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A COMPREHENSIVE STUDY OF THE USE OF CHLORINE GAS FOR RESIDENTIAL SWIMMING POOLS

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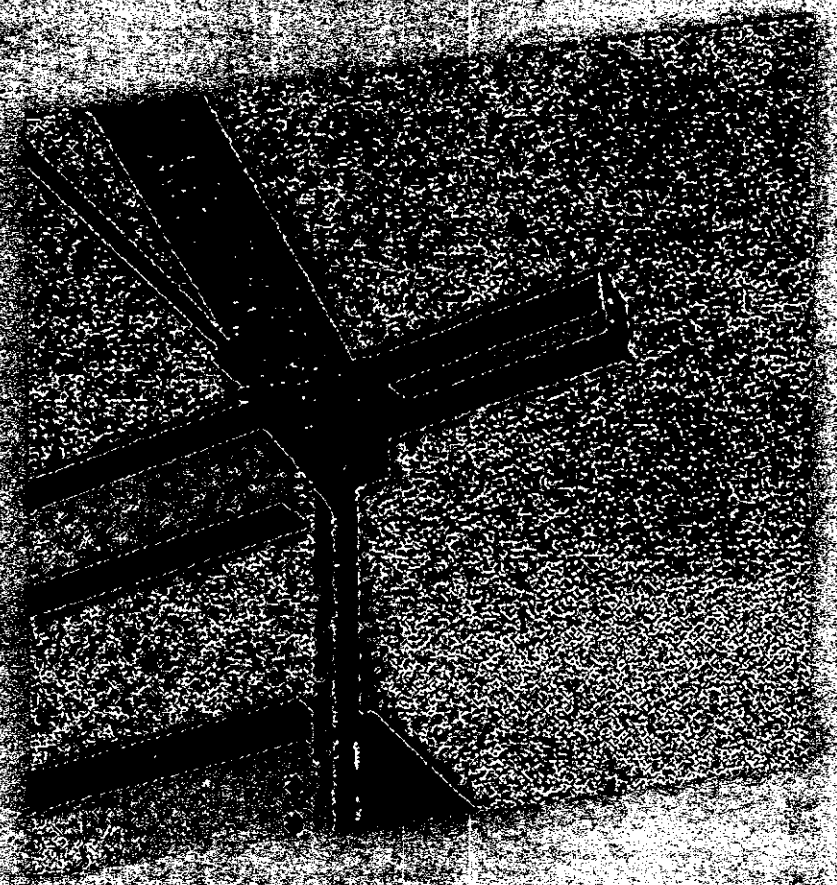

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A Comprehensive Study of the Use of Chlorine Gas for Residential Swimming Pools

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List of Terms

A.T.A. -- American Trucking Association

Calcium Hardness -- the measure of dissolved calcium minerals in pool water; expressed as parts per million of calcium carbonate

C.E.U. -- Continuing Education Unit

C.F.R. -- Code of Federal Regulations (U.S.)

Chlorine Institute, Inc. -- trade association for the chlor-alkali industry, based in Washington, DC, comprised of active members of the chlorine industry who pool their knowledge and expertise to develop recommendations for the safe handling and use of sodium and potassium hydroxides, sodium hypochlorite and the safe transportation of hydrochloric acid and anhydrous chloride gas; a special task force is currently revising existing safety guidelines for the use of chlorine gas in residential pools

C.I.C.C. -- California Chemical Company. This corporation is the world's largest swimming pool chemical service corporation comprising licensees from across the U.S. who utilize a uniform system for chlorine gas application in residential swimming pools.

Compressed Gas -- any material kept in a container with a pressure exceeding 40 p.s.i. at 70 degrees Fahrenheit, or 104 p.s.i. at 130 degrees.

Contaminant -- any undesirable physical, chemical, or microbiological substance

C.S.F. -- Confidential Statement of Formulation. Required by the State of Florida Department of Agriculture and Consumer services on its Registration of Pesticides Form.

Cylinder -- a pressure vessel designed for pressures higher than 40 p.s.i.

D.A.C.S. -- Department of Agriculture and Consumer Services

D.E. -- Diatomaceous Earth

D.E.P. -- Department of Environmental Protection (Florida)

D.O.L. -- Department of Labor (Federal)

DOT -- Department of Transportation (Federal)

D.P.R. -- Department of Business and Professional Regulation

D.T.S.C. -- Department of Toxic Substance Control (Federal)

EPA -- Environmental Protection Agency (Federal)

F.A.C. -- Free Available Chlorine

F.I.F.R.A. -- The Federal Insecticide Fungicide and Rodenticide Act

F.M.C.S.R. -- Federal Motor Carrier Safety Regulations (Title 49)

HAZMAT (Hazardous Material) -- any material that poses an unreasonable risk to health, safety, and/or property during transportation. These materials are named by the DOT in the Hazardous Material Table

HOCl -- Hypochlorous Acid. A sanitizing by-product of a chlorine-water mixture

Marking -- applying the descriptive name, instructions, cautions, weight, or specification marks required to be placed on the outside containers of Hazardous Materials.

M.S.D.S. -- Material Safety Data Sheets (as required by OSHA)

NAGC -- National Association of Gas Chlorinators; a trade association comprised of companies in the pool chlorination industry; represents many residential chlorine gas applicators

NFPA -- National Fire Protection Association

NSPI -- National Spa and Pool Institute; the major trade association for the swimming pool industry; (the NSPI is working with the NAGC to revise existing guidelines for chlorine gas use in swimming pools)

NIOSH -- National Institute for Occupational Safety and Health

OSHA -- Occupational Safety and Health Administration

OSHA Act -- The Occupational Safety and Health Act

pH -- the negative base 10 logarithm of the hydrogen ion activity (a scale used to measure relative acidity and basicity)

Pollutant -- any contaminant which is considered dangerous or harmful to human health or the environment

P.P.E. -- Personal Protective Equipment

Proper Shipping Name -- the name of the Hazardous Material shown in Roman print (not italics) in the Hazardous Material Table

Registered Hazardous Waste Transporter -- a person registered by the DTSC who engages in the offsite transportation of Hazardous Waste by air, rail, highway, or water

Repackaging -- the transferring of chlorine gas from large shipping containers to smaller containers (cylinders); this process can be done from pipelines directly into cylinders and ton containers

S.C.B.A. -- Self-Contained Breathing Apparatus

Shock Treatment -- the process of periodically adding a high dose of available chlorine to a pool (5 to 10 ppm) in order to oxidize ammonia compounds and other organic materials, including algae and bacteria

"Suck-Back" -- back siphoning through the dispensing lines after the pressure in the cylinder has dropped allowing moisture into the cylinder

Superchlorination -- a large dose (approximately 10 times the existing chlorine level in the pool) of any form of chlorine into a swimming pool, used to reach break point chlorination

Total Alkalinity -- the measure of the buffering capacity of the water and its ability to resist changes in pH; listed as ppm of calcium ($CaCO_3$); exists as predominately bicarbonate ions at pool water pH's

Executive Summary

For decades, chlorine has been used in various forms to rid water systems of undesirable bacteria, viruses, and other microbial contaminants. Chlorine is the most widely used chemical disinfectant and is available in gaseous form as elemental chlorine or as solid and liquid chlorinating compounds. Investigators from the University of Florida, M.E. Rinker School of Building Construction conducted a comprehensive study focusing specifically on the use and regulation of chlorine gas via portable systems in residential swimming pools in Florida.

The use of chlorine gas in Florida must be accomplished safely and those who are at any risk of exposure to the gas must be protected. In Florida, regulations to control the use of chlorine gas in residential pools are the responsibility of the Florida Department of Agriculture and Consumer Services (DACS). On Federal highways, the DOT has established rigid regulations for the transport of chlorine gas, regardless of use.

The chlorine gas applicators are further regulated by DACS in the application of gas chlorine in swimming pools. In addition to these two primary enforcing agencies, the Occupational Safety and Health Administration (OSHA) governs employee safety, the Environmental Protection Agency (EPA) has enforcement responsibility for package labeling and site registration, and the local fire marshall regulates storage.

This study concludes that residential gas chlorinators are involved in an industry that is governed by numerous regulations in all aspects of its activities and that is open to scrutiny by multiple governmental agencies. This report also contains recommendations to improve the safe use of chlorine gas in residential swimming pool applications.

Chapter 1
INTRODUCTION

1.1 Overview

Chlorine gas has many beneficial uses. However, despite its many benefits, chlorine is also highly toxic. In low concentrations (3 to 5 parts per million, airborne), chlorine is an irritant to mucous membranes, the respiratory system, and the skin. These risks can be avoided and must be contrasted with the powerful disinfecting qualities of this chemical. One of the many beneficial uses of chlorine is the treatment of water in swimming pools. The gas is safe when properly used in disinfection of swimming pools by trained professional applicators. It can be dangerous, however, if released into the air in significant quantities because its dispersion is very difficult to control. Experts on a special task force of the Chlorine Institute in Washington, D.C. created Pamphlet 97 which contains recommendations on the safe use of chorine gas in residential swimming pools. Pamphlet 97 is available from the Chlorine Institute.

For over twenty years chlorine gas has been safely and effectively used to sanitize residential swimming pool water in Florida by licensed companies. Historically, residential swimming pools have also been treated with chlorine supplied by a granular or pellet form of chlorinating compound. Commercial chlorinators in Florida have used on-site gas chlorine as a primary sanitizer since the 1950's.

The use of chlorine gas is regulated by local, state, and Federal governments. Chlorine gas is classified as a hazardous chemical and the State of Florida enforces Federal regulations for the use and transport of chlorine gas. In Florida, the courts, legislature, and even the Florida Construction Industry Licensing Board (CILB) have clarified that chlorine gas is a pesticide and that chlorine gas injection in residential swimming pools is appropriately regulated by the Florida DACS. This interpretation is consistent with the Federal Insecticide, Fungicide and Rodenticide Act (F.I.F.R.A.) when chlorine gas is used to disinfect swimming pools. Additionally, the use of chlorine gas as a disinfectant for treating residential swimming pools is also regulated by the U.S. EPA, the U.S. and Florida DOT, OSHA, the Fire Marshall, and various local boards and agencies.

The dispute over whether or not a company using the portable chlorine gas system must be licensed as a contractor was clarified by a 1992 CILB ruling. Pool

technicians practicing only gas infusion are not contractors. The contractor's exam and apprenticeships do not deal with the business, technology, or training related to the sanitation of swimming pool water with chlorine gas.

1.2 Research Objectives

The investigators have conducted a comprehensive study of the use of chlorine gas in residential swimming pools in Florida. The objectives of this research are twofold. The primary objective is to document the effects of chlorine gas used in swimming pools, both on humans and on the pools. This will require investigating:

- How residential gas chlorinators protect swimmers from improperly balanced pool water
- Any risk of danger to the community and the individuals using the chlorine gas either during transport and/or during service
- Any risk of damage to the pool finish or the pool equipment

NOTE: The above risks and/or dangers may also be attributed to dry chlorinating compounds or liquid bleach. However, this study will focus on the gaseous form of chlorine only.

The second objective is to examine existing regulations governing chlorine gas applicators and to recommend improved regulations with regard to:

- Licensing or certification of chlorine gas handlers and service personnel injecting the gas into a pool
- Minimum training required for these individuals
- Required and recommended safety equipment
- Minimum recommended safety procedures

1.3 Methodology

The research process to achieve the objectives outlined in the previous section included, but was not limited to the following:

- Comprehensive research of the subject matter, particularly the hazards and degree of risk involved in the use and transportation of

chlorine gas and the existing regulations and licensing and training requirements implemented by the U.S. DOT, Florida and other states and jurisdictions.

- Interviews with swimming pool technicians, public safety officials, trade organizations, experts in handling hazardous materials, and other appropriate individuals and organizations.
- Analysis and evaluation of the information obtained from the literature search and interviews.
- Preparation and submittal of a full report to BCIAC. This report includes all objectives of this proposal and also documents the research methods used and the findings of the study.

