during loading to prevent "whip" and dislodging from loading port in receiving tank? Yes ( ) No ( )

26. Is storage tank area diked to contain spills? Yes ( ) No ( )

27. Are high pressure and high temperatures alarms provided for critical processes? Yes ( ) No ( )

28. Are all pipes, pumps, fittings, and tanks which will be contacted by ammonia free from:

    Copper? Yes ( ) No ( )
    Galvanized iron? Yes ( ) No ( )
    Other non-compatible materials? Yes ( ) No ( )

29. Are hydrostatic relief valves installed at all points where anhydrous ammonia can be blocked or trapped? Yes ( ) No ( )

30. Are anhydrous ammonia unloading hoses:

    Inspected regularly? Yes ( ) No ( )
    Replaced promptly when found to be damaged? Yes ( ) No ( )

31. Are anhydrous ammonia and aqua ammonia pressure vessels periodically:

    Inspected? Yes ( ) No ( )
    Tested? Yes ( ) No ( )

32. Are quick opening plugs or rising stem valves located so accidental opening will not cause injury? Yes ( ) No ( )

33. Are self contained breathing devices:

    Available in the anhydrous ammonia unloading and storage area? Yes ( ) No ( )
    Inspected regularly? Yes ( ) No ( )

34. Is protective equipment provided, such as:

    Impervious gauntlet gloves? Yes ( ) No ( )
    Aprons or rainsuits? Yes ( ) No ( )

35. Are emergency showers and eye wash stations quickly available in areas where ammonia exposure is possible? Yes ( ) No ( )

36. Are showers and eye wash stations protected against freezing during cold operating periods? Yes ( ) No ( )

37. Are key workers trained in handling ammonia emergencies? Yes ( ) No ( )

38. Have all workers been briefed to avoid working up-wind of ammonia releases to prevent being trapped? Yes ( ) No ( )

39. Are all workers told that pipes containing ammonia must not be heated or cut with a torch? Yes ( ) No ( )

CHAPTER VIII - UTILITY SECTION

Chemicals used in the Utility Section of a Fertilizer Manufacturing Plant for water treatment will vary in number and type for each plant location. This section deals with some specific chemicals and other chemicals and operating procedures that are used in the treatment of:

-- Raw Water
-- Cooling Water
-- Boiler Feed Water
-- Waste Water

The various chemicals used can have toxic effects on employees, and can cause irritation to the skin, eyes, throat, and the lungs when high concentrations are present. The degree of danger to the employee depends upon the specific chemical, its concentration and length of exposure.

It is important that all employees are made aware of the properties of all the different chemicals used in the utility section so that proper safeguards can be established and maintained. Potential health hazards can also rise in the work area from chemical mists or dust exposure.

This section also covers sanitary systems, potable water systems for a plant, and operation of auxiliary steam boilers. The questions are designed to identify potential health and safety hazards to employees in the work area resulting from exposure to the various water treatment chemicals and operations in the utility section and to evaluate the company's program to protect employees from these potential hazards.

A general guide for establishing a program should include the following:

-- Regular monitoring of chemicals in the work environment.
-- Engineerng and administrative controls to protect employees from harmful exposure.
-- The use of personal protective equipment by employees where engineering controls have not sufficiently reduced the exposure.
-- Precautions for the storage and handling of chemicals.
-- Periodic medical surveillance to assess the effect of exposure on individual employees, (see chapter 1).

GLOSSARY

1. Ion Exchange - A method of removing impurities in water by passing through ion exchange material in a tank. The ion exchange material (resin) has the ability to exchange one ion for another, hold it temporarily in chemical combination, and give it up to a strong regenerating solution.

2. Anion and Cation - Impurities and chemicals that dissolve in water dissociate to form positive and negative charged particles called ions. The positive ions are called cations because they migrate to the negative electrode (cathode) in an electrolytic cell and the negative ions are called anions since they are attracted to the anode.

3. Demineralizer - The equipment and process for removing impurities from water by ion exchange. The process usually involves at least two ion exchange reactions for removal of dissolved impurities or solids.

4. Fluid Bed/Fixed Bed Ion Exchange - Refers to whether the ion exchange bed (resin) is moving in the reaction vessel (fluid bed) or is stationary (fixed bed) in the vessel. Most water treating ion exchange units are fixed bed. The continuous fluid bed ion exchange unit referred to in this text is for the treatment of waste water.

5. Hexavalent/Trivalent Chromium Form - The chromium ion normally exists in the hexavalent form in the cooling water treatment process. The hexavalent refers to the positive 6 valence chromium ion, Cr+6 in the chromate ion CrO4-2. Trivalent refers to the the positive 3 valence chromium ion, Cr+3, which is less toxic than the Cr+6 chromium ion.

6. Chromate Reduction Process - The chromates used in water treatment are from the waste water before discharge from the plant. A method for removing the chromate ion is the reduction process where the hexavalent chromium ion is reduced to the trivalent chromium ion by either the chemical reduction process (using sulfur dioxide) or the electrochemical reduction process using ion electrodes. In both cases, the Cr+3 ion is precipitated as a chromic hydroxide sludge for further handling.

