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1. INTRODUCTION

1.1 SCOPE

This pamphlet has been developed by the Chlorine Institute to assist member companies in the continued safe handling and disposal of asbestos.

The safety and health of workers and of the general public in dealing with possible airborne emissions and their protection from hazards associated with asbestos are of paramount concern.

The pamphlet addresses safe asbestos handling procedures for the chlor-alkali industry. Cited examples may not be universally accepted and do not represent the only safe method of handling asbestos.

The pamphlet deals primarily with North American requirements and references U.S. Federal and some Canadian requirements that are in effect at the publication date. Additional federal, state and local, as well as foreign requirements may impose different or additional obligations. All users are urged to keep abreast of all governmental requirements concerning asbestos.

For purposes of this publication, the OSHA General Industry Asbestos Standard, 29 CFR 1910.1001, is applicable to U.S. chlor-alkali cell renewal operations. In the chlor-alkali industry, consideration should be given not only to how asbestos is handled relative to the production of chlorine and caustic in diaphragm cells, but also the potential for asbestos or asbestos containing materials to be present in other areas. Such things to consider may include asbestos gaskets, past construction practices and insulating techniques. OSHA's construction industry standard (29 CFR 1926.1101) may also be triggered.

This CI pamphlet summarizes information found in the reference documents. It is not a primer on everything an employer needs to know, but a reminder of some requirements. A thorough review of governmental requirements should be conducted periodically and compared with performance practices to assure compliance.

1.2 CHLORINE INSTITUTE STEWARDSHIP PROGRAM

The Chlorine Institute exists to support the chlor-alkali industry and serve the public by fostering continuous improvements to safety and the protection of human health and the environment connected with the production, distribution and use of chlorine, sodium and potassium hydroxides, and sodium hypochlorite; and the distribution and use of hydrogen chloride. This support extends to giving continued attention to the security of chlorine handling operations.

Chlorine Institute members are committed to adopting CI's safety and stewardship initiatives, including pamphlets, checklists, and incident sharing, that will assist members in achieving measurable improvement. For more information on the Institute's stewardship program, visit CI's website at www.chlorineinstitute.org.

1.3 DEFINITIONS AND ACRONYMS

Approved Respirator	A respirator approved by the National Institute of Occupational Safety and Health for asbestos use. See 29 CFR 1910.134
Asbestos	OSHA defines asbestos to include chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos and any of these minerals that have been chemically treated and/or altered.
Asbestos Containing Material (ACM)	Any material containing more than 1% asbestos.
Asbestos Standard	The Asbestos Standard means the OSHA Asbestos Standard for General Industry, 29 CFR 1910.1001.
Aspect Ratio	The ratio of the length of the fiber to its width. Usually this is defined as the length to the width, e.g., 3 to 1 or 3:1.
CFR	Code of Federal Regulations (U.S.)
DOT	Department of Transportation (U.S.)
Excursion Level	Same as Excursion Limit. The regulation language uses alternate wording in the various sections.
Excursion Limit	An OSHA established limit in addition to the PEL-TWA. The regulation requires that no employee be exposed to an airborne concentration of asbestos in excess of 1.0 f/cc as averaged over a sampling period of thirty minutes by the method prescribed in the standard. (Reference 9.1)
EPA	U.S. Environmental Protection Agency
f/cc	fibers per cubic centimeter
FR	U.S. Federal Register
Friable asbestos	Asbestos which can be crumbled, pulverized, or reducible to a powder with hand pressure (29 CFR 1926.1101 Appendix H).
HEPA	High Efficiency Particlulate Air filter (99.97% efficient for 0.3 micron particles).
IDLH	Immediately Dangerous to Life or Health (NIOSH). No IDLH value has been established for asbestos.

NESHAP	National Emission Standard for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
OSHA	U.S. Occupational Safety and Health Administration of the Department of Labor
PACM	Presumed asbestos containing material.
PEL-TWA	Permissible Exposure Limit–Time Weighted Average. The OSHA regulation requires that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 f/cc of air measured as an eight hour time weighted average (TWA) as measured by the method prescribed in the standard. (Reference 9.1)
PCM	Phase Contrast Microscopy is the method mandated by OSHA (and some states) to determine airborne fiber concentrations in and around areas where asbestos fibers may be concentrated. The method counts all fibers (asbestos and others) which are greater than 5 microns in length and have an aspect ratio equal to or greater than 3:1 (length at least three times greater than the width).
PPE	Personal Protective Equipment
Regulated areas	Areas where airborne asbestos levels exceed or are likely to exceed the PEL-TWA or Excursion Limit.
SDSs	Safety Data Sheets
TWA	Time Weighted Average

1.4 DISCLAIMER

The information in this pamphlet is drawn from sources believed to be reliable. The Institute and its members, jointly and severally, make no guarantee, and assume no liability, in connection with any of this information. Moreover, it should not be assumed that every acceptable procedure is included, or that special circumstances may not warrant modified or additional procedures. The user should be aware that changing technology or regulations may require changes in the recommendations contained herein. Appropriate steps should be taken to ensure that the information is current when used. These recommendations should not be confused with federal, state, provincial, municipal, or insurance requirements, or with national safety codes.

1.5 APPROVAL

The Institute's Health, Environment, Safety and Security Issue Team approved the 7th edition of this pamphlet on March 9, 2016.

1.6 REVISIONS

Suggestions for revisions should be submitted to the Secretary of the Institute.

1.6.1 Significant Revisions in Current Edition

There are no significant revisions to Edition 7 of this pamphlet.