1.4 Benefits of the Study

The people of the State of Florida will benefit from the information that is compiled in this report, gaining an improved awareness that will increase public safety. Government agencies will now have a documented basis for review of regulations concerning the use of chlorine gas in swimming pools. This study identifies the importance of the safe usage of chlorine gas which cannot be underestimated, especially in light of the many advantageous uses of the gas. The chlorine gas industry will be able to reduce liability by controlling the risks which are outlined in this report, and regulators will have a tool to help improve operators who present a hazard to the public. In specific, the Florida DACS will be able to use this document to assist their formulation of licensing requirements for this industry.

Chapter 2
BACKGROUND INFORMATION

2.1 History of Chlorine

The 200 year history of chlorine forms one of the most interesting and importan chapters in the field of chemistry. Long before any other mineral resources of the earth had bee utilized for human endeavors, salt (NACl) was a factor in the organization of the primitive society. Since all body fluids contain chloride, the maintenance of proper chloride levels is essential for life The preparation of dilute aqueous hydrochloric acid from the distillation of common salt with water soluble sulfate appears in early records. Boyle observed the evolution of chlorine gas in 1727 However, it was Carl Wilhelm Scheele who is credited with making a closer examination of th gas. In 1774, while investigating the properties and source of another chemical's odor, h accidentally discovered chlorine gas. While collecting the evolved gas and testing it with severa agents, he noticed the greenish-yellow color of chlorine, then discovered its bleaching effect o vegetable matter and its suffocating effect on insects. He called it dephlogisticated marine acid ai and, by 1785, defined it as oxymuriatic acid. It was only in 1809 that chlorine was considered to b an element.

2.2 Uses of Chlorine

Today the largest quantities of chlorine are used in manufacturing chemicals. These include:

Solvents and other chemicals
Pesticides and herbicides
Plastics and fibers such as vinyl chloride and vinylidene chloride
Refrigerants and propellants
Deodorizers
Disinfectants
Sodium hypochlorite production
Bleaching pulp, paper, and textiles
Drinking and swimming water purification
Sanitation of industrial and sewage wastes
Aluminum and aluminum recycling processes

2.3 Alternatives to Pool Chlorination

There are several alternatives to chlorine gas disinfection of water including ozone, ultraviolet radiation, and ion exchange. Ion exchange involves a chemical process for the removal of dissolved ionic contaminants. Polymeric resins that exchange "more acceptable" ions for the ones to be removed may be used. Iodine is an alternative as are chlorine compounds in the form of solid compounds. However, in general, chlorine is the most common, versatile, and inexpensive disinfectant.

"Other members of the halogen family, bromine and iodine, are used for treating pool water. New developments in the use of ozone, ultraviolet light, ionization of salts, and other chemical compounds continue to provide new challenges and techniques in pool water treatment," (VanRossen, 31).

2.4 Characteristics of Chlorine

Chlorine is an element found in nature virtually always in a combined or compounded state, usually with sodium as common salt (NACl). It is a member of the halogen family. At standard conditions, it is a greenish-yellow gas which readily can be compressed into a clear, amber colored liquid. Chlorine as used in commerce, is a compressed, liquefied gas under pressure, about one and a half times as heavy as water. It is packaged in steel containers. The compressibility coefficient of liquid chlorine is greater than that of any other liquid element.

The physical properties of chlorine need to be identified for a better understanding of the benefits of this disinfectant, and how it may be used safely. NIOSH, in its publication, *Occupational Health Guidelines for Chlorine*, has identified some of the primary characteristics of chlorine. These physical and chemical properties are outlined in the following sub-sections.

2.4.1 Physical Properties of Chlorine

- Molecular weight = 70.9
- Boiling point at atmospheric pressure (760 mm Hg)= -29.3 F (-34.1 C)
- Specific gravity = 1.41 (relative to water)
- Vapor density = 2.5 (relative to air)
- Melting point = -149 F (-101 C)
- Solubility in water, g/100 g water at 68 F (20 C) = 0.7

NOTE: For more detailed information concerning the physical properties of chlorine, see Appendix A.

2.4.2 Chemical Properties of Chlorine

- Chemical symbol is Cl.
- Chlorine is the 17th element in the Periodic Table of Elements.
- Chlorine is a strong oxidizer
- Chlorine, as a result of acid formation (hydrochloric and hypochlorous) upon reaction with water, affects the water pH and consumes alkalinity. When chlorine is introduced in water, it reduces alkalinity.
- Chlorine reacts with a great number of inorganic compounds. The products of some of these reactions have great commercial value. The preparation of soda and lime bleaches through the reaction of alkalides and alkaline earth metal hydroxides are prime examples.

2.4.3 Reactivity

- *Conditions contributing to instability:* Elemental chlorine is stable
- *Incompatibilities:* Contact with substances such as gasoline and petroleum products, turpentine, alcohol, acetylene, hydrogen, ammonia, sulfur and certain finely divided metals can cause fires and explosions.
- *Hazardous decomposition products:* None
- *Special precautions:* Chlorine will attack some forms of plastics, rubber and coatings.

2.5 Chlorine Gas

Chlorine vapor, when inhaled, smells like household bleach and acts as a severe irritant. In heavy concentrations it appears greenish-yellow in color. However, in lower concentrations, gaseous chlorine is almost colorless. Chlorine gas is 2.5 times as heavy as air. "Because its density is higher than that of air, it tends to collect in low spots if it leaks into the atmosphere. The vapor diffuses slowly in still air; however, air currents can cause it to disperse throughout the work area," (National Safety Council, 1).

Considerably more weight of solid or liquid chlorinating chemicals are needed compared to elemental chlorine gas and the economics generally favor elemental chlorine. On a typical 15' by 30' swimming pool, an average of one to two pounds of chlorine gas is needed. By comparison, conventional treatments (pellet or liquid chlorine) require 16 to 20 pounds of a liquid that contains 15% chlorine, by weight, in bleach form. A number of factors can influence the amount of chlorine needed to adequately sanitize a pool:

- Time of the year
- Amount of rainfall
- Existing condition of the pool
- Usage of the pool
- Condition of pool equipment
- Temperature of the pool water
- Beginning chemical balance of the pool
- Size and shape of the pool
- Exposure to ultraviolet light
- Type of circulation and filtration systems

Chapter 3
CHLORINATION OF RESIDENTIAL SWIMMING POOLS

3.1 Reasons for Chlorination

The primary reason for using chlorine in swimming pools is for the protection of public health. Although use of chlorine as a disinfectant has been a standard procedure for a number of years, it should be remembered that the removal of all bacteria and other organisms from pool water is extremely difficult.

Disease transmission via contact with swimming pool water can be prevented by maintaining a free chlorine residual. Free chlorine, both HOCl and OCl^-, oxidize chloramines, the leading cause of eye irritation and odors in swimming pools, (Wallace 2-3). The objective of maintaining an appropriate chlorine level is a complex one. Of the total chlorine residual in the swimming pool water, it is the free chlorine residual in the form of HOCl that most effectively performs the critical functions of:

- Disinfection and algicide;
- Bleaching of suspended and dissolved organic matter;
- Destruction of nitrogenous compounds such as chloramines which cause eye irritation and objectionable odors.

A secondary reason for chlorination is to prevent the growth of algae. The free chlorine level must be tightly controlled to achieve the objectives of disinfection and algae control as well as to ensure the comfort of bathers. In summary,

"While there are many chlorinating agents (or sources of chlorine), the active chemical that is always formed when any is added to water is hypochlorous acid (HOCl). Hypochlorous acid is an extremely active and powerful chemical. It not only destroys harmful organisms such as bacteria, algae, fungi, and viruses, it also destroys impurities that are not removed by filtration.

The use of chlorine to clean water is a supplement to filtration. Filters remove the dirt and debris suspended in water, but even the best filter cannot remove dissolved impurities because they are not physically separate from the water. If the water looks dull or hazy, even though the filter system is operating properly, the operator should consider a

chlorine shock treatment to oxidize the dissolved organic impurities and restore the clarity of the water," (VanRossen, 27 - 28).

3.2 Balancing pH and Alkalinity

Understanding the relationship between pH and alkalinity levels is vital to the maintenance of a healthy swimming pool environment. According to Bicarbonate Experts, "In general, when alkalinity increases, the pH of the pool tends to be higher," (Bicarbonate Experts, 5). Determining the proper pH range for swimming pools is dependent upon a pool's primary sanitizer. In addition, the alkalinity of the pool water should be between 80 and 150 ppm, not exceeding 250 ppm. The alkalinity, measured as calcium carbonate but predominately found as bicarbonate ions at the pH of most pools, provides a buffering range against the acidity added by the creation of HOCl and OCL^- during gas chlorination. Generally, when the pH of pool water is too low, it is wise to raise the level of alkalinity. According to Dr. James Brownell, University of California, Berkeley, water with normal alkalinity usually has enough pH buffering capacity to neutralize any acidity caused by standard chlorine gas injection. Dr. Brownell states that, "Bicarbonate results from the equilibrium between the water and carbon dioxide from air. Its maximum concentration is set by the pH, total dissolved solids and other ions in the water" (Brownell, 3-5).

There is little doubt that the addition of chlorine gas to pool water will reduce the pH, but not to a dangerous level, (Herman, 42). The lowest pH level measured (between 4 and 5) was directly above the gas dispenser (Herman, 43). Dr. Brownell conducted a three-year study on the effects of chlorine gas on the pool environment. He determined that although the gas rising from the dispenser was very acidic (a pH of 4 was the lowest observed), the active chlorine in uncirculated pools diffused throughout the pool within minutes, thus avoiding the creation of *hot spots* of chlorine, (Brownell, 5). Both studies show that the pH quickly reaches normal levels.

3.3 Pool Treatment

When applying chlorine gas to a pool, technicians must perform the following steps to ensure the pool treatment is accomplished in at least a minimally satisfactorily manner from a health and safety standpoint:

- Measure the existing conditions of the pool water for free chlorine residual, pH, and alkalinity with respect to the buffering agent.
- Add chlorine gas, if necessary.
- Add buffering agents to balance pH and alkalinity, if necessary.

The above steps assume a properly balanced pool condition. If the pool is out of balance, a more complicated procedure is necessary. Clearly then, there are three issues involved in the proper application of chlorine gas. First, a means of measuring the free chlorine, pH, and alkalinity must be available. Second, sufficient application time must be allowed to ensure that the pool has achieved the desired concentration of chlorine, to meet the sanitizer demand of the pool. Third, there must also be a sufficient amount of stabilizer in the water to ensure a proper chlorine residual throughout the week.

Swimming pools require periodic checks for cyranurate acid, because "free-chlorine" is subject to photolytic decompression by sunlight. Consequently, in swimming pools and other applications cyanuric acid is used as a chlorine stabilizer (Engel, 115). It should be noted that because cyanuric acid inhibits the bactericidal effect of free chlorine, a higher total chlorine level is necessary when cyanuric acid is used.

3.4 Infusion

When preparing for chlorine injections into a residential swimming pool, the immediate area should be cleared of all people. This should be done before beginning the injection sequence. In addition, chlorine tank exchanges and gas treatments should always be made only while the pool is vacant of bathers. Before injecting the chlorine gas, the pH, alkalinity, and residual chlorine levels of the pool water should be checked.

Chlorine bubbles should not be allowed to escape the pool water. This can be avoided by placing the chlorine gas dispensing device in the deepest area of the pool. If bubbles escape, despite proper placement of the dispenser, the rate at which the gas is being injected should immediately be reduced. The amount of chlorine remaining in a cylinder during injection should be closely monitored. When a cylinder is empty, and it is below the pool water

level, a phenomenon known as *suck-back* can occur. Suck-back, when the pressure drops in an empty cylinder allowing liquid to be back-siphoned through dispensing lines and into the cylinder, can harm the cylinder and cause a hazard. Therefore, accurate measurement to avoid such an incident is essential.

The NAGC published a series of recommendations concerning the safety measures to be followed when using chlorine gas for the treatment of residential swimming pools. These recommendations are located in Appendix B.

3.5 Cleanup and Disposal

The understanding of emergency procedures for clean-up and neutralization of chlorine gas leaks is vital to the successful use of the substance. OSHA's emergency response regulations are contained in 29 CFR 1910.120. The Canadian Centre for Occupational Safety and Health in their *Chemical Infogram*, recommends the following precautions concerning clean-up and disposal:

- Only trained personnel should perform clean up.
- Ensure appropriate ventilation is provided.
- Use appropriate protective clothing and respirators.
- Follow manufacturer's recommendations for clean-up and neutralization.
- For disposal, comply with environmental regulations.