7. Ferric/Ferrous Ions - Refers to the electrochemical chromate reduction process where iron electrodes are used to generate ferrous (iron) ions, Fe+2, and ferric ions, Fe+3, and hydroxyl ions (OH-) in the process.

8. Blowdown - Refers to the water that is periodically drained from a cooling water system or a steam boiler water system to remove impurities that build up in the system such as suspended solids, dissolved solids, and chemicals. The blowdown can be either intermittent or continuous. The quantity should be kept to a minimum to reduce the chemicals that are lost from the system and to reduce the waste water that has to be treated.

9. Chlorine Residual Concentration - Referred to in treating drinking water and cooling water systems. It is the amount of chlorine remaining after a specified contact or treatment period. It is necessary to maintain a chlorine residual level to assure complete and proper treatment of the water system, that is, to kill bacteria, algae, and to improve taste and odor.

10. National Interim Primary Drinking Water Regulations (NIPDWR) - The regulations for primary drinking water systems have been issued for public water systems as guidelines for the States upon final implementation. A public water system means a system of piped water for human consumption which has at least 15 service connections or regularly serves an average of at least 25 individuals daily, at least 60 days out of the year. The regulations require additional monitoring for coliform bacteria, nitrate levels, and turbidity for suface water systems, and the maintaining of records.

11. Auxiliary or Utility Steam Boilers - Refers to steam boilers which are independently fueled using natural gas, fuel oil, etc. for the generation of steam for use in other areas of the plant. The auxiliary boiler differs from the waste heat boiler which uses a waste heat gas stream to generate steam and is usually part of the process.

12. Package/Stationary Boilers - The package steam boiler refers to a boiler that has been essentially fabricated in the shop and moved to the plant site, usually skid mounted and smaller in size than a stationary boiler. The stationary boiler is usually constructed at the plant site and permanently located. Both steam boilers generate steam for use within the plant area.

13. Draft Pressure - Refers to the static pressure within the furnace firing area of a steam boiler. This static pressure is maintained by the operation of either a forced draft or induced draft fan in the system. A negative or zero pressure indicates that the draft fan on the furnace is operating properly and the burners can be lighted and the gas flow and heat will flow out of the boiler stack.

14. Turnarounds - Refers to plant maintenance periods where major repairs and inspections are completed on the plant operating equipment. These are usually scheduled for once or twice per year for a given plant and may last from several days up to several weeks.

WATER TREATMENT CHEMICALS

A variety of chemicals are used in the treatment of the plant's water systems. The chemicals may be added to adjust the pH, to fix dissolved oxygen, neutralize carbon dioxide, to form protective film on metal surfaces for corrosion control, to kill bacteria, and many other applications. Chemicals are also indispensable in most water treating equipment. Salt, caustic, and acid are used to regenerate ion exchange units, lime and soda ash precipitate hardness as an insoluble compound in both hot and cold process water softeners, and coagulants help remove suspended solids in clarifiers. While most of these chemicals are used in low concentrations in the water systems, the unloading, storing, and usage of the chemicals is usually in concentrated form and requires certain precautions to prevent exposure and potential injury while handling the chemicals.

The following is a general discussion for the handling, unloading, and storing of chemicals in the Utility Section.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

CHEMICAL HANDLING - GENERAL

1. Are emergency showers and eye-wash fountains (with 15 minutes of continuous flow) provided in all areas where acids and caustics and other chemicals are present? Yes ( ) No ( )

2. Are all storage tanks for acids and caustics curbed to provide containment of spills or leaks? Yes ( ) No ( )

3. Are acid and caustic tanks labeled by type and concentration? Yes ( ) No ( )

4. Are acid and caustic filling pipes prominently labeled or color coded? Yes ( ) No ( )

5. Have air concentrations of acids, caustics, or other chemicals been measured? Yes ( ) No ( )

6. Is protective clothing and/or equipment (plastic suit, boots, glasses, face shield, acid goggles, respirator, hard hat, apron) readily available at the acid, caustic, and chemical handling locations? Yes ( ) No ( )

7. Are employees required to use protective equipment when working with or around chemicals? Yes ( ) No ( )

8. Are employees who work with or are exposed to acids, caustics, and other chemicals forbidden to wear contact lenses? Yes ( ) No ( )

9. In the chemical unloading area, are the transfer hoses stored in separate racks off the ground and clear of the roadway or track? Yes ( ) No ( )

10. Are chemical unloading pipes guarded to protect from truck damage in the unloading area? Yes ( ) No ( )

11. Are unloading procedures posted at the unloading area for truck driver and operator to see? Yes ( ) No ( )

12. Are grounding cables required for the unloading of fuel oil tank cars and trucks? Yes ( ) No ( )

13. Are "No Smoking" signs posted in the unloading and chemical tank areas? Yes ( ) No ( )

14. Is the unloading area sufficiently lighted for unloading chemicals at night? Yes ( ) No ( )

15. Have all unloading piping and equipment been checked for corrosion and leaks before unloading begins? Yes ( ) No ( )

16. If air pressure is used to unload tank cars or trucks, is a pressure regulator provided on the air supply line to prevent overpressuring the tank car or truck? Yes ( ) No ( )