1.7 REPRODUCTION

The contents of this pamphlet are not to be copied for publication, in whole or in part, without the prior written approval of the Institute.

2. ASBESTOS USE IN CHLORINE MANUFACTURING

Most of the world's chlorine is produced by the electrolysis of brine in diaphragm, mercury and membrane cells. Asbestos is used in many diaphragm cells. Although exposure to asbestos can cause serious adverse health effects, by following safe handling procedures and complying with governmental regulations, asbestos can be handled, used, and disposed of safely. In diaphragm cells, chlorine produced in the anolyte compartment must be kept separate from the alkali metal hydroxide and hydrogen formed in the catholyte compartment. This separation can be accomplished by an asbestos diaphragm.

The chlor-alkali industry has used asbestos as a diaphragm separator for over a century and continues to promote safe handling and use of the mineral. The industry developed processes to render the asbestos into non-friable diaphragm forms; exposures are carefully monitored, and handling of dry, friable fibers is minimized.

Saturated brine is fed into the anolyte compartment where the chloride ion is electrolyzed to chlorine. The depleted brine and the cation pass through the diaphragm to the cathode compartment where the alkali metal hydroxide and hydrogen are produced. The diaphragm separates the chlorine which is liberated at the anode from the sodium hydroxide and hydrogen which are produced at the cathode. Figure 2.1 shows a typical diaphragm cell.

The diaphragm material is the key to the successful and safe operation of a diaphragm cell. Essential characteristics include sufficient mechanical strength, high chemical resistance to both acids and bases, low electrical resistance, uniform and consistent deposits on the cathode, appropriate physical structure to permit flow of depleted brine with minimum back-migration of hydroxyl ion, and an acceptable service life.

Asbestos is very well suited as a diaphragm material because it exhibits a highly favorable combination of these characteristics. Chrysotile asbestos, also known as white asbestos, is the form of asbestos used for diaphragms in most areas of the world.

The unique characteristics of asbestos in the chlor-alkali cell environment have long been studied. The deposited fibers on the cathode function more than just a filter media. A gel layer forms in the mat (under proper depositing and operating conditions) and plays a significant role in the performance of the diaphragm, especially in minimizing the back-migration of the hydroxyl ion.