Clearly, chlorine gas is a substance which must be handled with a high degree of care and caution. Facilities which are intended to store or use chlorine in any amount should be constructed to ensure that no amount of chlorine is released into the environment. The Compressed Gas Association offers suggestions on dealing with accidental releases.

"If accidental release should occur, the environmental effects, as well as all relevant reporting requirements, must be considered. In the case of chlorine emergencies, or if a chlorine-consuming process involves the discharge of wastes containing chlorine, all governmental regulations regarding health and safety or the pollution of natural resources must be followed.

Chlorine is only slightly soluble in water and there normally would be little absorption in water from a cloud of chlorine gas. Many forms of aquatic life are adversely affected by chlorine in concentrations well below 1.0 ppm, but harmful concentrations are unlikely unless chlorine or wastes containing chlorine are directly discharged into the water.

Atmospheric releases of chlorine, where possible to contain, should be absorbed in an alkali solution. Chlorine affects most vegetation, sometimes retarding growth rate or yield" (Compressed Gas Association, 316).

The above procedure is used primarily concerned with large chlorine cylinders, whereas the maximum 25-pound cylinders used by residential chlorine gas applicators are not be expected to produce a catastrophic situation (Engel, 1995).

A dispersion study of chlorine gas releases in hypothetical scenarios was not conducted for this report because of the complexity of conducting dispersion studies of any type of atmospheric release of chlorine or other gases. A wide variety of possible meterologic conditions with a wide variety of variables can be hypothesized. Wind speed, temperature, humidity, and the assumptions concerning the incident itself would have to be factored into the dispersion study. There are technical publications that do contain dispersion data for large releases on the order of thousands of pounds of gas. However, extrapolating this information to the case of the relatively small release that could occur from a vehicle carrying 25-pound chlorine cylinders cannot be accomplished with any significant degree of confidence. In the opinion of the investigators, the regulations of the Federal and State of Florida Departments of Transportation governing transport of chlorine gas, in either small or large quantities, appear to be adequate for protecting the public.

Chapter 4
THE EFFECTS OF CHLORINE

4.1 Symptoms of Airborne Chlorine Gas Exposure

It is of vital importance that pool technicians working with chlorine gas understand and respect safety guidelines to avoid harmful exposure to themselves and others. Chlorine gas can cause serious respiratory damage and, in higher concentrations, death. Chlorine gas is primarily a respiratory irritant. Concentrations in the air of 0.2 to 0.3 ppm will produce an odor that is readily detectable. At concentrations above 5 ppm, it is unlikely that any person will remain in a chlorine contaminated area unless he or she is unconscious or trapped (Compressed Gas Association, 313).

Exposure to chlorine gas will cause various effects depending upon the exposure concentration and the duration of the exposure. The U.S. DOT lists chlorine as a "poisonous" gas in their *Guide 20*. The guide states that chlorine may be fatal if inhaled and that direct contact may cause burns to the skin and eyes. According to the Chlorine Institute's publication, *First Aid and Medical Management of Chlorine Exposures*, "Chlorine is a strong oxidizing agent that forms hypochlorous and hydrochloric acid on contact with moist mucous membranes," (Chlorine Institute, 1). Low level airborne chlorine exposure (less than 3-5 ppm) of chlorine gas may cause:

- Skin irritation with discomfort or pain
- Eye irritation with discomfort, tearing or blurring of vision
- Irritation of the upper respiratory passages, characterized by throat burning and choking sensation, (Chlorine Institute, 1-2)

High level airborne exposure to concentrations greater than 3-5 ppm may have the following effects:

- Skin burns or ulceration
- Eye corrosion with corneal or conjunctival ulceration
- Corrosion of mucous surfaces with respiratory irritation characterized by coughing, discomfort, difficulty in breathing, or shortness of breath, (Chlorine Institute, 2)

A feeling of suffocation, which may lead to severe breathing difficulties can also occur due to the fact that, "Chlorine in high concentrations acts as an asphyxiant by causing cramps in the muscles of the larynx and thus, choking," (Industrial Exposure and Control Technology for OSHA, 402).

The results of high or prolonged exposure (usually longer than 8 hours) may cause delayed lung edema and even death, (Chlorine Institute, 2). "The symptoms of exposure to high concentrations are retching and vomiting, followed by difficult breathing. In extreme cases, the difficulty of breathing may increase to the point where death can occur from suffocation," (Compressed Gas Association, 313).

In some cases of extreme exposure to chlorine gas, the symptoms and restrictive abnormalities were observed to have completely cleared within roughly three months. However, in other cases, the recovery period was much longer and less successful. Insufficient evidence currently exists to present any reliable medical conclusions. Further information on the various thresholds for chlorine gas exposure adopted by OSHA and NIOSH are listed in Appendices C and D. With regard to extreme exposure, the Chlorine Institute has recommended that cylinder sizes for residential gas chlorination be no larger than 25 pounds, making extreme exposure unlikely.

4.2 Exposure Monitoring

Persons afflicted with asthma, bronchitis, and other chronic lung conditions or irritations of the upper respiratory tract should not be employed to work in areas where the gas is handled. All prospective employees working with chorine gas should be given pre-employment physical screening. If, after screening, physical fitness is in question, further testing may be necessary. Once the worker is an active employee, periodic physical examinations, including X-rays should be given, (Compressed Gas Association, 315).

4.3 Employee Training

Training is perhaps the single most important factor when addressing employee safety concerns. By adhering to prudent employee training programs an employer is directly strengthening the company's safety record and reducing the chances of liability.

Employees should be trained to handle chlorine safely with special emphasis placed on actions to be taken and equipment to be used in case of an emergency. Each employee should be instructed in the properties and physiological effect of chlorine gas, the

location and proper use of several types of respiratory equipment, and the conditions under which each type must be used. Each employee should be trained in first aid procedures (see Sections 4.1.4 and 4.1.5), particularly in administering CPR, (Compressed Gas Association, 315) (See Chlorine Institute Pamphlet #151).

The Compressed Gas Association suggests that a list of several physicians to be contacted in case of emergency be located at all work stations. In addition, they suggest that physicians on the list should familiarize themselves with any type of emergency associated with chlorine, including worker exposure. Each employer should provide physician phone numbers as well as the number of the chlorine gas supplier. A similar list should be posted in the area where the gas is handled. It should also include hospital, fire department, police department, and emergency medical rescue phone numbers. Finally, a nearby phone extension should be located prior to the handling of chlorine gas.

4.4 General First Aid Procedures For Acute Chlorine Exposure

There is no single, specific antidote for chlorine exposure. However, prompt medical attention and assessment are necessary for a full recovery. The Chlorine Institute states, "Prompt treatment of anyone overcome or seriously exposed to chlorine is of the utmost importance. The patient should be removed from the contaminated area and medical assistance obtained as soon as possible," (Chlorine Institute, 8). General First Aid Procedures as determined by the Chlorine Institute are provided below:

- Move victim to fresh air and call emergency medical care; if not breathing, perform artificial respiration and avoid breathing the exhaled, contaminated breath of the victim; if breathing is labored, a trained attendant should administer oxygen.
- In case of contact with material, immediately flush skin or eyes with cool running water for at least fifteen minutes.
- Remove and isolate contaminated clothing and shoes at the site.
- Give nothing by mouth if person is unconscious or convulsing.
- Keep victim quiet and maintain normal body temperature.
- Firmness and assurance will help alleviate anxiety.
- Effects may be delayed; keep victim under observation. "For those who have been *exposed* but are not in immediate medical distress, obtain pulmonary function test data and compare with baseline," (Chlorine Institute, 2)

Emergency phone numbers and further First Aid Information, if needed, can be found printed on any Material Safety Data Sheet (MSDS). The sheet can be obtained from the chlorine supplier and is required by OSHA on every job site where chlorine is used. An alternative source is the *Emergency First Aid Treatment Guide for Chlorine* published by the EPA. In addition, CHEMTREC, a 24 hour emergency service, may be contacted at 1-800-424-9300 or the National Response Center (NRC) at 1-800-424-8802.

4.5 Chlorine Gas Inhalation First Aid Procedures

According to the Chlorine Institute, *if breathing has ceased*:

- Remove to fresh air and remove and dispose of any contaminated clothing.
- Call for emergency medical assistance.
- Begin artificial respiration.
- If pulse has also ceased, begin cardiopulmonary resuscitation (CPR) immediately.
- Trained personnel should administer humidified oxygen by inhalation as soon as possible, (Chlorine Institute, 2).

If breathing has not ceased:

- Move to fresh air and remove any contaminated clothing.
- Place patient in a comfortable position.
- Encourage slow, regular breathing.
- Trained personnel should administer humidified oxygen as soon as possible.
- Keep patient warm and at rest.
- Render any other necessary first aid.
- Alleviate anxiety by explaining the various procedures being used and obtain cooperation, especially for breathing exercises.
- Position patient in chair; in severe cases have the patient lie down with the head and trunk elevated to a 45-60 degree position, (Chlorine Institute, 3).

4.6 Recommended Safety Equipment

Facility:	B-Kit (Emergency kit for one-ton container leaks)
	Coffin for small cylinders (Cylinder containment vessel)
	SCBA's (self-contained breathing apparatus)
	Escape respirators (used to protect breathing)
	Eyewash (to dilute or wash out chlorine)
	Shower (to rinse the affected area)
	Oxygen
	Safety cap for chlorine valves
	Ammonia vapors to be used to identify chlorine leaks
	Spare chlorine wrenches
	Mobile radio for emergency communication
Vehicles:	Safety caps
	Escape respirator
	Mobile radio
	Spare wrenches

Note: These recommendations exceed or are the same as those required by OSHA, EPA and DOT.

4.7 The Effects of Chlorine Gas on Swimming Pools and Equipment

The pH balance of pool water can also affect the condition of a pool's finish and equipment. When properly buffered, however, chlorine gas, aside from being a highly effective means of disinfection and algae control in pools, has little, if any, effect on pool equipment and liners. In equivalent quantities, chlorine gas creates more hypochlorous acid (HOCl) than any other form of chlorination. HOCl results from the addition of any active chlorine compound into pool water. It is this creation of HOCl by all chlorinating compounds and by gaseous chlorine that necessitates chlorine buffering.

According to Dr. James Brownell, in studies funded by C.I.C.C., active chlorine usually diffuses through the pool within minutes, and if properly injected, contact between the small volume of treated water and any pool component is prevented, (Brownell, 1). A recent study, entitled *The pH Dynamics of Gas Chlorine Injection*, was conducted by Pool Chlor and Aqua Clear. The pH levels from three different locations were closely monitored. As chlorine gas was injected into the pool (with the pool's circulation system turned off), the pH reactions

were measured in terms of dispersion rate and intensity. The results of this study were published in *Pool and Spa News* by Eric Herman who wrote, "So far, the data indicates that the area most affected by the gas is a funnel-shaped area directly above the point of injection. As a result, the area that may be the least affected by chlorine gas applications appears to be right next to the plaster," (Herman, 43). "This differs from powder and liquid chlorine applications, which have a tendency to sink and then spread from the bottom up," (Herman, 44). These tests were conducted with the water circulation system off. Chlorine gas injection is via a proprietary wand that is attached via a flexible hose to the chlorine gas bottle. For actual pool servicing the pump is not to be restarted for 3 hours. The active chlorine is usually diffused throughout the pool within minutes, (Brownell, 1). In a study of 60 pools conducted in the early 1990's, 2 pounds of chlorine were injected at a rate of 0.5 lb per minute in order to determine the distribution of pH as a function of location and time. The lowest pH of 6.0 was located just above the injection point in the deepest section of the pool during injection. The lowest pH at the periphery of the pool during injection was 7.2. The average starting pH of the pools prior to chlorine injection was 8.0 and the average final pH was 7.8.

These studies show that the buffer chemistry and dispersion techniques used by this industry provide for adequate protection against improper water chemistry and its effects on pools and equipment.

Chapter 5
REGULATION OF CHLORINE GAS

5.1 Federal Regulation

Nationwide, the use of chlorine gas in residential swimming pools is not a new practice. It is currently used in residential swimming pools throughout the U.S., with concentrated use in Florida, Texas, California, and Arizona. Communication between states regarding chlorine gas and hazardous materials is, in general, limited. Federal agencies such as OSHA, the EPA, and the DOT provide for existing interstate communication lines. The EPA is currently investigating and considering making chlorine a restricted-use pesticide, which would mandate training and supervision requirements.