17. Are employees instructed to relieve pressure on the system before breaking hose and pipe connections? Yes ( ) No ( )

18. Are all chemical spills promptly cleaned up and disposed of properly? Yes ( ) No ( )

19. Has an emergency team been trained and procedures established for emergency and rescue work in the event of major chemical spills or leaks? Yes ( ) No ( )

20. Are all chemical storage areas posted with appropriate warning signs? Yes ( ) No ( )

21. Are employees trained to understand the hazards associated with water treatment chemicals and the proper procedures for working with them? Yes ( ) No ( )

22. Have all employees been instructed individually in the use and operation of respiratory protection equipment, such as the canister type, fresh air mask type, and self-contained breathing apparatus? Yes ( ) No ( )

23. Have precautions been taken to prevent exposure of the chemical drums and storage containers from heat, moisture, and corrosive atmosphere? Yes ( ) No ( )

RAW WATER TREATMENT

The raw water supply source to the plant can come from one or more sources such as wells, rivers, lakes or from municipal water systems. The degree of treatment and the chemicals for the treatment of potable water and for plant water will depend upon the water quality of the supply source. The water is usually filtered and aerated before use in the plant. The potable water quality should comply with the National Interim Primary Drinking Water Regulations (NIPDWR).

Chlorine gas is commonly used in the treatment of raw water to kill certain bacteria, control odor and taste, and to prevent algae formation in the sanitary water facilities. (Refer to section on Chlorine Handling.) The sanitary facilities for a plant should be constructed and maintained to meet all local and state public health laws as well as Federal requirements. The following questions concern the treatment of raw water and drinking water standards required for plant facilities.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. If chlorine is used to treat raw water for drinking water purification:

   Is the free chlorine residual concentration maintained at safe levels? Yes ( ) No ( )

   Are there adequate controls on the chlorination system to shut off the chlorine flow in the event of low water flow or low water pressure on the water system? Yes ( ) No ( )

   Are analytical checks made daily or more often on the drinking water system in order to maintain the proper chlorine levels? Yes ( ) No ( )

2. Has an adequate number of potable water outlets been provided in all places of employement for drinking, washing, cooking, restrooms, etc.? Yes ( ) No ( )

3. Are the non-potable water outlets separate (i.e. free from cross connections) from potable water system? Yes ( ) No ( )

4. Are outlets from non-potable water systems, such as firewater or cooling water, marked clearly that the water is unsafe and is not to be used for drinking or other personal use? Yes ( ) No ( )

5. Are the proposed National Interim Primary Drinking Water Regulations for potable water systems being met? Includes; monitoring of coliform bacteria and nitrate levels and turbidity for surface water. Yes ( ) No ( )

6. Are the required reports to the State or EPA on water analysis and adequate records being kept as specified by the proposed Primary Drinking Water Regulations? Yes ( ) No ( )

7. Are the sanitary facilities of the plant constructed and maintained in accordance with the appropriate standards and regulations (State and Federal)? Yes ( ) No ( )

CHLORINE HANDLING

Chlorine gas (Cl_2) is used in several areas of a plant for control of the water quality. It is used to purify raw water for sanitary purposes, for chlorination of the cooling tower water to control bacteria growth, and in waste water for controlling algae and slime growth. Chlorine gas is primarily a respiratory irritant.It is so intensely irritating that low concentrations in the air are readily detectable as a strong pungent odor. At higher concentrations, it will irritate the mucous membranes, the respiratory system, and the skin. In addition, excess exposure will cause irritation of the eyes, coughing and labored breathing.

Chlorine is usually handled and stored in 100 pound and 150 pound pressurized liquid cylinders for small uses, and in one ton cylinders for larger consumption. The chlorine can be used as a gas from the cylinders or pulled off as a liquid and passed through a vaporizer using hot water or steam as the heating medium.

Chlorine gas is heavier than air and will tend to settle to floor level or in low areas. It is the responsibility of management to comply with all applicable federal, state and local regulations. Extreme precautions should be exercised by all employees working in possible chlorine exposure areas.