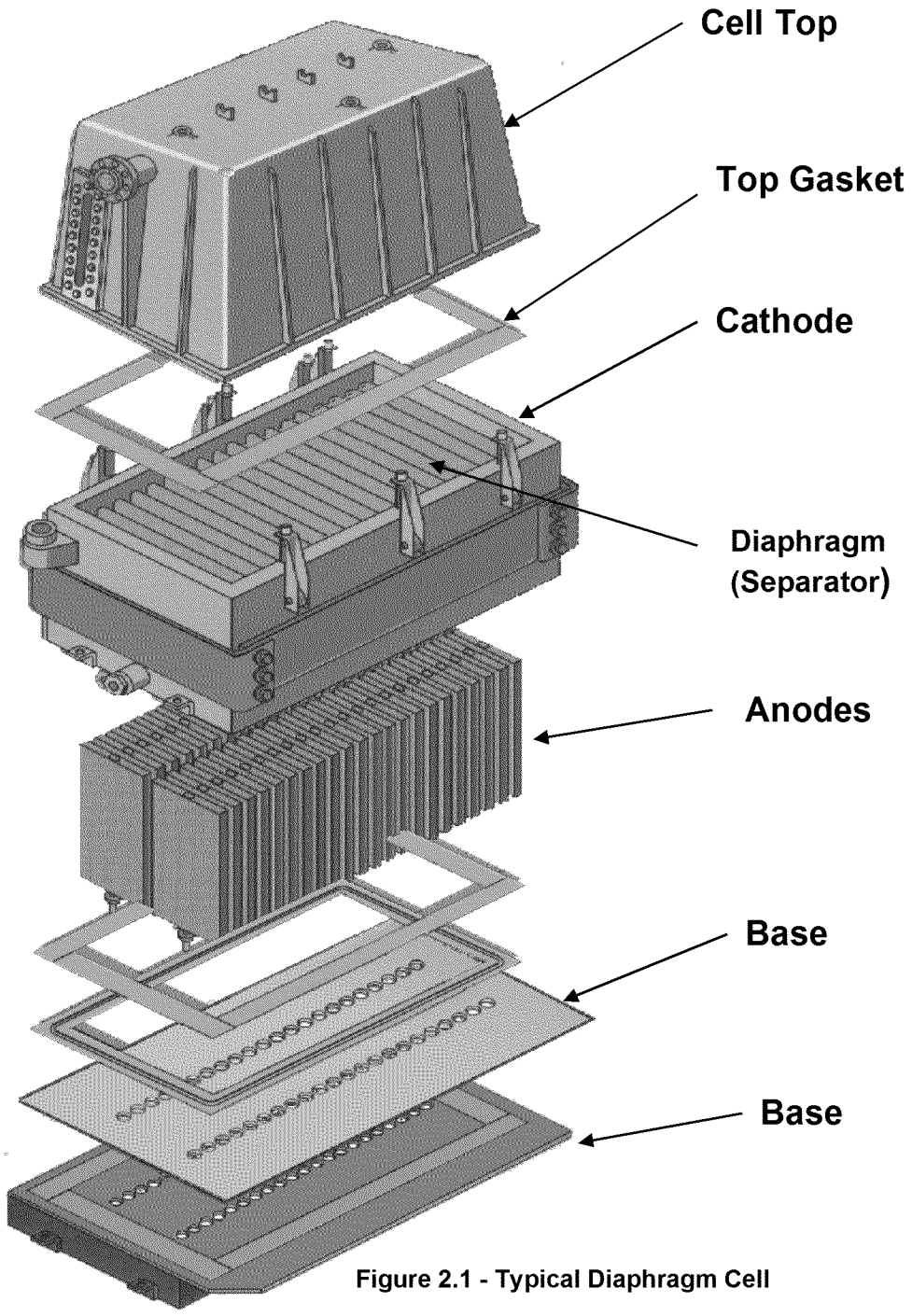

Figure 2.1 - Typical Diaphragm Cell

3. REGULATIONS

3.1 UNITED STATES

Reference 9.1 lists various OSHA, EPA, and DOT regulations applicable to asbestos use by the chlor-alkali industry. In addition to these governmental requirements, there may also be state requirements that must be met.

3.1.1 Asbestos Standard (OSHA 29 CFR Part 1910.1001)

The following briefly summarizes the Asbestos Standard, but is not a comprehensive review.

The Asbestos Standard:

- Establishes a PEL of 0.1 f/cc of air as an 8-hour TWA and an excursion limit of 1.0 f/cc as averaged over a thirty-minute sampling period. Fibers are defined as particles five micrometers or longer with a length to width ratio of at least three to one.

- Requires that the analytical test procedure to be utilized is the NIOSH Method 7400. (29 CFR 1910.1001 Appendix A)

- Establishes methods for collecting industrial hygiene monitoring samples, analyzing samples and communicating sample results to employees. The standard also specifies the frequency with which samples must be collected and when increased or decreased sampling may be appropriate. It also permits employees or their designated representative to observe the monitoring.

- Establishes regulated areas where airborne asbestos levels exceed or are likely to exceed the PEL-TWA or Excursion Limit which must be demarcated from the rest of the workplace, have limited access, and require personnel entering the regulated area to wear respiratory protection. Eating, drinking, smoking, using smokeless tobaccos, chewing gum or applying cosmetics are prohibited in any regulated area.

- Prescribes various methods of compliance, including engineering controls and work practice techniques. If the PEL-TWA and/or the excursion limit is exceeded, a written program must be developed to reduce exposure levels to or below the PEL-TWA and to or below the excursion limit by means of engineering and work practice controls, except to the extent that such controls are not feasible. Wherever the feasible engineering controls and work practices that can be instituted are not sufficient to reduce employee exposure to or below the PEL-TWA and/or excursion limit, the employer must use them to reduce employee exposure to the lowest levels achievable by these controls and supplement them by the use of respiratory protection.

- Describes the situations where a respirator must be worn, type of respirator to be worn, requirements of the respiratory protection program, and respirator fit testing.

- Identifies the type of protective work clothing and equipment which must be provided if the PEL-TWA or the excursion level is exceeded, and the appropriate handling, storage, cleaning, replacement and disposal practices for the clothing and equipment.

- Identifies requirements for change rooms, showers and lunchrooms, if the PEL-TWA and/or excursion limit is exceeded.

- Prescribes specifications for warning signs, labels and SDSs. Additionally, for all employees exposed to asbestos at or above the regulatory limits, employee training requirements and frequency of such training are specified.

- Establishes certain housekeeping requirements, including waste disposal.

- Specifies preplacement, annual and termination medical examinations and the transfer of information to the examining physician regarding the Asbestos Standard, employee work duties, exposure levels, personal protective equipment use and previous medical exam results. The Asbestos Standard requires the examining physician to submit a written opinion on each affected employee's ability to perform the identified work duties and to identify limitations the employee should follow. The Asbestos Standard also requires the physician to inform employees of examination results. The medical examination requirements apply to employees exposed at or above the PEL-TWA and/or excursion limit.

- Establishes certain record-keeping requirements regarding exposure measurements, medical surveillance, training and transferring of records.

3.1.2 Hazard Communication Standard (OSHA 29 CFR 1910.1200)

This regulation is commonly known as the Worker Right to Know Law. The purpose of the standard is to ensure that the hazards of chemicals are evaluated and communicated to employees. Asbestos is regulated under OSHA 1910.1200 as a hazardous substance.

3.1.3 Emergency Response to Hazardous Substance Releases (OSHA 29 CFR 1910.120 (HAZWOPER))

This standard is also applicable to the chlor-alkali industry with regard to spill clean-up, waste management and emergency response.

3.1.4 EPA - EPCRA

Asbestos is not regulated under The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) as an extremely hazardous substance (EHS). There are several sections of the Act that affect facilities that manufacture chlorine utilizing asbestos diaphragm or other technologies.

Section 304: Accidental Release-Emergency Notification (40 CFR Part 355)

Release of a quantity equal to or greater than the federal reportable quantity (RQ) triggers immediate notification to the National Response Center (NRC), and state and local agencies. The federal RQ for asbestos (friable) is one pound.

Section 311: Community Right-to-Know-SDSs or Lists (40 CFR 370)

This section requires submission of SDS forms or a list of regulated chemicals to emergency regulatory agencies if the facility has greater than or equal to threshold quantities at the facility at any time during the year. The threshold quantity for asbestos is 10,000 pounds. This is a one-time report unless the SDS changes.

Section 312: Community Right-to-Know - Chemical Inventory (40 CFR 370.25)

This section requires submission of an annual inventory and locations of hazardous substances to emergency regulatory agencies if the facility has greater than or equal to threshold quantities. The threshold quantity for asbestos is 10,000 pounds.