5.2 State Regulation

In the State of Florida, the Department of Agriculture and Consumer Services (DACS) is the primary regulating agency for gas chlorinators. According to the Florida Pesticide Law, Chapter 487 F.S., chlorine is considered to be a pesticide, and therefore, all manufacturers and distributors of chlorine must be approved for registration by the Department of Agriculture and Consumer Services. Currently, DACS is responsible for a test that all registration holders must successfully complete to be properly licensed in Florida. Appendix E gives an example of the DACS's *Application Form for the Registration of Pesticides* in the State of Florida. A sample of a registration form for a New or Amended Brand Pesticide is shown in Appendix F. For each product to be registered, the department requires the following:

- Registration fee of $225 per year
- One copy of the printed label
- Confidential Statement of Formulation
- Material Safety Data Sheet (MSDS), including a statement of emergency treatment

Also, before beginning a chlorine gas injection business, applicators must contact the local fire marshall and fire department to determine their particular regulations for storage of chlorine gas.

The following is a list of official forms which all residential gas chlorinators must submit when working in the state of Florida:

- Application for Registration of Pesticides
- Florida Department of Agriculture and Consumer Services Pesticide Registration Notice
- Florida State Emergency Response Commission for Hazardous Materials Annual Registration

It should also be noted that all residential gas chlorine firms must have their own EPA product registration, EPA establishment number, training program, and documented equipment and transportation maintenance program. All firms must comply with all other applicable Federal (OSHA, DOT, etc.), state, and local regulations.

5.3 Current State Legislation

Florida's Legislature is considering a series of licensing criteria for applicators of chlorine gas. Chlorine gas received attention in a recent legislative session during which two changes occurred:

- The swimming pool/spa servicing contractor license under the Department of Professional Regulation now regulates chlorine gas infusion only if the applicator attaches any equipment to the pools, a common practice in commercial pools.
- Under the Department of Agriculture, a new licensing category within the commercial applicator classification was established for chlorine gas infusion in pools via a portable system. Training and exam requirements for this category became effective January 1, 1995.

5.4 Federal Agencies

5.4.1 Environmental Protection Agency (EPA)

Companies using chlorine gas must be registered with the EPA. The EPA requires that all containers of chlorine be labeled, specifying where and how they will be used.

Before beginning a chlorine gas injection business, registration is necessary; the following forms and information must be filed with the EPA:

- EPA Primary Registrant Label
- Notice of Supplemental Registration of Distributor with the EPA for subregistration of a license (an example of this notice can be found in Appendix G); this form is only required for multiple-location operations
- Application of Pesticide-Producing Establishment (an example of this notice can be found in Appendix H)
- Pesticides Report for Pesticide-Producing Establishments (an example of this notice can be found in Appendix I)

The registration kit described in Appendix J lists all additional forms to be filed before any business wishing to register a pesticide with the EPA's office of Pesticide Programs may operate.

Finally, all gas chlorination businesses are subject to inspection by the EPA to determine compliance with the Federal Insecticide Fungicide Rodenticide Act (FIFRA). FIFRA regulates the registration, record-keeping, inspections, reporting, transportation, and other areas of the gas applicator's business. An index to the FIFRA can be found in Appendix K. In Florida, the inspection and enforcement agency for the EPA is the Florida Department of Agriculture and Consumer Services.

5.4.2 The Occupational Safety and Health Administration (OSHA)

OSHA lists chlorine as an acutely toxic chemical. Additionally, in accordance with the Department of Labor's published regulations, OSHA expressly requires compliance with its Hazard Communications Standard (HCS). This standard is part of the Code of Federal Regulations and is listed as 29 CFR 1910.1200. The HCS is designed to result in the flow of hazard information from the producers of chemicals to industrial users of these products.

As of November 25, 1985, chemical manufacturers, importers, and distributors were required to label shipped containers of hazardous chemicals, and to provide Material Safety Data Sheets to manufacturing purchasers of these chemicals.

Companies practicing chlorine gas injection may be subject to random, on-site inspections conducted by Health and Safety Compliance Officers (HSCO) to ensure compliance with the HCS Code. The company employer is evaluated based upon compliance with the written program requirements, use of labels, availability of MSDS and appropriate training for employees (applicators). Citations are given for any violations discovered by HSCO's.

OSHA divides the various responsibilities of handling hazardous material (in this case, chlorine gas) into two categories:

- Specific Supplier Responsibilities
  ◊Perform Hazard Determinations
  ◊Comply with labeling
  ◊MSDS Requirements
- Specific User Responsibility: Perform hazard determination for hazardous chemicals created within and used exclusively on-site.

OHSA also requires, in accordance with the Department of Labor's 29 CFR 1910.1200(e), that all employers have a Written Hazard Communication Program. Each program will vary, depending on the nature of the site and will be used as a guide for HSCO's in determining acknowledgment of the employer of the requirements of 29 CFR 1910.1200(e). A citation will be given to any employer who fails to provide a Written Hazard Communication Program. This program should include:

- Labels
- Material Safety Data Sheets
- Training

Finally, as of 1983, all residential chlorine gas businesses were required to comply with regulations 1910.101 and 1910.166 (see Appendix L). The State of Florida Bureau of Industrial Safety and Health also provides free on-site safety and health consultation services.

5.5 Labeling

Labeling is an important aspect of handling chlorine gas. Warning signs are required on all chlorine containers. Federal requirements are the minimums that are required to be placed on the tanks. The labeling typical of what is required can found in Appendix M.

The National Safety Council in its Data Sheet on chlorine provides the following, "In addition to any label or warning statement required by statutes, regulations, or ordinances, containers should be informatively labeled according to recommendations of the American National Standard Z129.1-1976, Precautionary Labeling of Hazardous Industrial Chemicals," (National Safety Council, 3). An example of a label which conforms with recommendations of the American National Standard mentioned above can be found in Appendix N.

Labeling is not only recommended by the National Safety Council, but is required by OSHA and EPA, as set forth under FIFRA. As previously stated, Material Safety Data Sheets are required wherever the gas is used. These sheets provide an important support function to the labeling requirement.

5.6 Emergency Response

The State of Florida has established a State Emergency Response Commission to help those involved with hazardous materials (such as chlorine gas) operate more safely. In addition, this commission is available to assist in emergencies and provide useful advice on emergency prevention by offering opportunities such as their Emergency Planning Committee Meetings. Appendix O provides an *Emergency Response Commission Hazardous Materials Annual Registration Form*, and Appendix P demonstrates an example of a *Facility Representation Notification Form*. The address for this organization can be found at the end of this document.

Chapter 6
Proposed Regulations

6.1 Overview

Safety and First Aid concerns must be the primary focus of any regulation relating to the handling and use of chlorine gas to protect applicators and the public at large. Training in this regard is essential for all chlorine gas applicators.

6.2 Minimum Recommended Service Procedures

The minimum licensing requirements for companies introducing chlorine gas directly into residential swimming pools in the State of Florida are being established by the Florida DACS. The service procedure for chemically treating residential swimming pools with chlorine needs to be clear and concise. Some suggested, generalized procedures to further mitigate risks in residential settings are as follows:

- Non-service personnel and animals shall not be allowed in the pool area during chlorine gas application.
- Pool service personnel shall not leave the pool area while the chlorine cylinder is dispensing chlorine.
- Service personnel shall apply chlorine to a pool from a cylinder larger than a twenty-five pound capacity.
- Permanent records of events transpiring at each site visit and treatment shall be maintained. Any instructions given to the pool owner by the servicing personnel shall be documented.

6.3 Licensing of Applicators

Chlorine is classified as a general-use pesticide. Because of this rating, no EPA qualification or training of applicators is required at this time. Currently, the training of applicators of chlorine gas is up to the companies themselves, as dictated by their EPA label. Presently, the EPA is considering changing chlorine to a restricted-use pesticide, which would then require formal training guidelines.

The NAGC, in their *Chlorine Applicator's Study Guide*, provides a proposed sample test for those intending to apply chlorine gas in residential swimming pool, which may be an appropriate starting point for potential gas applicators.

Chapter 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Chlorine gas and other forms of chlorinating compounds are both beneficial and dangerous chemicals which must be handled properly and with considerable care in order for the benefits of the chemical to out-weigh its risks of usage. Because of the widespread application of chlorine gas in industry and water treatment systems, the use and handling of this gas is well understood. The safety record of chlorine gas in the U.S. is at least as good as that of any other dangerous gas. This record is primarily the result of handling and use guidelines established by the Chlorine Institute, Inc. and regulations established by the Federal government.

Due to the requirements established by Federal and Florida rules and regulations, chlorine gas injection is a safe and effective method for disinfecting residential swimming pools. Maintaining safe levels of chlorine to disinfect pool water is a process that requires close monitoring. This study has shown that the storage, use, and handling of chlorine gas is regulated by many overlapping regulatory authorities. Licensing and testing of residential swimming pool gas chlorinating companies by Florida DACS will further insure safe operations.

7.2 Recommendations

The following are recommendations for chlorine gas application in residential swimming pools.

1. Companies involved with chlorine gas application into residential swimming pools need to be held responsible for properly training and equipping their employees.
2. Existing regulations must be uniformly enforced.
3. The Department of Agriculture and Consumer Services (DACS) needs to be provided with additional funding and personnel to monitor and enforce safe operations for chlorine gas application into residential swimming pools throughout the State of Florida.

4. DACS needs to complete the testing requirements and licensing of companies in the residential chlorine gas industry.
5. The penalty system needs to be enforced to ensure that those who violate chlorine gas application regulations will receive fines, and/or loss of certification.
6. The Department of Transportation needs to uniformly enforce regulation of chlorine gas safety procedures while gas is being transported over public highways.
7. Governmental agencies need to work together to ensure safe transportation, handling, and infusion of chlorine gas into swimming pools.
8. Chlorine gas applicators should make written copies of their training and safety programs available for the Department of Agriculture to review.
9. The Florida regulations regarding chlorine gas need to be compiled in a condensed format and made available to the Florida regulating agencies involved with residential swimming pool chlorine gas application.
10. Employees who handle chlorine gas in residential swimming pool application need to be certified by their own company. This certification should address all areas of chlorine gas operation related to this industry (i.e., application, transportation, or infusion) and general chlorine safety.

Appendix A
Properties of Chlorine

Chemical Symbol:	Cl
CAS Registry Number:	7782-80-5
DOT Classification:	Nonflammable Gas
DOT Label:	Nonflammable Gas and Poison
Transport Canada Classification:	2.4
UN Number:	UN 1017
RTEC Number:	F02100000 (assigned in the US by the National Institute for Occupational Safety and Health)

Physical Constants of Chlorine

	US Units	SI Units
Chemical Formula	Cl	Cl
Atomic Weight	35.453	35.453
Molecular Weight	70.906	70.906
Density of the gas at 32° F (0° C) and 1 ATM.	0.20057 lb/ft	3.2127 kg/m
Specific Gravity of the gas at 32° F (0° C) and 1 ATM.	2.485	2.485
Specific Volume of the gas at 70° F (21.1° C) and 1 ATM.	5.3882 ft/lb	0.33638 m/kg
Boiling Point at 1 ATM.	-29.15 F	-33.97 C
Melting Point at 1 ATM.	-149.76 F	-100.98 C
Critical Temperature	290.75 F	143.75 C
Critical Pressure	1157 psia	7977 kPa
Critical Density	35.8 lb/ft	573 kg/m
Triple Point	0.20226 psig	1.3945 kPa
Latent Heat of Vaporization at boiling point	123.85 BTU/lb	288.08 kPa

Latent Heat of Fusion at melting point	38.836 BTU/lb	90.331 kPa
Viscosity (liquid) at 68° F and 1 ATM.	0.346 cP	0.346 mPa
Viscosity (gas) at 68° F and 1 ATM.	0.0134 cP	0.0134 mPa
Weight of the Liquid at 70° F (21.1° C)	11.73 lb/gal	1405.3 kg/m
Specific Gravity of saturated liquid at 32° F (0° C) and 53.51 psia (368.92 kPa)	1.4667	1.4667

Appendix B
Recommended Minimum Safety Guidelines

The following information, regarding the application of chlorine gas in swimming pools, was taken from the National Association of Gas Chlorinators' *Recommended Minimum Safety Guidelines.*

a. The use of a positive locking device (threads, quick-connect, or similar connector) to attach the dispensing device to the cylinder valve is highly recommended. The attached system must be able to withstand 200 psig. This device should be made with CI-approved materials only.

b. All cylinder valves are to be reconditioned and serviced a minimum of every six months. All valve manufacturers have standards for servicing valves and criteria for specific part replacements.

c. A chlorine cylinder that does not have a minimum of one pound of product in the tank should not be used. Extreme care must be used to ensure that positive pressure is maintained within the cylinder to prevent suck-back of any element into the cylinder.