Read all of the questions in this section, discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Are all employees trained in the handling and the potential hazards of working with chlorine? Yes ( ) No ( )

2. Are all employees informed of the signs, symptoms, and effects of overexposure, as well as emergency procedures, and precautions to take to minimize exposure to chlorine? Yes ( ) No ( )

3. Are emergency first aid procedures posted in the workplace and readily accessible to workers where chlorine is stored or used? Yes ( ) No ( )

4. Are two approved self-contained breathing apparatus readily available outside of the immediate chlorine work area? Yes ( ) No ( )

5. Have employees been instructed not to use water on liquid chlorine leaks due to accelerated corrosion? Yes ( ) No ( )

6. Are the chlorine cylinders safely secured to prevent from falling, upsetting, or rolling? Yes ( ) No ( )

7. Are the chlorine cylinders protected from flame, heat corrosion, and mechanical damage? Yes ( ) No ( )

8. Are full and empty cylinders marked accordingly and are the cylinders that are in use marked "in service"? Yes ( ) No ( )

9. Are new lead gaskets used each time the chlorine system connections are made? Yes ( ) No ( )

10. Are emergency eyewash fountains and safety showers located immediately outside the chlorine work area ? Yes ( ) No ( )

11. In enclosed chlorine working areas, are ambient chlorine concentration surveys been conducted periodically to determine if concentrations are at or below the action level (1/2 the PEL)? Yes ( ) No ( )

12. Have warning signs been posted in the chlorine working areas to warn employees of:

The chlorine hazard area? Yes ( ) No ( )
The effects of chlorine exposure such as burns and eye damage? Yes ( ) No ( )
The location of the protective air masks in the area? Yes ( ) No ( )

13. Are all chlorine piping systems plainly marked and are critical shut-off valves conspicuously labeled? Yes ( ) No ( )

14. Are adequate employee medical records kept for employees exposed to high concentrations of chlorine? Yes ( ) No ( )

15. Have employees been instructed how to check for chlorine leaks using aqua ammonia vapor near the suspected area? Yes ( ) No ( )

16. Are employees required to wear respiratory protective equipment while checking for leaks and placing equipment in service? Yes ( ) No ( )

17. Have employees been instructed how to connect tubing and piping to the chlorine vapor or liquid valves on the cylinders? Yes ( ) No ( )

18. Are training classes conducted periodically for both new and old employees on the safe handling of chlorine? Yes ( ) No ( )

19. Have employees been cautioned not to heat the chlorine cylinders to increase the vapor flow? Yes ( ) No ( )

20. Are employees instructed not to open the main chlorine block valve on the cylinder over one full turn? Yes ( ) No ( )

21. Have employees been trained in the unloading and handling of the cylinders to prevent damage to the cylinder and possible leaking of chlorine? Yes ( ) No ( )

COOLING WATER TREATMENT

Cooling water is circulated throughout most fertilizer plants to provide cooling for the various pieces of equipment, such as heat exchangers, compressors, condensers, etc. This cooling water is usually recirculated after passing through the equipment to a cooling tower where the water is cooled and returned back to the plant. Various chemicals are used in the treatment of cooling water to prevent corrosion and scale formation, to adjust pH, and to control microbiological growth in the system.

The three most commonly used chemicals are; the chromates and zinc for corrosion control, chlorine for control of bacteria growth, and sulfuric acid for pH control. Several other chemicals may be used, such as the non-chromate organic based corrosion inhibitors, dispersants, deposit control, slimicides, algaecides, and biocides. These chemicals can be handled safely when the necessary precautions are taken. The cooling water can also be treated externally with side stream filters and water softening treatment.

Sodium and potassium dichromates are not dangerous to transport or use, when properly handled. These chemicals may cause local irritation of mucous membranes and skin and can produce harmful effects if swallowed or inhaled. It is not known to be absorbed through unbroken skin, but may cause ulceration of skin wounds.

Chlorine gas is used to treat cooling water to control the biological growth and deposits in the system. Chlorine gas is injected into the cooling water to kill bacteria by maintaining a free chlorine residual concentration of 1.0 ppm for a period of time. The frequency and length of treatment will vary for each plant. Refer to the Section on Chlorine Handling.

Sulfuric acid is a colorless to cloudy liquid, which due to its corrosive, oxidizing, and sulfonating properties, can produce rapid destruction of tissues and severe burns on contact with the skin. Inhalation of concentrated vapor or mist is injurious to the lungs. Safety in the handling of sulfuric acid (as well as other chemicals) depends, to a great extent, upon the effectiveness of employee training in safe practices, and the use of safety equipment. All employees should be trained in emergency first-aid. At least one person per shift in each work area should be designated as the first-aid person responsible, and have had first-aid training.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Have employees been instructed in the safe handling and the potential hazards involved with the cooling water treatment chemicals? Yes ( ) No ( )

2. Are the chemicals, if received in bags or drums, stored in a dry location away from heat and excessive moisture? Yes ( ) No ( )

3. Have employees been advised to report promptly any signs of illness or skin problems while working in this area? Yes ( ) No ( )

4. Are employees trained in emergency first aid ? Yes ( ) No ( )

5. Have employees been instructed in the safe operation of the chlorine injecting system? Yes ( ) No ( )

6. Are periodic analyses made on the cooling water to ensure that excessive amounts of chemicals are not being used? Yes ( ) No ( )

7. Do the cooling tower chemical storage areas have containment walls to prevent contamination of the sewers and employee exposure? Yes ( ) No ( )

8. Have employees been instructed not to mix other chemicals with sulfuric acid? Yes ( ) No ( )

9. To prevent splashing of the acid when diluting sulfuric acid, have employees been trained to always add the acid to water? Yes ( ) No ( )