Section 313: Annual Toxic Chemical Release Inventory (TRI) (40 CFR 372)

This section requires submission of Form R Reports to EPA by June 30 if greater than 10,000 pounds is used during a calendar year. Only releases of asbestos in a friable form are required to be reported as part of the TRI. The threshold quantity for reporting is 0.1 pounds.

3.1.5 EPA - Air (40 CFR Part 61)

Asbestos is a designated hazardous air pollutant under the Clean Air Act and is regulated under the National Emission Standard for Hazardous Air Pollutants (NESHAP). Certain aspects of asbestos waste disposal are addressed in these regulations.

In summary, the regulations [61.144(a)(9)] require an owner/operator of a chlorine manufacturing facility utilizing asbestos diaphragm cell technology to adhere to the following:

- No visible discharge to the outside air.
- Use of specified methods to clean emissions containing asbestos material prior to being emitted. (61.152)
- Deposit all asbestos-containing waste material from chlor-alkali operations at waste disposal sites operated in accordance with regulations and discharge no visible emissions to the outside air during each stage of disposal or use of specified disposal methods.
- Monitoring of emission sources by visual observation on a daily basis.
- Asbestos from chlor-alkali facilities must be adequately wetted and wrapped in leak-tight materials. Containers are used to transport debris. Large pieces may be wrapped in leak-tight materials. All containers must be labeled with

the OSHA warning label and the generator's name and address. Most states require the use of manifests for asbestos waste transportation.

- Inspection of air cleaning systems on a weekly basis.
- Submit information regarding asbestos emissions, disposal practices, etc. to the EPA.

3.1.6 EPA - Water (40 CFR Part 415)

Effluent limitations applicable to the chlor-alkali industry are not specific for asbestos, although there are restrictions on the discharge of suspended solids, in 40 CFR Part 415 Subpart F. These regulations are promulgated under the Clean Water Act.

3.1.7 EPA - Toxic Substances Control Act (40 CFR Part 763)

Section 8(a) Inventory Update Rule (40 CFR 710) - This regulation affects manufacturers of asbestos as well as those that may import asbestos.

3.1.8 DOT - Hazardous Materials Sub-Chapter C-Hazardous Materials Regulation

Regulations promulgated under the Hazardous Materials Transportation Act address commercial shipments of asbestos as well as the transportation of cell parts and waste asbestos containing materials. In summary, the regulations require that asbestos be properly containerized, labeled, marked, loaded, transported, and unloaded in a manner to minimize occupational exposure to airborne asbestos particles.

- Part 171 provides general information of the shipment of hazardous goods.
- Part 172 prescribes the requirements for shipping papers, package marking, labeling and placarding of hazardous goods.
- Part 173.216 defines packaging requirements for asbestos.

3.2 CANADA

Under the National Pollutant Release Inventory (NPRI), there are reporting requirements of asbestos emissions or waste transfers.

The Canadian Occupation Health and Safety Regulations, Part X, designates chrysotile as a hazardous substance. It imposes requirements and applies only to government operations and federally regulated entities.

3.2.1 Canadian Workplace Standards

Most regulations are vested at the provincial level, therefore a thorough review of provincial requirements is necessary. Exposure limits vary by province and may be dependent on the type of asbestos. For instance, Alberta Regulation 393/88 Chemical Hazard Regulation – Part 3 details the requirements for asbestos handling and is similar to 29 CFR 1910.1001.

3.2.2 Canadian Environmental Regulations

When transporting asbestos, disposing of asbestos wastes, or where the potential exists for release of asbestos into the environment, the requirements of federal and provincial regulations must be followed.

3.3 MEXICO

The Mexican Occupational Health and Safety regulation NOM-052-SEMARNAT2005 designates chrysotile fibers and friable products as a hazardous waste. It imposes requirements and applies to all industries using asbestos.

In November 2004, the asbestos user industry, represented by IMFI, signed a voluntary agreement with the federal government health organization (COFEPRIS) for asbestos process sanitary control focused to protect people against sanitary risks.

Through this agreement, the asbestos industry and the federal government are committed to the following actions:

- Prepare a Safe Practices Guide for Asbestos Use, which should be compiled by all industry associates of the Mexican Fibre Industries Institute, following international recommendations.
- The federal government (COFEPRIS) must establish the mechanism for compliance verification for the chrysotile asbestos use industry.
- The federal government (COFEPRIS) must establish a certification mechanism in order to recognize the processor or user as a responsible asbestos industry.
- The chrysotile asbestos industry must establish a program to evaluate and improve the process and use and conditions for chrysotile asbestos, considering that the risks can affect workers health when exposed.
- The asbestos using industry must send to the federal government (COFEPRIS) reports of:
    - work environment surveillance and monitoring
    - a workers health control and training program

3.3.1 Mexican Workplace Standards

Regulation NOM-010 STPS –2014 – This regulation describes the health and safety conditions in the workplaces where chrysotile asbestos is handled, transported, processed, or stored as a chemical substance with potential risk for occupational environment. This standard establishes the maximum fibers permissible exposure for chrysotile asbestos form, as amphiboles should no longer be used.

Regulation NOM-125-SSA1-1994 – This regulation establishes the sanitary requirements for chrysotile asbestos processing and use. Its compliance is verified by the Mexican Health Secretariat.

3.3.2 Mexican Environmental Regulations

Regulation NOM-002-SCT-2011 - This regulation establishes the requirements for dangerous materials and wastes land transportation. It describes the classification, labeling and special packing requirements for dangerous substances and material usually transported.