Appendix C
Hazards of Chlorine at Various Atmospheric Concentrations

The following information was published by the Chlorine Institute:

Chlorine Concentration in the air		
ppm	**mg/m**	**Degree of Hazard**
0.2 - 0.3	0.6 - 0.9	Threshold of odor perception for the average person
3-5	9-15	Slight irritation of the nose and upper respiratory tract
5-8	15-24	Irritation of the respiratory tract and eyes
15-20	45-60	Immediate severe irritation of the respiratory tract; intense coughing and choking
30	60	Shortness of breath, chest pain; possibly nausea and vomiting
40-60	120-180	Development of chemical bronchitis and fluid in the lungs, which may occur after several hours; chemical pneumonia may occur several days later
Prolonged exposure, above 50 ppm.		Unconsciousness and death
1000		Death within several breaths

Appendix D
OSHA's *Standards for Safe Chlorine Exposure*

The safe range for chlorine exposure is under scrutiny and is now subject to change. The current OSHA standard for chlorine is a ceiling level of 1 part of chlorine per million parts of air (ppm) limit over an 8 hour day. This is also expressed as 3 milligrams of chlorine per cubic meter of air (mg/m) using the SI system. NIOSH has recommended that the permissible exposure limit be reduced to 0.5 ppm (1.5 mg/m) measured over a 15 minute period. The NIOSH *Criteria Document for Chlorine* should also be consulted for more detailed information.

Appendix E

Sample *Application for the Registration of Pesticides*

This form must be completed by the manufacturer and approved by the State of Florida Department of Agriculture and Consumer Services.

APPLICATION FOR REGISTRATION OF PESTICIDES

FLORIDA DEPARTMENT OF AGRICULTURE & CONSUMER SERVICES, PESTICIDE REGISTRATION SECTION,
(please type) Room 213 Mayo Building, Tallahassee, Florida 32301
For Calendar Year Ending December 31, 1988

BM NAME & ADDRESS (same as on label)	CITY	STATE	ZIP	DATE
		FL		10/27/87
CORRESPONDENCE ADDRESS	CITY	STATE	ZIP	TELEPHONE #
				(813)
SUBMITTED BY	SIGNATURE			SS or F.E.I.D.

FEES : FIRST TEN (10) PRODUCTS, $20 EACH, ADDITIONAL PRODUCTS, $5 EACH
LIST BELOW THE PRODUCTS OR NAME BRANDS TO REGISTER. FOR EACH PRODUCT LISTED INCLUDE:
1. TWO COPIES OF THE FINAL PRINTED LABEL ✓
2. CONFIDENTIAL STATEMENT OF FORMULATION (CSF) ✓
3. MATERIAL SAFETY DATA SHEET (MSDS) ✓
INCLUDING A STATEMENT OF EMERGENCY TREATMENT

EPA REGISTRATION #	PRODUCT (BRAND) NAME
4-3407-1-58618	CHLORINE LIQUEFIED GAS (non-flammable)

ACCEPTED
FOR REGISTRATION
JAN 29 1988
under the Florida Pesticide Law, Chapter 487 F.S. by the Department of Agriculture & Consumer Services

NUMBER OF PRODUCTS LISTED (1)
(DACS use only)
MONEY ENCLOSED $
MONEY IN SUSPENSE $

CERTIFICATE OF REGISTRATION

The above named applicant has applied to register the listed brand names under the provisions of Section 487.041 F.S., and Chapter 5E-2.31 F.A.C. The said pesticides are hereby registered in the State of Florida expiring each year on December 31.

Date of Registration _____ By _____

CC0033

Appendix F

Sample *Application for New or Amended Brand Pesticide Registration*

This application must be filed with the Florida Department of Agriculture and Consumer Services.

State of Florida
Department of Agriculture and Consumer Services
Division of Agricultural Environmental Services
Application for New or Amended Brand Pesticide Registration

Please Type — For the Calendar Year Ending:

Firm Name	Street Address	City	State	Zip
Mailing Address (for Correspondence)		City	State	Zip
Contact Person (Name and Title)	Signature of Authorized Representative			
Area Code and Phone Number	Date of Application	Social Security No. or Federal ID Number		
Registration No.	Product Brand Name (List alphabetically. Use additional forms if necessary.)			

NOTICE TO REGISTRANTS

Applicant's accompanying check will be negotiated by the Department as required by law. This act of negotiation has no bearing on the applicant's entitlement and may not be used as a basis of estoppel or other doctrine impacting on the right of the Department to deny the permit, registration, or license sought.

MONEY ENCLOSED $ — (Do not write in the space otherwise used) MONEY IN CLEARANCE $ — NUMBER OF BRANDS ACCEPTED:

APPLICATION REQUIREMENTS - FOR EACH BRAND LISTED INCLUDE:

1. ONE FINAL PRINTED LABEL (THAT WHICH APPEARS ON THE PRODUCT CONTAINERS).
2. ONE EPA STAMPED ACCEPTED LABEL, INCLUDING A COPY OF ANY EPA COMMENT LETTER ISSUED IN CONNECTION WITH ACCEPTANCE OF THE LABEL.
3. ONE CONFIDENTIAL STATEMENT OF FORMULA (EPA Form 8570-4).
4. ONE MATERIAL SAFETY DATA SHEET WHICH INCLUDES A STATEMENT OF EMERGENCY TREATMENT.
5. FOR SUBREGISTRATIONS, THE INFORMATION REQUIRED IN ITEMS 2 AND 3 MUST BE OBTAINED OR SUBMITTED BY THE MANUFACTURER (BASIC REGISTRANT).

REGISTRATION FEES, PROCESSING INFORMATION AND MAILING INSTRUCTIONS:

6. ONLY ORIGINAL APPLICATION FORMS WILL BE ACCEPTED. DO NOT SUBMIT PHOTOCOPIES OF THIS FORM.
7. FEE PAYMENTS IN THE AMOUNTS OF $500.00 FOR EACH BRAND, AND $100.00 FOR EACH SPECIAL LOCAL NEED (SLN), AND EXPERIMENTAL USE PERMIT (EUP) MUST BE INCLUDED WITH THE APPLICATION. IT SHOULD BE IN THE FORM OF A CHECK OR MONEY ORDER MADE PAYABLE TO THE "FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES".
8. RETAIN THE PINK PAGE OF THE COMPLETED FORM FOR YOUR RECORDS. THE WHITE AND YELLOW COPIES OF THE FORM, ATTACHMENTS AND FEE PAYMENT SHOULD BE MAILED TO THE FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES, PESTICIDE REGISTRATION SECTION, 3125 CONNER BOULEVARD, MD 2, TALLAHASSEE, FLORIDA 32399-1650. TELEPHONE (904) 487-2130.
9. COMPLETE NEW BRAND REGISTRATION APPLICATIONS WILL BE PROCESSED AND ASSIGNED PRE-ESTABLISHED EFFECTIVE DATES ACCORDING TO THE FOLLOWING SCHEDULE:

APPLICATION RECEIVED ON OR BEFORE	DATE REGISTRATION IS ACCEPTED/EFFECTIVE:
January 15	January 30
March 15	March 30
May 15	May 30
July 15	July 30
September 15	September 30
November 15	November 30

10. APPLICANTS WILL BE NOTIFIED OF INCOMPLETE OR ERRONEOUS REGISTRATION APPLICATIONS AND NEEDED CORRECTIONS. APPLICATIONS NOT CORRECTED WITHIN 60 DAYS OF NOTIFICATION WILL BE RETURNED AND UNUSED FEES REFUNDED.

CERTIFICATE OF REGISTRATION (DO NOT WRITE IN THIS SPACE - OFFICIAL USE ONLY)

This above named applicant has applied to register the listed brand name(s) under the provisions of Section 487.041, Florida Administrative Code. The pesticide(s) listed above are approved for registration in the State of Florida, effective on the date listed below, and expires on December 31, 19___. The pesticide brand(s) that are not approved for registration are struck through with a single line. Please note that it is a violation of Florida law to sell or distribute pesticide products in Florida before the effective date of registration determination. Products found in channels of trade before this date will be subject to enforcement action.

Accepted by: _____

EFFECTIVE DATE OF ACCEPTANCE: _____

Bob Crawford
Commissioner of Agriculture

FORM 80-10S (Revised 6/98 Previous editions are obsolete.)

Appendix G
Sample *Notice of Supplemental Registration of Distributor*

This document must be filed with the EPA by the manufacturer of chlorine gas.

EPA NOTICE OF SUPPLEMENTAL REGISTRATION OF DISTRIBUTOR

EPA REGISTRATION NO. OF PRODUCT	DISTRIBUTOR COMPANY NUMBER
1729 - 135	55845

NAME AND ADDRESS OF BASIC REGISTRANT

NAME OF REGISTERED PRODUCT

GUARDEX CHLORINATING CONCENTRATE

DISTRIBUTOR PRODUCT NAME

CHLORINATING CONCENTRATE

NAME AND ADDRESS OF DISTRIBUTOR

SEP 2 2 1988

DISTRIBUTOR

[illegible]

SIGNATURE AND TITLE OF DISTRIBUTOR	DATE
Mgr/Dir	8-23-88

REGISTRANT

[illegible]

SIGNATURE AND TITLE OF REGISTRANT	DATE
H. Glen Heady, ... Products	9-09-88

INSTRUCTIONS

[illegible]

NOTE. DO NOT submit distributor product labels.

CONDITIONS

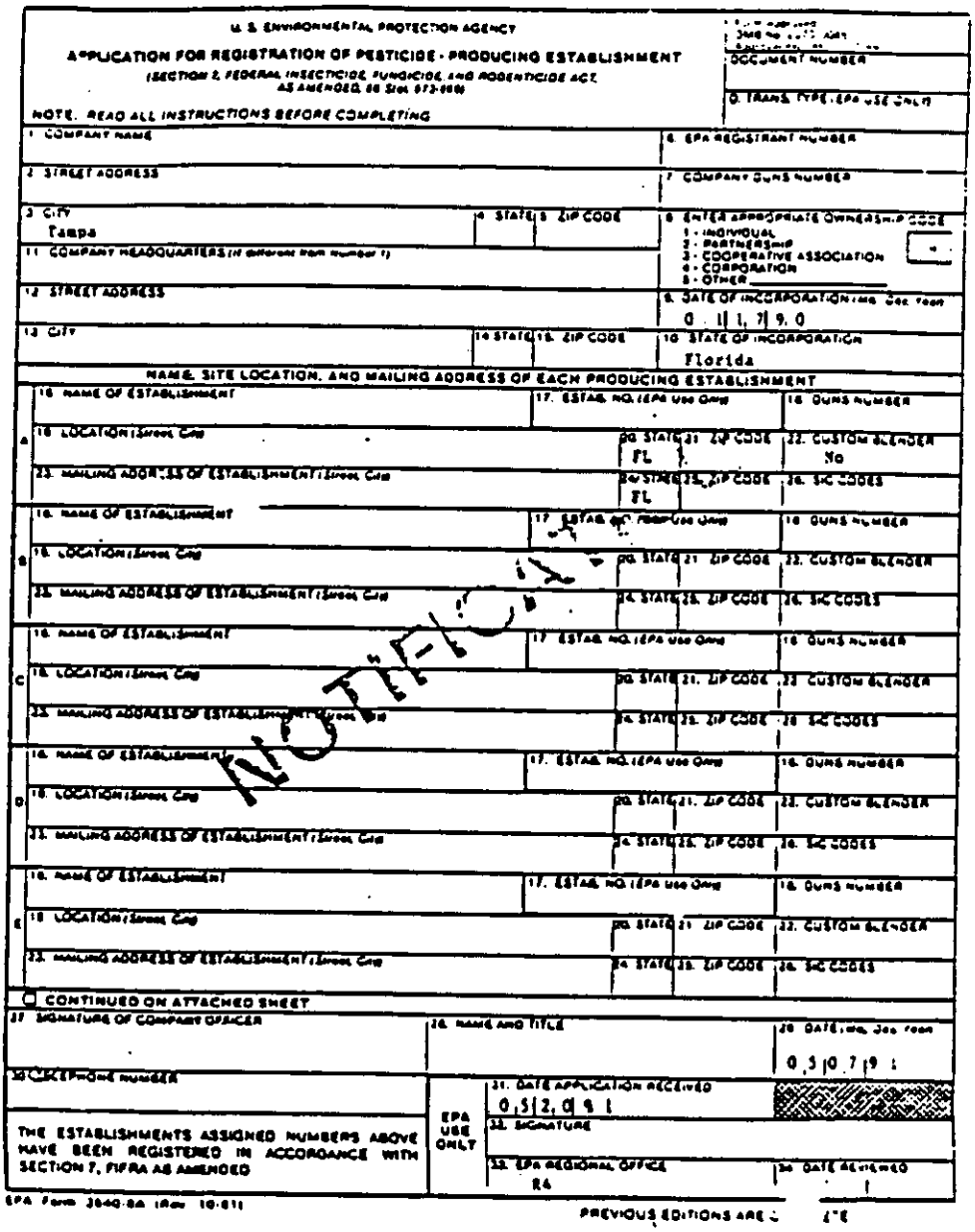
1. The distributor product must have the same composition as the basic registered product.
2. The distributor brand product must be manufactured and packaged by the same person who manufactures and packages the registered basic product.
3. [illegible]
4. The product must remain in the manufacturer's unbroken container.
5. [illegible]
6. [illegible]
7. [illegible]