10. Are "No Smoking" signs posted around sulfuric acid tanks, and drums, due to possible hydrogen vapors being generated? Yes ( ) No ( )

11. Are sulfuric acid tanks labeled with the potential hazards listed and the first aid steps to take? Yes ( ) No ( )

12. Are drum carriers and cradles required for use in transporting and storing of chemicals in drums? Yes ( ) No ( )

BOILER FEED WATER TREATMENT

The type of treatment for boiler feed water depends primarily upon the quality of the incoming water and the operating pressure of the steam boiler system. Generally as the boiler pressure increases, the water quality requirements also increase. There are a number of treatment methods and combinations that are used in the industry to treat the water before it enters the steam boilers. All raw waters have certain impurities which have to be removed, such as dissolved solids, calcium and magnesium salts, turbidity, and alkalinity. Lime softeners and ion exchange systems have been the most effective methods to treat boiler feed water.

Internal treatment of the boiler water is required to adjust the water conditions to provide protection for the steam generating boilers and safe operation of the high pressure steam equipment, such as steam turbines and evaporators. Various water treating chemicals at different concentrations and quantities are used to control the water analysis of the boiler.

ION EXCHANGE - DEMINERALIZERS

Ion exchange resin units such as the anion and cation exchangers and the mixed-bed demineralizers are used to remove unwanted ions in the water such as magnesium, calcium and silica. This external treatment of the boiler feed water occurs before the water enters the steam boiler. The ion exchange resins have the ability to exchange one ion for another, hold it temporarily in chemical combination, and give it up to a strong regenerating solution. Cation units remove positive ions such as calcium and magnesium and are regenerated with a strong acid. The anion units remove the negative ions such as silica and carbon dioxide and are regenerated with a strong base solution. The mixed-bed demineralizers combine a mixture of cation and anion resins to provide final treatment (polishing) of boiler feed water for feed to high pressure steam boilers. The operation of the ion exchange units can be manual or automatic, however, the operator should be properly trained to prevent accidental exposure to the regeneration chemicals.

The chemicals normally used to regenerate the ion exchange resin bed are caustic soda (NaOH) and sulfuric acid (H_2SO_4). Both of the chemicals can cause severe burns to the skin and they should be handled carefully while used in the ion exchange process with the correctly prescribed safety equipment such as: gloves, goggles, and face shields. Caustic is usually received as 50 percent caustic in tank cars or trucks. It is further diluted to 10-30 percent for use in the plant area. Sulfuric acid is received as 92-93 percent acid in tank cars or trucks. Refer to the Section on the handling and storing of sulfuric acid.

Caustic soda (sodium hydroxide) is a strong alkali and is dangerous when improperly handled. The solid caustic and concentrated solutions are destructive to skin tissues producing severe burns. Contact with the eyes can cause severe damage to the eye and inhalation of the dust or mist is capable of causing injury to the respiratory tract.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Have all employees who work around acid and caustic areas been instructed in the proper safe handling of these chemicals and what first aid steps to take in the event of exposure? Yes ( ) No ( )

2. Is the correct safety equipment such as: protective clothing, goggles and/or face shield, rain suit and rubber boots, rubber gloves, and hard hat available for employees who may be potentially exposed to chemicals in this area? Yes ( ) No ( )

3. Are acid and caustic warning signs posted in the handling area listing the potential dangers and first aid treatment in an emergency? Yes ( ) No ( )

4. Are the alarms on the ion exchange system checked periodically to ensure safe operating conditions? Yes ( ) No ( )

5. Are all chemical lines and tanks in the water treating area properly labeled and identified? Yes ( ) No ( )

6. Are all spills of acid and caustic neutralized and washed down as soon as possible? Yes ( ) No ( )

7. Are employees instructed to flush contacted areas of the skin or eyes with water for at least 15 minutes after exposure to acid or caustic solutions? Yes ( ) No ( )

8. Are fresh air masks or canisters provided in this area in the event of concentrated sulfuric acid or caustic fumes or mist? Yes ( ) No ( )

BOILER WATER QUALITY CONTROL CHEMICALS

Internal treatment of the boiler water in the steam system is accomplished by the addition of various chemicals in order to protect the steam generating equipment against corrosion, to minimize scale formation, carryover, foaming and fouling of equipment, and to reduce blowdown to a minimum which in turn reduces the cost of water treatment for the system. There are numerous types of brand names of chemicals that are used in the industry to adjust the boiler water analysis to the optimum conditions. The amount and type of the chemicals depend on the plant operating conditions and the feedwater analysis. These chemical are enclosed and the chemicals used are in small quantities with minimum potential exposure.