4. CONTROL PROCEDURES

4.1 GENERAL

This section addresses safe handling and disposal practices of asbestos in the chlor-alkali industry. Examples of satisfactory asbestos control practices are only illustrative and should not be construed to have universal applicability or to represent the only available or suitable practices.

4.2 PURCHASING

When asbestos is ordered in bags, purchase orders should require the vendor to have palletized asbestos in bags in the railcar or truck, and cover the palletized bags with shrink-wrap, stretch-wrap or other nonporous material. This procedure minimizes the likelihood of torn bags or loose material and promotes ease of movement.

4.3 RECEIVING

4.3.1 Inspection

The asbestos shipment should be inspected before unloading. If any friable asbestos material is found, it should be cleaned up as discussed in Section 4.5.

4.3.2 Unloading

When moving asbestos to storage, it is important to prevent the puncturing of bags. The unloading operator should have an approved respirator and appropriate protective clothing readily available. Prior to any unloading the unloading personnel need to have been trained per the regulatory requirements.

4.4 STORAGE

An appropriate storage area is an important element of the asbestos handling program and its design should be carefully planned. Ideally, asbestos should be stored in an isolated and enclosed area (e.g., storage room) with restricted access and appropriate OSHA-specified warning signs. If air is recirculated, HEPA filters should be used.

If an access way exists between the asbestos storage area and the major work area of a cell renewal operation, it should have a well-fitted door. The door should remain closed

at all times and should be marked with appropriate OSHA-specified warning signs. The regulation requires warning signs to include the following information:

- DANGER
- CONTAINS ASBESTOS FIBERS
- MAY CAUSE CANCER
- CAUSES DAMAGE TO LUNGS
- DO NOT BREATHE DUST
- AVOID CREATING DUST

Another means of storage is the "assigned" railroad car or ISO container. The container should be marked with appropriate OSHA-specified warning signs.

The storage area and all other areas should be kept clean and free as practicable of loose asbestos fiber. Wooden pallets should not be allowed to accumulate in the storage area. Any area or surface showing signs of asbestos, whether on floors, walls, or pallets, should be cleaned with a HEPA filter-equipped vacuum cleaner (29 CFR 1910.1001(k)(4)). The asbestos waste, vacuum bag and filter should be enclosed in a labeled, heavy plastic bag or other impervious container and disposed. The asbestos may also be washed into a collection system or wetted down and recovered. Periodic inspections of the storage area are recommended.

4.5 CLEANUP

If broken bags or loose asbestos are evident, the individuals cleaning up the spill must wear approved respirators and suitable protective clothing. Prior to cleanup, the involved personnel need to have been trained per the regulatory requirements. See Section 3.1. Broken bags should be enclosed in a heavy-duty plastic bag. A HEPA filter-equipped vacuum cleaner should be used for cleanup before unloading proceeds. Where possible, water should be used to wash down and collect any loose asbestos. All other individuals should be kept from the area until cleanup is completed. If the spill occurred in an area not used for asbestos, after the cleanup, appropriate measures (e.g., air monitoring, wipe sampling) should be taken to ensure that the asbestos has been removed from this area.

4.6 DIAPHRAGM DEPOSITING AND TREATMENT

Exposure to asbestos can occur when asbestos is being prepared for use in making diaphragms. Damaged bags should be contained before transport to the point of use. A large heavy-duty plastic bag should be used to contain any broken bag during transport. Personnel in direct contact with asbestos should wear an approved respirator and suitable protective clothing.

Asbestos bag cutting and emptying should be performed under a vacuum vented hood or within an enclosed system. Transferring asbestos into a slurry tank should be performed under a vacuum vented or enclosed system to contain asbestos.

At times, it may be necessary to add asbestos slurry to an operating cell. Spilling the treatment slurry should be prevented to avoid contaminating the work area. Any spillage should be promptly cleaned up.

4.6.1 Sorting and Weighing

Asbestos bags should be opened within a vacuum-vented or enclosed system. Bags should be fully cut and carefully emptied with minimal disturbance of the contents. Bags should never be shaken. Delumping of asbestos and emptying of bags should be done cautiously to prevent asbestos release.

Empty bags should be folded over the cut within a vacuum-vented or enclosed system and be deposited in a closed and labeled container.

When only partial contents of a bag are required, the partially filled bag should be stored within the vacuum-vented hood or enclosed system. If partially filled bags must be moved outside the vacuum-vented hood or enclosed system, they should be resealed and HEPA-vacuumed before moving.

4.6.2 Protective Equipment 29 CFR 1910.1001(h)

Workers involved in the physical handling of asbestos bag transfer and slitting, sorting, weighing and slurry-preparation operations should wear approved NIOSH respirators and suitable protective clothing as discussed in Section 5.4. If friable asbestos fibers are spilled on protective clothing, they should be HEPA-vacuumed prior to removal of the protective clothing.

4.6.3 Housekeeping 29 CFR 1910.1001(k)

There should be no visible asbestos. Neither compressed air blowing nor dry broom sweeping should be used to clean up loose asbestos. Fugitive asbestos fibers should be removed with a HEPA filter-equipped vacuum cleaner or by wet cleaning.

4.6.4 Storage of Completed Diaphragms

Prior to installation in a cell, completed diaphragms should be managed in a manner to prevent asbestos from entering the atmosphere. Care should be taken in storage and handling to ensure that diaphragms are not damaged. Covering of stored diaphragms also may be appropriate.

4.7 PURCHASED AND PRE-DEPOSITED ASBESTOS DIAPHRAGMS

4.7.1 Storage

Purchased predeposited diaphragms should be placed on pallets with protective plastic covering or stored in the cell frame assembly. The properly protected diaphragms should be stored in a designated area.