RECEIVED BY EPA REGISTRATION DIVISION ON THE DATE STAMPED BELOW

Appendix H

Sample *Application for Registration of Pesticide-Producing Establishment*

This form must be filed with the EPA by the potential manufacturer or business engaged in chlorine gas use.



U. S. ENVIRONMENTAL PROTECTION AGENCY

APPLICATION FOR REGISTRATION OF PESTICIDE - PRODUCING ESTABLISHMENT

(SECTION 7, FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT, AS AMENDED, 86 Stat. 973-1000)

NOTE: READ ALL INSTRUCTIONS BEFORE COMPLETING

DOCUMENT NUMBER

D. TRANS. TYPE (EPA USE ONLY)

1. COMPANY NAME

4. EPA REGISTRANT NUMBER

2. STREET ADDRESS

7. COMPANY DUNS NUMBER

3. CITY: Tampa

4. STATE 5. ZIP CODE

6. ENTER APPROPRIATE OWNERSHIP CODE
1 - INDIVIDUAL
2 - PARTNERSHIP
3 - COOPERATIVE ASSOCIATION
4 - CORPORATION
5 - OTHER

11. COMPANY HEADQUARTERS (If different from number 1)

12. STREET ADDRESS

9. DATE OF INCORPORATION (mm, dd, yyyy) 0 1 1 7 9 0

13. CITY

14. STATE 15. ZIP CODE

10. STATE OF INCORPORATION: Florida

NAME, SITE LOCATION, AND MAILING ADDRESS OF EACH PRODUCING ESTABLISHMENT

A
16. NAME OF ESTABLISHMENT
17. ESTAB. NO. (EPA Use Only)
18. DUNS NUMBER
19. LOCATION (Street, City)
20. STATE: FL
21. ZIP CODE
22. CUSTOM BLENDER: No
23. MAILING ADDRESS OF ESTABLISHMENT (Street, City): FL
24. STATE
25. ZIP CODE
26. SIC CODES

B
16. NAME OF ESTABLISHMENT
17. ESTAB. NO. (EPA Use Only)
18. DUNS NUMBER
19. LOCATION (Street, City)
20. STATE
21. ZIP CODE
22. CUSTOM BLENDER
23. MAILING ADDRESS OF ESTABLISHMENT (Street, City)
24. STATE
25. ZIP CODE
26. SIC CODES

C
16. NAME OF ESTABLISHMENT
17. ESTAB. NO. (EPA Use Only)
18. DUNS NUMBER
19. LOCATION (Street, City)
20. STATE
21. ZIP CODE
22. CUSTOM BLENDER
23. MAILING ADDRESS OF ESTABLISHMENT (Street, City)
24. STATE
25. ZIP CODE
26. SIC CODES

D
16. NAME OF ESTABLISHMENT
17. ESTAB. NO. (EPA Use Only)
18. DUNS NUMBER
19. LOCATION (Street, City)
20. STATE
21. ZIP CODE
22. CUSTOM BLENDER
23. MAILING ADDRESS OF ESTABLISHMENT (Street, City)
24. STATE
25. ZIP CODE
26. SIC CODES

E
16. NAME OF ESTABLISHMENT
17. ESTAB. NO. (EPA Use Only)
18. DUNS NUMBER
19. LOCATION (Street, City)
20. STATE
21. ZIP CODE
22. CUSTOM BLENDER
23. MAILING ADDRESS OF ESTABLISHMENT (Street, City)
24. STATE
25. ZIP CODE
26. SIC CODES

NOTE-C

☐ CONTINUED ON ATTACHED SHEET

27. SIGNATURE OF COMPANY OFFICER

28. NAME AND TITLE

29. DATE (mm, dd, yyyy) 0 3 0 7 9 1

30. TELEPHONE NUMBER

THE ESTABLISHMENTS ASSIGNED NUMBERS ABOVE HAVE BEEN REGISTERED IN ACCORDANCE WITH SECTION 7, FIFRA AS AMENDED

EPA USE ONLY

31. DATE APPLICATION RECEIVED 0 5 2 0 9 1

32. SIGNATURE

33. EPA REGIONAL OFFICE: R4

34. DATE REVIEWED

EPA Form 3540-8A (Rev. 10-81)

PREVIOUS EDITIONS ARE

Appendix I

Sample *Pesticides Report for Pesticide-Producing Establishments*

This form must be filed with the EPA by the potential manufacturer or business engaged in chlorine gas use.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Pesticides Report For Pesticide-Producing Establishments

EPA

(Section 7, Federal Insecticide, Fungicide, and Rodenticide Act, as amended, 92 Stat. 829)

NOTE: Read all instructions before completing. Production and distribution/sales volumes information reported on this form is treated as BUSINESS CONFIDENTIAL.

6. Establishment Duns Number

7. EPA Establishment Number

8. EPA Establishment SIC Codes

ESTABLISHMENT NAME AND MAILING ADDRESS

1. Establishment Name | 2. Street Name and Number or Postal Number

3. City | 4. State | 5. ZIP Code

ESTABLISHMENT SITE ADDRESS

9. Street Name | 10. City | 11. State | 12. ZIP Code

13. Signature of Establishment Officer | 14. Title | 15. Date | 16. Telephone

PESTICIDE PRODUCTION INFORMATION

A
17. Product Code | 18. EPA Product Registration Number
19. Product Name
20. Product Classification | 21. Product Type | 21a. Specific Gravity (Liquids Only) stated as
22. Market Produced For | 23. Use Classification
24. Amount Produced Last Year
25. Amount to be Produced This Year
26. Amount Sold/Distributed Last Year
27. Unit of Measure

B
17. Product Code | 18. EPA Product Registration Number
19. Product Name
20. Product Classification | 21. Product Type | 21a. Specific Gravity (Liquids Only) stated as
22. Market Produced For | 23. Use Classification
24. Amount Produced Last Year
25. Amount to be Produced This Year
26. Amount Sold/Distributed Last Year
27. Unit of Measure: P=Pound, G=Gallon, K=Kilograms, L=Liters, T=Tons

C
17. Product Code | 18. EPA Product Registration Number
19. Product Name
20. Product Classification | 21. Product Type | 21a. Specific Gravity (Liquids Only) stated as
22. Market Produced For | 23. Use Classification
24. Amount Produced Last Year
25. Amount to be Produced This Year
26. Amount Sold/Distributed Last Year
27. Unit of Measure: P=Pound, G=Gallon, K=Kilograms, L=Liters, T=Tons

D
17. Product Code | 18. EPA Product Registration Number
19. Product Name
20. Product Classification | 21. Product Type | 21a. Specific Gravity (Liquids Only) stated as
22. Market Produced For | 23. Use Classification
24. Amount Produced Last Year
25. Amount to be Produced This Year
26. Amount Sold/Distributed Last Year
27. Unit of Measure: P=Pound, G=Gallon, K=Kilograms, L=Liters, T=Tons

E
17. Product Code | 18. EPA Product Registration Number
19. Product Name

CCJ:690

20. Product Classification | 21. Product Type | 21a. Specific Gravity (Liquids Only) stated as
22. Market Produced For | 23. Use Classification
24. Amount Produced Last Year
25. Amount to be Produced This Year
26. Amount Sold/Distributed Last Year
27. Unit of Measure: P=Pound, G=Gallon, K=Kilograms, L=Liters, T=Tons

FOR EPA USE ONLY

Appendix J
Sample *Registration Kit*

The following was assembled by the EPA to serve as a guide for any potential investors or businesses, as well as to help inform the reader of the necessity to strictly follow the procedures for filing.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

December 18, 1992

Dear Prospective Registrant:

For your convenience, we have assembled a registration kit which contains the following pertinent forms and information needed to register a pesticide product with the U.S. Environmental Protection Agency's, Office of Pesticide Programs:

1. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
2. PR Notices
   a. 83-2, Farm Worker Safety Label Improvement Program
   b. 83-3, LIP - Storage and Disposal Statements
   c. 84-1, Clarification of 83-2 and 83-3
   d. 86-5, Standard Format for Data Submitted under FIFRA
   e. 87-1, Label Improvement Program for Pesticides Applied through Irrigation Systems (Chemigation)
   f. 87-6 Inert Ingredients in Pesticide Products Policy Statement
   g. 90-1 Inert Ingredients in Pesticide Products; Revised Policy Statement
3. Pesticide Product Registration Application Forms
   a. EPA Form No. 8570-1, Application for Pesticide Registration/Amendment
   b. EPA Form No. 8570-4, Confidential Statement of Formula
   c. EPA Form No. 8570-20, Data Reference Sheet
   d. EPA Form No. 8570-27, Formulator's Exemption Statement
   e. EPA Form No. 8570-29, Certification with Respect to Citations of Data
4. Pesticide Data Submitters List Microfiche and General Information.
   a. Pesticide Data Submitters List Microfiche
   b. Fact Sheet - Instructions for Use of the Microfiche
   c. Registration Division Organization Chart & Personnel Contact List
   d. 53 FR 15952 - Pesticide Registration Procedures; Pesticide Data Requirements
   e. 40 CFR Part 158 - Data Requirements for Registration
   f. 50 FR 48833 - Disclosure of Reviews of Pesticide Data (November 27, 1985)

A very good source of information about registering pesticides is found in the booklet entitled, *General Information on Applying for Registration of Pesticides in the United States*, PB92-221811, which is now available from National Technical Information Service (NTIS) at the following address:

5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

Appendix K
Index to the *Federal Insecticide, Fungicide, and Rodenticide Act*

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

(THROUGH P.L. 100-460, 100-464 to 100-526, & 100-532)

(References [ ] in brackets are to title 7, United States Code)

TABLE OF CONTENTS

Bracketed material and footnotes did not appear in Acts.

Prepared by the Senate Legislative Counsel's Office.

Appendix L

Excerpt from the *Occupational Safety and Health's Standards and Interpretations*, sections 1910.101, 103, 105, and 1910.166

SUBPART H—HAZARDOUS MATERIALS

1910.101—COMPRESSED GASES (GENERAL REQUIREMENTS)

(a) Inspection of compressed gas cylinders.