Some of the chemicals that are used include:

Sodium sulfite (Na_2SO_3)	-	Prevents oxygen corrosion
Sodium Hydroxide ($NaOH$)	-	Increase alkalinity
Sodium Phosphates (Na_2HPO_4)	-	Precipitates calcium
Morpholine (amine)	-	Controls return condensate corrosion
Organic chemicals	-	Sludge and foam control
Sodium Nitrate ($NaNO_3$)	-	Inhibits caustic embrittlement
Hydrazine (N_2H_4)	-	Prevents oxygen corrosion

Each of the above chemicals has different properties and can cause varying degrees of injury to employees who are exposed to them. In general, none of the chemicals should be considered safe and should be handled and used with care. The chemicals may be received as a liquid in drums or in bulk, or as a dry chemical in bags.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Have employees been instructed in the use and concentration to use of the various boiler treatment chemicals in the plant? Yes ( ) No ( )

2. Have the chemical warning labels on the drums or bags and the chemical data information been made available to each employee working in the area? Yes ( ) No ( )

3. Have operating instructions been issued to each employee which incorporates all safety aspects of handling, mixing, and transferring of the chemicals? Yes ( ) No ( )

4. Are employees required to wear protective clothing, safety goggles and/or face shield, and rubber gloves while handling chemicals? Yes ( ) No ( )

5. Are spilled chemicals promptly cleaned up? Yes ( ) No ( )

6. When the boiler-treating chemicals are stored in an enclosed building, is the building properly ventilated? Yes ( ) No ( )

7. Are covers provided for chemical mixing tanks? Yes ( ) No ( )

8. Are chemical injection metering pumps and piping provided with adequate relief valves and check valves to prevent over-pressuring the system? Yes ( ) No ( )

9. Has an adequate sampling system been installed to safely take samples of the boiler water? Yes ( ) No ( )

10. Have operators been trained to sample the high pressure steam system? Yes ( ) No ( )

WASTE WATER TREATMENT

The waste water effluent from a fertilizer plant consists primarily of cooling tower blowdown, boiler blowdown, plant process waste streams, leaks and spills, and in some cases rainwater runoff. The treatment of these waste water streams is generally different for each plant due to the variables such as flow rates, waste concentrations, the chemicals involved in the initial water treatment, Federal and state regulations, and related safety questions.

CONTINUOUS ION EXCHANGE FOR TREATMENT OF AMMONIA/NITRATE WASTE STREAMS

The technology of ion exchange for the removal of nitrogen from waste water is relatively new in the fertilizer industry. The ion exchange system is composed of two fluid bed ion exchange vessels, the cation exchange bed for removal of the ammonium ion and the anion exchange bed for removal of the nitrate ion. The cation bed is regenerated with weak nitric acid and the anion bed regenerated with a weak aqua ammonia solution with the product of both regenerated streams being a weak ammonium nitrate solution. The treated water leaving the system, with the nitrogen removed, can be recycled or discharged from the plant.

There are also ion exchange units which have fixed bed ion exchange and operated by batching the waste water through the system. The potential hazards are similar for continuous and batch systems, however, the risk for occurrence is greater in the continuous process.

The main area of concern in the ion exhcange process is the use of nitric acid with both the anion and cation resins. Nitric acid at high concentrations will form explosive mixtures with organic materials such as the ion exchange resin, or when in the presence of chlorides and metal particles in the waste stream. To prevent the possibility of this occurrence, certain precautions should be taken in the operation of the ion exchange system. The following questions should be answered and discussed regarding the operation of the ion exchange system.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and while conducting a survey, complete this section with their help.

1. Have all employees who work in the ion exchange area been informed of the potential hazards in the operation of the unit? Yes ( ) No ( )

2. Are operators required to take a formal training course in the operation of the system before being allowed to operate it? Yes( ) No ( )

3. Have operators been trained regarding the safe handling and dilution of the nitric acid solution and the aqua ammonia solution? Yes ( ) No ( )

4. Have instruments been installed on the dilute nitric acid tank (to alarm and/or shutdown if the acid concentration exceeds the 18%-20% range) such as:

   A density indicator? Yes ( ) No ( )
   An acid conductivity indicator? Yes ( ) No ( )

5. Are analytical checks made on the various acid, ammonia, and ammonium nitrate streams to ensure that all concentrations are within range and to check the analytical instruments? Yes ( ) No ( )

6. Are operators required to wear safety equipment, such as gloves, aprons, goggles or face shields, while working around the acid and ammonia systems? Yes ( ) No ( )

7. Have the various pipelines or equipment in the process been labeled to identify the stream and function? Yes ( ) No ( )

8. Are emergency showers and continuous-flow eye wash fountains provided? Yes ( ) No ( )

9. Are high temperature indicators and alarms located on the anion and cation loops to detect any abnormal temperature rise in the system? Yes ( ) No ( )

10. Have pressure switches been installed in the system to open vents in the event of a pressure surge in the system? Yes ( ) No ( )

11. Are rupture discs installed in the process loop to provide additional overpressure protection for the vessels? Yes ( ) No ( )

12. Have external instrument monitoring panels, including television monitoring of resin bed levels, been located away from the ion exchange area to minimize operator exposure? Yes ( ) No ( )

13. Have precautions been taken to prevent possible acid carryover into the anion unit resin bed from the cation resin bed? Yes ( ) No ( )

14. Have procedures been instituted to prevent the introduction of algae to the cation unit from the waste water feed pond?