4.7.2 Shipping, Receiving and Assembly

Predeposited diaphragms should be shipped on pallets with protective plastic covering or in containers designed to hold the diaphragms. Personnel should wear the proper safety equipment, as outlined by their company's PPE policy, when handling diaphragms during shipping, receiving and cell assembly.

4.8 SPENT ASBESTOS

4.8.1 Hydro Blast Area

Asbestos diaphragms can be removed by hydro blasting and replaced at some frequency, depending on cell type, brine quality, and other variables.

The hydro blast area should be enclosed, i.e., a separate room or enclosure with shielding to contain asbestos, and have smooth surfaces to prevent asbestos from adhering and drying. The area should also contain a trench system for receiving and carrying away the asbestos and contaminated water to a sump or pit. A sloping concrete floor facilitates drainage. After each use of the hydro blast area or at the end of the workday, all surfaces should be carefully flushed to remove asbestos. Where appropriate, the area can be initially cleaned with a squeegee. Final wash down would then require a minimal quantity of water. PPE for operators should include protective clothing (see Section 5.4). If outer protective gear (e.g., "slicker suit") is needed to protect against water, consideration should be given to the use of disposable suits. If reusable suits are used, they should be washed clean of fibers and inspected prior to reuse. Allowing the suit to dry before reuse allows for any asbestos spilled on the suit to be more visible.

4.8.2 Water Separation

Separation of spent asbestos from the hydro blasting water wash is typically accomplished by gravity settling in separation tanks or filtration, e.g. plate and frame filters.

4.8.3 Landfills

Landfills which accept asbestos wastes are regulated by EPA and have specific recordkeeping requirements. The landfill operator may require the shipper to complete a waste profile prior to accepting such wastes.

5. EMPLOYEE PROTECTION

5.1 GENERAL

Asbestos can cause serious health problems if it is not properly used and handled. Asbestos exposure can cause such diseases as pulmonary asbestosis, carcinoma and pleural mesothelioma. However, quantifying the health risks associated with specific airborne concentrations, fiber types and dimensions, and the chemical composition of the fibers, is an inexact process. In addition, the long latency period between initial exposure and the appearance of disease complicates risk estimates. Consequently, exposure should be kept at or below the PEL-TWA and the excursion limit.

The Asbestos Standard requires that engineering controls such as exhaust ventilation and dust collection be used to maintain exposures at or below permissible levels. To the extent practicable, the Standard also requires that asbestos be handled in a wet state to prevent the emission of airborne fibers in excess of the PEL-TWA and/or the excursion limit.

Compliance must be achieved by instituting engineering controls and work practices. If such controls and work practices are not feasible, appropriate documentation must be maintained. In that event, the engineering controls and work practices shall be used to reduce exposure to the lowest levels achievable and those controls shall be supplemented by the use of respirators and other PPE.

5.2 WARNING SIGNS AND LABELS: 29 CFR 1910.1001(J)

Warning signs with OSHA-specified language must be displayed at all regulated areas and all approaches to these areas, and at and around disposal sites which contain asbestos waste (See Section 4.4). Some states may also have labeling requirements for tracking/identifying.

The Asbestos Standard (29 CFR 1910.1001(j)(4) requires that warning labels with OSHA-specified language be affixed to all raw materials, mixtures, scrap, waste, debris, etc. containing asbestos, or to asbestos waste containers destined for disposal except where specifically excluded under 29 CFR 1910.1001(j)(6). Exclusions include cases where "asbestos fibers have been modified by a bonding agent, coating, binder, or other material provided that the manufacturer can demonstrate that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of fibers of asbestos in excess of the TWA permissible exposure level and/or excursion limit will be released or asbestos is present in a product in concentrations less than 1.0%." States may also have generator identification number requirements.

5.3 RESPIRATORS: 29 CFR 1910.1001(G)

Where their use is required, respirators must be approved by the National Institute for Occupational Safety and Health.

OSHA regulations (Reference 9.1) require employers to establish respiratory protection programs, including choosing the appropriate respirator, training on its use and limitations, medical determination of ability to wear a respirator, and proper maintenance and storage.

Employees must wear approved respirators whenever exposures cannot be effectively reduced by engineering controls and asbestos exceeds or is likely to exceed the PEL-TWA or the excursion limit. The Institute provides information for respiratory protection in Pamphlet 65 (Reference 9.2).

5.4 PROTECTIVE CLOTHING: 29 CFR 1910.1001(H)

Any worker exposed to asbestos in excess of the TWA and/or excursion limit must wear protective clothing such as coveralls (or similar whole body clothing) and head (e.g.,

hard hat), hand and foot coverings. The protective clothing, which must be provided by the employer, should not contain pockets or side openings.

Employers may prefer to provide disposable coveralls, although reusable ones are permitted. For reusable coveralls, anti-static, cotton polyester fabric of fine weave has proven a satisfactory material.

Once worn, disposable protective clothing should be considered contaminated with asbestos and properly disposed. Reusable clothing, once worn, if contaminated, should be HEPA filter-vacuumed before placing in laundry containers. Clothing must not be shaken, brushed, or air blown.

Soiled protective clothing, whether reusable or disposable, should be placed and stored in closed containers which prevent dispersion of asbestos outside of the container. Contaminated clothing must be transported in sealed, labeled, impermeable bags or other closed, impermeable, labeled containers.

Laundering should be done to prevent release to the ambient air of adhered asbestos fibers. Water-soluble laundry bags may minimize the exposure potential in handling operations.