Each employer shall determine that compressed gas cylinders under his control are in a safe condition to the extent that this can be determined by visual inspection. Visual and other inspections shall be conducted as prescribed in the Hazardous Materials Regulations of the Department of Transportation (49 CFR Parts 171–179 and 14 CFR Part 103). Where those regulations are not applicable, visual and other inspections shall be conducted in accordance with Compressed Gas Association Pamphlets C–6–1968 and C–6–1962.

(b) Compressed gases.

The in-plant handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tankcars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association Pamphlet P–1–1965.

(c) Safety relief devices for compressed gas containers.

Compressed gas cylinders, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with Compressed Gas Association Pamphlets S–1.1–1963 and 1965 addenda and S–1.2–1963.

1910.102—ACETYLENE

(a) Cylinders.

The in-plant transfer, handling, storage, and utilization of acetylene in cylinders shall be in accordance with Compressed Gas Association Pamphlet G–1–1966.

(b) Piped systems.

The piped systems for the inplant transfer and distribution of acetylene shall be designed, installed, maintained, and operated in accordance with Compressed Gas Association Pamphlet G–1.3–1959.

(c) Generators and filling cylinders.

Plants for the generation of acetylene and the charging (filling) of acetylene cylinders shall be designed, constructed, and tested in accordance with the standards prescribed in Compressed Gas Association Pamphlet G–1.4–1966.

1910.103—HYDROGEN

(a) General.

(1) Definitions. As used in this section.

(i) Gaseous hydrogen system is one in which the hydrogen is delivered, stored and discharged in the gaseous form to consumer's piping. The system includes

Excerpt from the *Occupational Safety and Health's Standards and Interpretations*, sections 1910.101, 103, 105, and 1910.166

SUBPART M—COMPRESSED GAS AND COMPRESSED AIR EQUIPMENT

1910.166—INSPECTION OF COMPRESSED GAS CYLINDERS

(a) Definitions.

As used in this section:

(1) High- and low-pressure cylinders: High-pressure cylinders means those cylinders with a marked service pressure of 900 p.s.i. or greater; low-pressure cylinders are those with a marked service pressure less than 900 p.s.i.

(2) Minimum allowable wall thickness: The minimum allowable wall thickness means the minimum wall thickness required by the specification under which the cylinder was manufactured.

(3) Dents: Dents (in cylinders) means deformations caused by the cylinder coming in contact with a blunt object in such a way that the thickness of metal is not materially impaired.

(4) Cuts, gouges, or digs: Cuts, gouges, or digs (in cylinders) means deformations caused by contact with a sharp object in such a way as to cut into or upset the metal of the cylinder, decreasing the wall thickness at that point.

(5) Corrosion or pitting: Means corrosion or pitting in cylinders involving the loss of wall thickness by corrosive media. There are several kinds of pitting or corrosion to be considered.

(6) Isolated pitting: Means isolated pits of small cross-section which do not effectively weaken the cylinder wall but are indicative of possible complete penetration and leakage. Since the pitting is isolated the original wall is essentially intact.

(7) Line corrosion: Means pits which are not isolated but are connected or nearly connected to others in a narrow band or line. This condition is more serious than isolated pitting. Line corrosion frequently occurs in the area of intersection of the footring and bottom of a cylinder. This is sometimes referred to as "crevice corrosion."

(8) General corrosion: Means corrosion which covers considerable surface areas of the cylinder. It reduces the structural strength. It is often difficult to measure or estimate the depth of general corrosion because direct comparison with the original wall cannot always be made. General corrosion is often accompanied by pitting.

(9) "DOT" means the U.S. Department of Transportation.

(b) General requirements.

(1) Application.

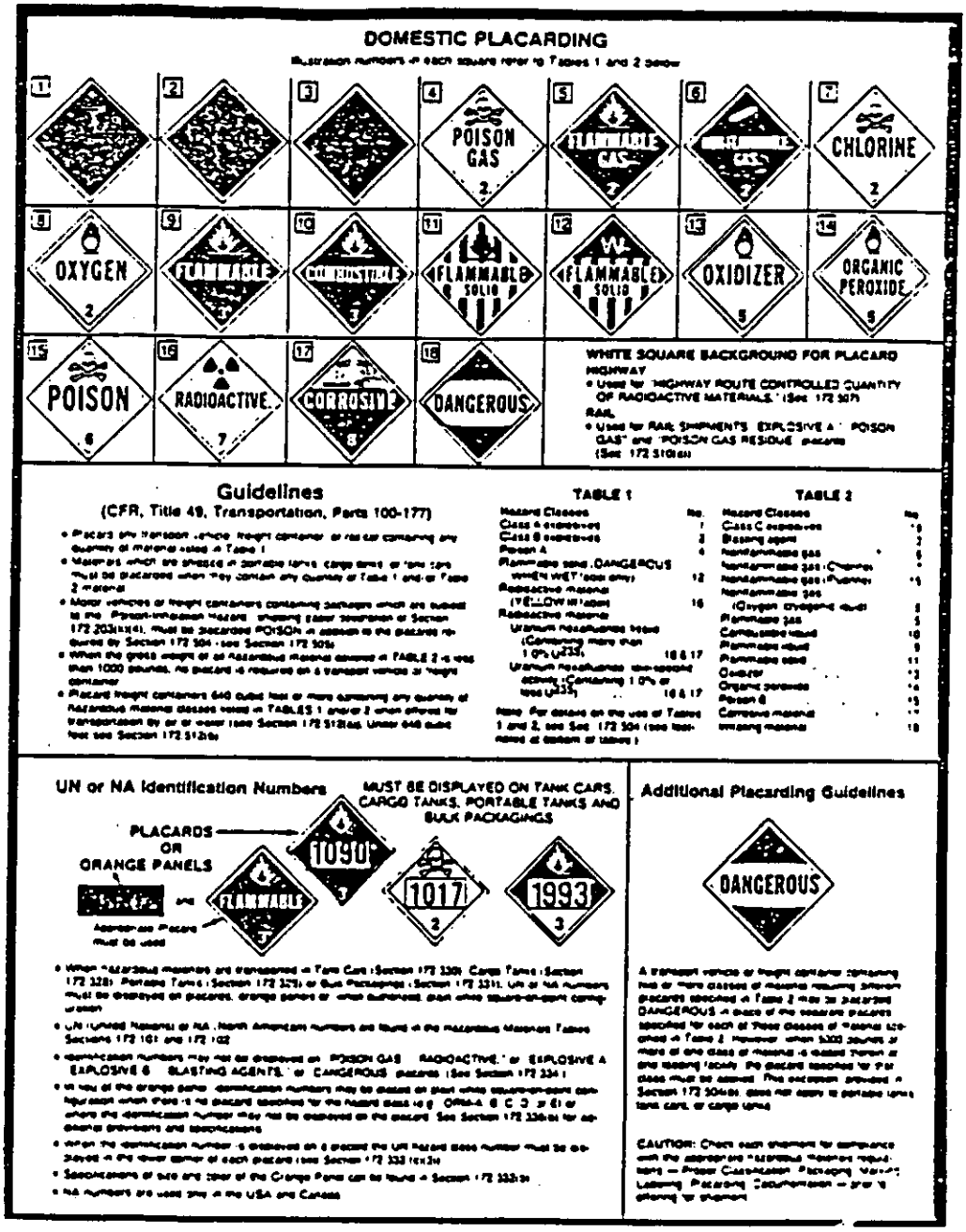
(i) Each employer shall determine that compressed gas cylinders under his control are in a safe condition to the extent that this can be determined by visual and other inspection required by this subparagraph.

(ii) The requirements contained in this section are not intended to apply to cylinders manufactured under specification DOT (ICC)-3HT (49 CFR Ch. I). Separate requirements covering service life and standards for visual inspection of these cylinders are contained in Compressed Gas Association Pamphlet C-8, "Standard for Requalification of ICC-3HT Cylinders."

(2) Quality of inspection. Experience in the inspection of cylinders is an important factor in determining the acceptability of a given cylinder for continued service. Users lacking this experience and having doubtful cylinders should return them to a manufacturer of the same type of cylinders for reinspection.

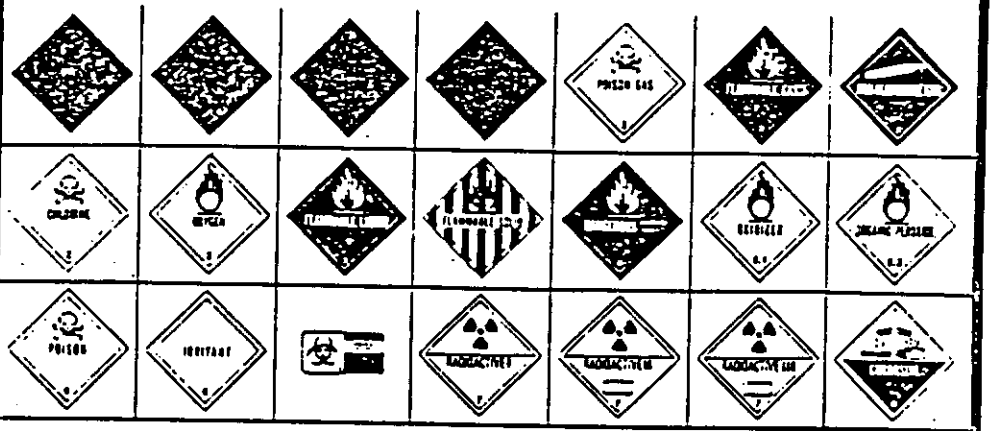
Appendix M

General Guidelines on Use of Labels



General Guidelines on Use of Labels

DOMESTIC LABELING

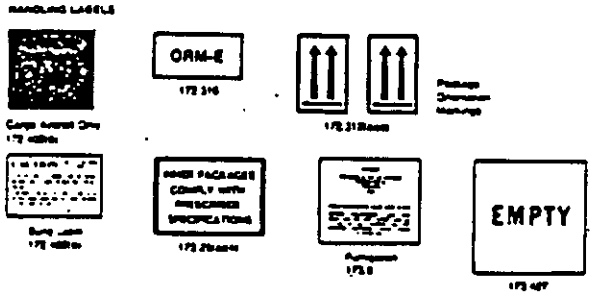


General Guidelines on Use of Labels
(CFR, Title 49, Transportation, Parts 100-177)

- Labels illustrated above are normally for domestic shipments. However, some air carriers may require the use of International Civil Aviation Organization (ICAO) labels.
- Domestic Warning Labels may display UN Class Number, Division Number (and Compatibility Group for Explosives only) (Sec. 172.407(g)).
- Any person who offers a hazardous material for transportation MUST label the package, if required (Sec. 172.400(a)).
- The Hazardous Materials Tables, Sec. 172.101 and 172.102, identify the proper label(s) for the hazardous materials listed.
- Label(s), when required, must be printed on or affixed to the surface of the package near the proper shipping name (Sec. 172.406(a)).
- When two or more different labels are required, display them next to each other (Sec. 172.406(c)).
- Labels may be affixed to packages (even when not required by regulations) provided each label represents a hazard of the material in the package (Sec. 172.401).

Check the Appropriate Regulations
Domestic or International Shipment

Additional Markings and Labels

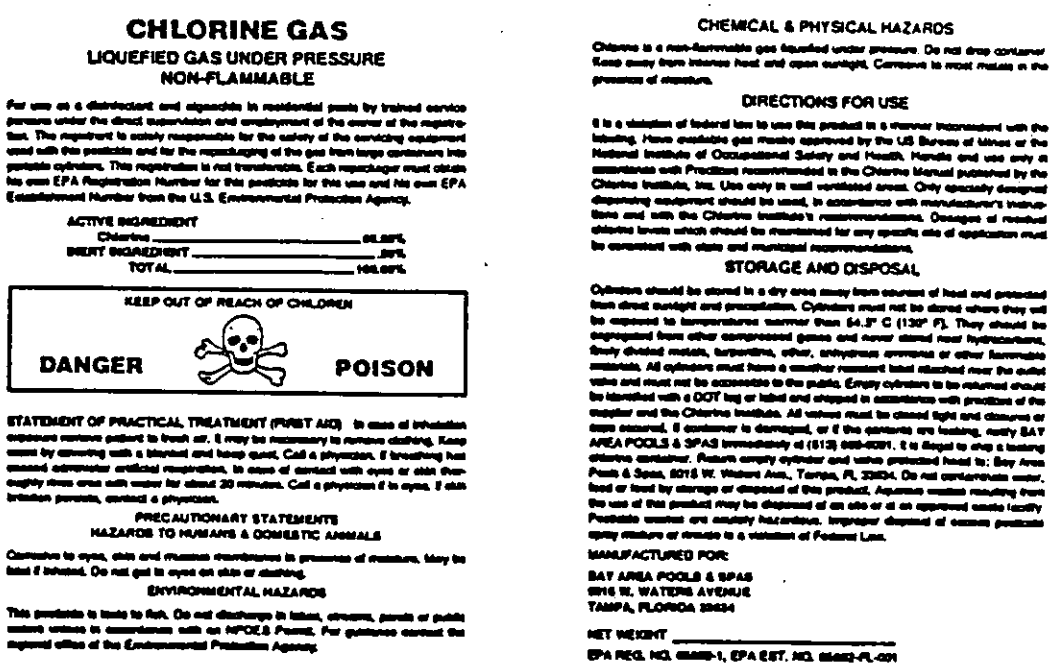


Here are a few additional markings and labels pertaining to the transport of hazardous materials. The section number shown with each item refers to the appropriate section in the HMR. The Hazardous Materials Tables, Section 172.101 and 172.102, identify the proper shipping name, hazard class, identification number, required label(s) and packaging sections.