Yes ( ) No ( )

15. Is the waste water feed pond checked periodically for contaminates such as: metallic ions, chlorides, organics, oil, etc.?

Yes ( ) No ( )

CHROMATE REMOVAL PROCESS FOR TREATMENT OF COOLING TOWER BLOWDOWN STREAMS

In the cooling water system, the chemicals most commonly used for corrosion control are sodium and potassium dichromates and zinc. These chemicals can be handled and used safely, but it is important that personnel be familiar with the chemical behavior and the means by which their potential hazards can be minimized. The chromates are non-combustible but may react slowly with certain organic materials. Exposure to the chromate dust or solution can irritate mucous membranes, eyes, skin, and the respiratory system.

The blowdown from the cooling tower contains soluble chromate in the hexavalent form and has to be removed before being discharged from the plant. The chromate in the blowdown water in this form can be toxic and has to be removed and destroyed. One method of accomplishing this is the chromate reduction process using sulfur dioxide. Other methods include an electrochemical reduction process and an ion exchange resin process for removing the chromate. Both of the chromate reduction processes also remove zinc from the waste water.

The chromate removal process using sulfur dioxide gas (SO_2) is a process to reduce the hexavalent chromium ion to the trivalent chromium ion which is then precipitated as chromium hydroxide sludge. The system consists of a series of tanks where the cooling tower blowdown water is mixed with sulfuric acid to lower the pH, then reacted with sulfur dioxide gas to reduce the hexavalent chromium to the trivalent state. The solution is then treated with caustic soda which causes the trivalent chromium to precipitate as chromium hydroxide sludge. The sludge is pumped to holding ponds where it settles and dries out and can be removed from the plant to approved sludge disposal facilities.

The electrochemical chromate removal process is a method of converting the hexavalent chrome in the waste water to chromium hydroxide by using consumable iron electrodes to generate ferrous ions with an electric current. The ferrous ions react with the chromate ions in a reduction process to form the chromium hydroxide/ferric hydroxide mixture. The resulting effluent is treated in the mixing, flocculation, and settling section of the plant to remove the trivalent chromium hydroxide sludge from the waste water. The electrodes in the cell are cleaned by circulating 5 percent solution of hydrochloric acid through the cells daily for 10-15 minutes to remove any deposits on the electrodes.

Extreme caution should be used in the handling of the sulfur dioxide gas, sulfuric acid, hydroxhloric acid, caustic soda, and the chromate solutions. The following discussion on sulfur dioxide handling along with related safety questions on the chromate removal process is listed below.

Sulfur dioxide gas (SO_2) is intensely irritating to the eyes, throat, and upper respiratory system. Contact with its liquid form will cause burns to the eyes and the skin. The sulfur dioxide gas when inhaled has a suffocating effect and causes coughing and constriction of the lungs. It is easily recognized by a strong, pungent, repulsive odor.

The harmful effects for sulfur dioxide are similiar in nature to the handling and exposure to chlorine gas. The questions developed in the section for Chlorine Handling, in most cases, are applicable to sulfur dioxide and should be reviewed for this section. A brief summary of the important questions follows.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Have all employees who are potentially exposed to sulfur dioxide in the plant area been instructed in the following:

   Know the potential hazards involved and instructed in the use of prescribed precautionary measures and safeguards? Yes ( ) No ( )
   Know the purpose, use, and maintenance of personal protective equipment, such as goggles, shields, rubber gloves, etc. Yes ( ) No ( )
   Promptly reporting leaks or equipment failures and possible corrosion effects? Yes ( ) No ( )
   Promptly reporting signs of illness or skin infections? Yes ( ) No ( )
   Know first aid steps to take in case of accidental contact with gaseous or liquid sulfur dioxide? Yes ( ) No ( )
   Know the location of safety showers, eyewash fountains, and respiratory masks? Yes ( ) No ( )

2. Have newly assigned and experienced employees been trained and periodically reviewed in the operation and safety precautions of the chromate reduction process? Yes ( ) No ( )

3. Are all chemical tanks, equipment, and piping labeled and identified? Yes ( ) No ( )

4. Have precautions been taken to minimize employee exposure to the chromate sludge? Yes ( ) No ( )

5. Are sludge storage ponds lined to prevent ground seepage? Yes ( ) No ( )

6. For the electrochemical process, have extra precautions been taken to prevent electrical shock to the operator by:

   Providing adequate grounds for electrical equipment and conduits? Yes ( ) No ( )

   Ensuring that all electrical connections are tight and sealed in air tight junction boxes? Yes ( ) No ( )

WATER SOFTENING SYSTEM

Some fertilizer plants treat the cooling tower blowdown to selectively remove the calcium and magnesium buildup (hardness) in the water by the use of a water softening system. The calcium and magnesium are removed as a sludge and the treated water with the chromate corrosion inhibitor still in solution is returned to the cooling tower. The chemicals which are usually added to the treatment system to precipitate the calcium and magnesium in the softener are lime [calcium hydroxide and soda ash (sodium carbonate)], along with an organic polymer to speed up the precipitation and sulfuric acid for pH control.