If contract laundering is used, the employer must inform the contractor, preferably in writing, of the applicable regulations. Contract launderers' facilities should be periodically inspected.

5.5 CHANGE ROOMS: 29 CFR 1910.141 (D AND E) GENERAL ENVIRONMENTAL CONTROLS

Employers must provide change rooms and showers for workers who are exposed to asbestos above the TWA and/or excursion limit. Change rooms must not be used for other purposes (e.g., food and drink area, break room, office) and must be equipped with two separate lockers or other containers for each worker to prevent contamination of the worker's street clothes. If disposable clothing is worn, it should be placed in a disposal container and the worker should then enter the shower area.

6. INDUSTRIAL HYGIENE MONITORING: 29 CFR 1910.1001(D)

An effective monitoring program identifies employee exposure and aids in developing practices to reduce that exposure.

6.1 EXPOSURE MONITORING

The Asbestos Standard requires exposure monitoring whenever there has been a change in the production, process, control equipment, personnel or work practices that may result in new or additional exposures above the TWA permissible exposure limit and/or excursion limit or when the employer has any reason to suspect that a change may result in new or additional exposures above these limits. In addition, the standard also requires periodic (compliance) exposure monitoring at a frequency not to exceed six months for those employees whose exposures may reasonably be foreseen to exceed the PEL-TWA or the excursion limit.

Reference 9.1 contains a detailed description of the exposure monitoring requirements. All affected facilities should develop an industrial hygiene monitoring program for asbestos and audit it to insure compliance with regulations and company policy.

6.2 EMPLOYEE NOTIFICATION

The affected employee must be notified in writing of any monitoring results within 15 working days of the employer's receipt of the results. If the exposure exceeds the TWA and/or excursion level, written notice must include the corrective action steps necessary to reduce exposure to, or below these levels.

6.3 RECORDS: 29 CFR 1910.1001(M)

Exposure monitoring records must be kept for at least 30 years. Additional requirements for monitoring records are included in the Asbestos Standard and other OSHA Act regulations such as 29 CFR 1910.1020 (Reference 9.1).

7. MEDICAL SURVEILLANCE : 29 CFR 1910.1001(I)

The Asbestos Standard requires employers to institute a medical surveillance program for all employees who are or may be exposed to asbestos at or above the TWA and/or excursion level.

7.1 PRE-PLACEMENT EXAMINATIONS

Before an employee is assigned to an occupation where exposure to airborne concentrations of asbestos fibers at or above the TWA and/or excursion limit may occur, a pre-placement medical examination shall be provided or made available by the employer at no cost to the employee. At a minimum, the examination must include:

- medical and work history
- complete physical exam of all systems with emphasis on the respiratory system, the cardiovascular system and digestive tract
- completion of the medical questionnaire in Appendix D of the Asbestos Standard
- a chest roentgenogram (posterior-anterior 14 x 17 inches) (Roentgenograms shall be interpreted and classified only by a B-reader, a board eligible/certified radiologist, or an experienced physician with known expertise in pneumoconiosis according to Appendix E of the OSHA standard.)
- pulmonary function test

7.2 PERIODIC EXAMINATION

For employees exposed to asbestos at or above the PEL-TWA or the excursion limit, an annual medical surveillance examination must be made available. It is nearly identical to the preplacement examination except that the frequency of chest X-rays depends on age and years since first exposure and the medical exam is abbreviated.

7.3 TERMINATION EXAMINATIONS

Within 30 days before or after termination, the employer must make available a medical examination to workers exposed to asbestos at or above the TWA and/or excursion limit. If the employee received the OSHA-designated examination within the past year, a termination examination is not required.

7.4 PHYSICIAN'S INVOLVEMENT

7.4.1 Employer Provided Information

The employer must provide to the physician information which includes:

- A copy of the Asbestos Standard and Appendices D and E of the standard
- A description of the affected employee's duties as they relate to the employee's exposure
- The employee's representative exposure level or anticipated exposure level
- A description of any personal protective and respiratory equipment used or to be used
- Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician

7.4.2 Physician Provided Information

The employer must obtain from the physician a written, signed opinion which includes the following:

- The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos
- Any recommended limitations on the employee or upon the use of personal protective equipment such as clothing or respirators
- A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions resulting from asbestos exposure that require further explanation or treatment
- A statement that the employee has been informed by the physician of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure

7.5 EMPLOYEE NOTIFICATION

The employer must provide a copy of the physician's written opinion to the affected employee within 30 days of its receipt.

7.6 RECORDS

Medical surveillance records must be retained for the duration of the individual's employment plus 30 years.

8. EMPLOYEE TRAINING

A well-designed and well-conducted employee training program is an essential part of providing a safe work environment. In addition to employees involved in the manufacture of chlor-alkali products, consideration should also be given to the training needs of personnel performing housekeeping activities in areas where asbestos may be present.