Poisonous Materials

Appendix N
Sample Chlorine Label

Every chlorine container should have an informative label, in addition to any other identification required by law. The following EPA approved label was provided by Bay Area Pool Service.



CHLORINE GAS

LIQUEFIED GAS UNDER PRESSURE
NON-FLAMMABLE

For use as a disinfectant and algaecide in residential pools by trained service persons under the direct supervision and employment of the owner of the registration. The registrant is solely responsible for the safety of the servicing equipment used with this pesticide and for the repackaging of the gas from large containers into portable cylinders. This registration is not transferable. Each repackager must obtain his own EPA Registration Number for this pesticide for this use and his own EPA Establishment Number from the U.S. Environmental Protection Agency.

ACTIVE INGREDIENT
Chlorine 99.50%
INERT INGREDIENT ..... .50%
TOTAL 100.00%

KEEP OUT OF REACH OF CHILDREN

DANGER POISON

STATEMENT OF PRACTICAL TREATMENT (FIRST AID) In case of inhalation exposure remove patient to fresh air. It may be necessary to remove clothing. Keep warm by covering with a blanket and keep quiet. Call a physician. If breathing has ceased administer artificial respiration. In case of contact with eyes or skin thoroughly rinse area with water for about 20 minutes. Call a physician if in eyes. If skin irritation persists, contact a physician.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS & DOMESTIC ANIMALS

Corrosive to eyes, skin and mucous membranes in presence of moisture, may be fatal if inhaled. Do not get in eyes on skin or clothing.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to fish. Do not discharge in lakes, streams, ponds or public waters unless in accordance with an NPDES Permit. For guidance contact the regional office of the Environmental Protection Agency.

CHEMICAL & PHYSICAL HAZARDS

Chlorine is a non-flammable gas liquefied under pressure. Do not drop container. Keep away from intense heat and open sunlight. Corrosive to most metals in the presence of moisture.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with the labeling. Have available gas masks approved by the US Bureau of Mines or the National Institute of Occupational Safety and Health. Handle and use only in accordance with Precautions recommended in the Chlorine Manual published by the Chlorine Institute, Inc. Use only in well ventilated areas. Only specially designed dispensing equipment should be used, in accordance with manufacturer's instructions and with the Chlorine Institute's recommendations. Dosages of residual chlorine levels which should be maintained for any specific site of application must be consistent with state and municipal recommendations.

STORAGE AND DISPOSAL

Cylinders should be stored in a dry area away from sources of heat and protected from direct sunlight and precipitation. Cylinders must not be stored where they will be exposed to temperatures warmer than 54.5° C (130° F). They should be segregated from other compressed gases and never stored near hydrocarbons, finely divided metals, turpentine, ether, anhydrous ammonia or other flammable materials. All cylinders must have a weather resistant label attached near the outlet valve and must not be accessible to the public. Empty cylinders to be returned should be identified with a DOT tag or label and shipped in accordance with practices of the supplier and the Chlorine Institute. All valves must be closed tight and closures or caps secured. If container is damaged, or if the contents are leaking, notify BAY AREA POOLS & SPAS immediately at (813) 888-8081. It is illegal to ship a leaking chlorine container. Prepare empty cylinder and valve protected head to: Bay Area Pools & Spas, 8015 W. Waters Ave., Tampa, FL 33634. Do not contaminate water, food or feed by storage or disposal of this product. Aqueous washes resulting from the use of this product may be disposed of on site or at an approved waste facility. Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal Law.

MANUFACTURED FOR:

BAY AREA POOLS & SPAS
8015 W. WATERS AVENUE
TAMPA, FLORIDA 33634

NET WEIGHT _____

EPA REG. NO. 69699-1, EPA EST. NO. 69692-FL-001

Appendix O

Example of an *Annual Registration Form* for the State of Florida Emergency Response Commission for Hazardous Materials

FLORIDA
STATE EMERGENCY RESPONSE COMMISSION
FOR
HAZARDOUS MATERIALS
ANNUAL REGISTRATION

COMPANY NAME: _____

BUSINESS ADDRESS: _____

_____

_____

CONTACT PERSON: _____

TELEPHONE: _____

PLEASE LIST ALL FACILITIES SUBJECT TO SARA, TITLE III, SECTION 302 AND/OR SECTION 312 ON THE REVERSE SIDE.

A. NUMBER OF EMPLOYEES (STATEWIDE) _____ X $10 = $_____

(MINIMUM FEE $25, MAXIMUM FEE $2,000)

OR

B. INDUSTRIES REGULATED UNDER CHAPTERS 368, 527, AND SECTION 376.303, FLORIDA STATUTES:

NUMBER OF EMPLOYEES (STATEWIDE) _____ X $2.50 = $_____

(MINIMUM FEE $25, MAXIMUM FEE $500)

TOTAL SUBMITTED = $_____

CHECK NUMBER = _____

TIER TWO FORM ATTACHED _____ YES _____ NO

_____ SENT UNDER SEPARATE COVER

REMINDER: SUBMIT A COPY OF THE TIER TWO TO (1) YOUR LOCAL EMERGENCY PLANNING COMMITTEE, AND (2) YOUR LOCAL FIRE DEPARTMENT.

MAKE CHECKS OR MONEY ORDERS PAYABLE TO: CASHIER, DEPARTMENT OF COMMUNITY AFFAIRS (SEND NO CASH).

MAIL TO: STATE EMERGENCY RESPONSE COMMISSION
2740 CENTERVIEW DRIVE
TALLAHASSEE, FLORIDA 32399-2149

DUE DATE: MARCH 1, 1989

Appendix P

Example of an *Emergency Planning and Facility Representative Notification Form* from the State of Florida Emergency Response Commission for Hazardous Materials

SARA-Title III
Section 302 - Emergency Planning Notification
Section 101 - Facility Representative Notification

This is a notification that the facility has above the Threshold Planning Quantity of an Extremely Hazardous Substance.

Name of Business: _____

Date of Notification: _____

Business Address: _____

_____

Physical Address:
(if different from business address) _____

(use separate pages for additional facilities)

Total number of facilities:_____ Amount Submitted:$_____
($50 per facility)

Facility Representative: _____

Phone Number: _____

Has your Local Emergency Planning Committee also been notified:
_____ yes _____ no

Signature:

There is a one-time $50 per facility fee for every facility subject to Section 302. Checks must be made payable to "Cashier, Department of Community Affairs" and included with this notification. This should be mailed to the following address:

State Emergency Response Commission
2740 Centerview Drive
Tallahassee, Florida 32399-2149

(904) 488-1472
(800) 635-7179

Would you like to receive notices of the Local Emergency Planning Committee meetings in your area?
_____ yes _____no

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Bicarbonate Experts. "Alkalinity First...A Better Way to Balance Pool and Spa Water." Church and Dwight Co., Inc.: 1990.

Brownell, James R. Ph.D. "The Effect of Chlorine Source on Biologic Safety and Pool Chemistry." Cambria, California: October, 1993.

California International Chemical Company. "Directions for Use Manual, Chlorine-Liquefied Gas." CICC: November, 1993.

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Chlorine Institute, Inc. "Safety Guidelines for Residential Swimming Pool Chlorination," Pamphlet 97.

Chlorine Institute, Inc. "The Chlorine Manual," Pamphlet 1, Section 4.

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Wallace, Jerry, President NAGC. "A letter in Response to an Earlier Draft of This Report." November, 1994.

Whitney, Dow and Brown, Brisbane. "Technical Publication No. 74, A Study of Marcite (Plaster) Deterioration in Swimming Pools." March 30, 1991.

Address List

Canadian Centre for Occupational Health and Safety
250 Main Street East
Hamilton, Ontario
Canada L8N 1H6
Phone: (416) 572-2981
FAX: (416) 572-2206

The Chlorine Institute
2001 L. Street, NW
Washington DC 20036
Phone: (202) 775-2790
FAX: (202) 223-7225

Church and Dwight Co., Inc.
(The Biocarbonate Experts)
Chemicals Division
PO Box CN5297
Princeton, NJ 08543-5297
Phone: (800) 221-0453

Compressed Gas Association
c/o Mr. Chet Roberts
1725 Jefferson Davis Highway, Suite 1004
Arlington, VA 22202-4102
Phone: (703) 412-0900 ext. 711
FAX: (703) 412-0128

EPA
Regional Office
345 Cortland Street, NE
Atlanta, GA 30365
Phone: (404) 881-4727

Florida Dept. of Agriculture and Consumer Services
Pesticide Registration Section
Room 213, Mayo Building
Tallahassee, FL 32301

Florida Emergency Response Commission
2740 Centerview Drive
Tallahassee, FL 32399-2149
Phone: (904) 488-1472
(800) 635-7179

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690
Phone: (518) 377-8854

HHS Region IV
101 Marietta Tower, Suite 1007
Atlanta, GA 30323
Phone: (404) 221-2396

National Association of Gas Chlorinators
Association Offices
30555 Trabuco Canyon Road, Suite 100
Trabuco Canyon, CA 92679-3002
Phone: (714) 459-8735

National Institute of Environmental Health Services
PO Box 12233
Research Triangle Park, NC 27709
Phone: (919) 541-3345

National Safety Council
Chemical Section, Industrial Division
444 North Michigan Avenue
Chicago, IL 60611
Phone: (312) 527-4800

National Spa and Pool Institute
2111 Eisenhower Avenue
Alexandria, VA 22314

Pool Chlor
3114 E. Pennsylvania St.
Tucson, AZ 85714

U.S. Department of Labor
OSHA
Regional Office #IV
1375 Peachtree Street, NE, Suite 587
Atlanta, GA 30367
Phone: (404) 347-3573

U.S. Department of Labor
OSHA
OSHA Publications Office
200 Constitution Avenue, NW
Room N3101
Washington DC 20210
Phone: (202) 523-9667

Also, copies of the *Code of Federal Regulations*, Title 49, may be purchased from:

Superintendent of Documents
US Government Printing Office
Washington DC 20402
Phone: (202) 783-3238

Phone List

Florida

Department of Agriculture, Tallahassee	(904) 488-3022
Department of Environmental Protection, Tallahassee	(904) 488-4805
Division of Air Resources	(904) 488-1344
Department of Transportation, Tallahassee	(904) 488-6816
Hazardous Materials Division	(904) 488-7920
Emergency Response Commission, Tallahassee	(904) 488-1472
Toll-Free	(800) 625-7170
EPA, Regional Office, Tallahassee	(904) 488-1554
EPA, NE District Office, Alachua County	(904) 488-4300

Washington DC

The Chlorine Institute	(202) 775-2790
Chlorine Manufacturers of America	(202) 887-1100
EPA	(202) 260-2090

Miscellaneous

Chlorinators Inc.	(800) 327-9761
The Compressed Gas Association, Arlington, VA	(703) 412-0900
The National Institute of Environmental Health Sciences	(919) 541-3345
The National Toxicology Program	(919) 541-1167
JJ Keller Publishers	(800) 558-5011
American Trucking Association	(800) ATA-LINE

University of Florida

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