All of these chemicals should be handled with care and protective measures taken to prevent contact with the skin and eyes. Lime and soda ash chemicals are usually handled in dry powder form, either in bulk or in bags, and the powders are mixed with water for use in the treating system.

1. When handling dry lime and soda ash chemicals, are employees required to wear the following:

Dust tight goggles?	Yes ( ) No ( )
A dust mask?	Yes ( ) No ( )
Rubber gloves?	Yes ( ) No ( )
Long sleeve shirts?	Yes ( ) No ( )

2. Is the building where the dry chemicals are stored and mixed ventilated with exhaust fans? Yes ( ) No ( )

3. Have employees been instructed in the chemical properties and possible safety hazards in working with the water treating chemicals? Yes ( ) No ( )

4. Are there level indicators or high level alarms on the chemical mixing tanks? Yes ( ) No ( )

5. Are employees who may be potentially exposed instructed to wear rubber gloves, rainsuit and face shield while working around sulfuric acid equipment? Yes ( ) No ( )

6. Are the solution storage tanks and chemical areas labeled to indicate the type of chemical and the safety equipment to be worn in the area? Yes ( ) No ( )

7. Are exposure records kept on employees exposed to chemical dusts and gases? Yes ( ) No ( )

8. Have employees been instructed to wash skin areas immediately after exposure to the dry chemicals? Yes ( ) No ( )

9. Have engineering controls been utilized to minimize chemical dust and vapor exposure to employees? Yes ( ) No ( )

STEAM GENERATION - AUXILIARY OR UTILITY BOILERS

The utility section of a fertilizer plant, in most cases, includes auxiliary steam boilers for generation of steam for use throughout the plant. These boilers vary in capacity and operating pressure and include package boilers and stationary boilers. The construction and maintenance of fired steam boilers is covered by the American Society of Mechanical Engineers (ASME) Boiler Construction Code. The code requires that all steam boilers be constructed according to the code's specifications and inspected during the construction and after completion. Yearly inspections are also required by the State and insurance companies for the boilers and the steam system safety controls.

In addition to the required safety controls on a fired steam boiler system, the following general questions should be used to evaluate the operation of a plant's auxiliary steam generation equipment.

Read all of the questions in this section; discuss the questions with those workers at your establishment who know the most about the areas covered; and, while conducting a survey, complete this section with their help.

1. Have operators been fully trained in the operation of the steam boiler? Yes ( ) No ( )

2. Have operators been instructed in all aspects of safety while operating the steam boiler? Yes ( ) No ( )

3. Are the steam boiler's internals and instrument controls thoroughly inspected and maintained during regularly scheduled turnarounds? Yes ( ) No ( )

4. Have operators been instructed not to light a burner until the boiler has been properly purged at a minimum of 70% of air flow for 5-10 minutes? Yes ( ) No ( )

5. Is a combustible gas analyzer available to check the firebox for possible fuel leakage before lighting a burner? Yes ( ) No ( )

6. Are operators instructed not to light a burner unless the furnace draft pressure is at zero inches of water or in the negative range? Yes ( ) No ( )

7. Have employees been instructed not to stand in front of peep holes when lighting a burner? Yes ( ) No ( )

8. Are fuel lines (i.e. natural gas and fuel oil) labeled in the boiler area? Yes ( ) No ( )

9. Are "No Smoking" signs posted in the steam boiler area? Yes ( ) No ( )

10. Are operators forbidden to bypass trip systems on the boiler controls unless an emergency exists or the supervisor is notified of the need to do so? Yes ( ) No ( )

11. Are the boiler drum liquid levels continuously monitored and visually checked periodically? Yes ( ) No ( )

12. Have precautions been taken to measure noise levels and notify operators of results in and around the steam generation areas? Yes ( ) No ( )

13. Is approved personal hearing protection equipment available for employees working in a noisy area? Yes ( ) No ( )

14. Are maximum noise exposure times, in hours, posted through out the work area for employees to see? Yes ( ) No ( )

15. Are fresh air masks and self-contained air masks available for use in the boiler control area? Yes ( ) No ( )

16. Is fire fighting equipment such as fire extinguishers, foam generation equipment, and fire hose connections located in or near the boiler control area? Yes ( ) No ( )

17. Is there a fire alarm system located in the boiler area? Yes ( ) No ( )

18. Have employees been instructed in the correct blowdown procedure for the steam drums? Yes ( ) No ( )

19. Are operators required to wear safety equipment such as hard hat, rubber gloves safety glasses or goggles when sampling the high pressure boiler? Yes ( ) No ( )

20. Is there a fire blanket located near the steam generation furnance? Yes ( ) No ( )

21. Have the operators been trained in switching from natural gas to fuel oil and vice versa? Yes ( ) No ( )

22. Have safety procedures been established for the storage, handling, and use of fuel oil in the auxiliary boilers? Yes ( ) No ( )

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