8.1 OPERATING INSTRUCTIONS AND INITIAL TRAINING: 29 CFR 1910.1001(J)(7)(II)-(J)(7)(III)(J)

Workers who may be exposed to asbestos at or above PEL-TWA or the excursion level should receive detailed written operating instructions specific to their duties. These instructions should include appropriate procedures for moving and handling asbestos, required PPE and clean-up practices. In particular, training should be provided to include as a minimum:

- The health effects associated with asbestos exposure
- The relationship between smoking and exposure to asbestos, resulting in lung cancer
- The quantity, location, manner of use, release, and storage of asbestos, and the specific nature of operations which could result in exposure to asbestos
- The engineering controls and work practices associated with the employee's job assignment
- The specific procedures implemented to protect employees from exposure to asbestos, such as appropriate work practices, emergency and clean-up procedures, and personal protective equipment to be used
- The purpose, proper use, and limitations of respirators and protective clothing, if appropriate
- The purpose and a description of the medical surveillance program
- The content of the Asbestos Standard, including appendices
- The names, addresses and phone numbers of public health organizations which provide information, materials, and/or conduct programs concerning smoking cessation. The employer may distribute a list of such organizations to comply with this requirement.
- The requirements for posting signs and affixing labels and the meaning of the required legends for such signs and labels

8.2 ASBESTOS AWARENESS TRAINING: 29 CFR 1910.1001(J)(7)(IV)

The employer shall provide, at no cost to employees, an awareness training program for employees who perform housekeeping operations in an area that contains ACM or PACM. An asbestos awareness training course shall at a minimum contain the following elements:

- health effects of asbestos and locations of asbestos in the area
- recognition of ambient asbestos fibers
- requirements in the OSHA Asbestos Standard relating to housekeeping
- proper response to fiber release episodes

Each such employee shall be so trained at least once a year.

8.3 CONTRACTORS

When contract employees may potentially be exposed to asbestos, the contracting company must be informed of the presence and hazards of asbestos, i.e., applicable standards (asbestos, OSHA, EPA, DOT, state). The Institute provides information for assisting facilities in meeting the contractor requirements of the OSHA Process Safety Management rule in Pamphlet 85 (Reference 9.2).

8.4 RECORDS

Employee training records must be maintained for the duration of employment plus one year.

9. REFERENCES

Web links are provided for many references. Most CFRs can be accessed online at the following link: http://www.gpoaccess.gov/cfr/index.html

9.1 CHLORINE INSTITUTE REFERENCES

The following publications are specifically referenced in CI Pamphlet 137. The latest editions of CI publications may be obtained at http://www.chlorineinstitute.org.

Pamphlet #	Title
65	*Personal Protective Equipment for Chlor-Alkali Chemicals*, ed. 6; Pamphlet 65; The Chlorine Institute: Arlington, VA, 2015.
85	*Recommendations for Prevention of Personnel Injuries for Chlorine Production and Use Facilities,* ed. 5; Pamphlet 85; The Chlorine Institute: Arlington, VA, 2010.

9.2 OSHA REGULATIONS

9.2.1 Code of Federal Regulations. Title 29. Part 1910.1001. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.2.2 Code of Federal Regulations. Title 29. Part 1910.1200. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.2.3 Code of federal Regulations. Title 29. Part 1910.120 (q). Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.2.4 Code of Federal Regulations. Title 29. Part 1910.134. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.2.5 Code of Federal Regulations. Title 29. Part 1910.1020. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.2.6 Code of Federal Regulations. Title 29. Part 1910.141. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.3 EPA REGULATIONS

9.3.1 Code of Federal Regulations. Title 40. Parts 301-303, 304, 311-12, 313, 355, 370, 372. Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.3.2 Code of Federal Regulations. Title 40. Part 6. 144 (a) (q). Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.3.3 Code of Federal Regulations. Title 40. Part 415.60 – 415.66. Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.3.4 Code of Federal Regulations. Title 40. Part 710. Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.3.5 Code of Federal Regulations. Title 40. Part 707. Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.3.6 Code of Federal Regulations. Title 40. Part 763. Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

9.4 DOT REGULATIONS

9.4.1 Code of Federal Regulations. Title 49. Sub Chapter C Part 171-173. Office of Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

APPENDIX A - CHECKLIST

This checklist is designed to emphasize major topics for someone who has already read and understood the pamphlet. Taking recommendations from this list without understanding related topics can lead to inappropriate conclusions.

Place a check mark (□) in the appropriate box below:

Yes	No	N/A			
□	□	□	1.	Does the facility understand the OSHA, EPA, DOT and any other applicable regulations?	{3.1 - 3.3}
□	□	□	2.	Does the facility have purchasing specifications in place to minimize spillage in shipments?	{4.2}
□	□	□	3.	Does the facility have in place procedures to unload asbestos safely?	{4.3 and 4.6}
□	□	□	4.	Does the facility have in place procedures to store asbestos safely?	{4.4, 4.6 and 4.7}
□	□	□	5.	Does the facility have in place procedures to clean up spills?	{4.5}
□	□	□	6.	Does the facility have in place procedures to use asbestos safely?	{4.6 and 8.1}
□	□	□	7.	Does the facility have in place procedures to handle and dispose of spent asbestos safely?	{4.8}
□	□	□	8.	Does the facility provide appropriate PPE for employees handling asbestos?	{5}
□	□	□	9.	Does the facility have in place procedures to perform exposure monitoring and notify employees as required?	{6.1 and 6.2}
□	□	□	10.	Does the facility have in place procedures to retain exposure monitoring records per the regulatory requirements?	{6.3}
□	□	□	11.	Does the facility have in place procedures to conduct employee medical surveillance and notification for employees per the regulatory requirements?	{7.1-7.5}
□	□	□	12.	Does the facility have in place procedures to retain medical surveillance records per the regulatory requirements?	{7.6}
□	□	□	13.	Does the facility have in place procedures to train employees including contractors and housekeeping per the regulatory requirements?	{8.1-8.3}
□	□	□	14.	Does the facility have in place procedures to retain training records per the regulatory requirements?	{8.4}

REMINDER: Users of this checklist should document exceptions to the recommendations contained in this pamphlet.

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