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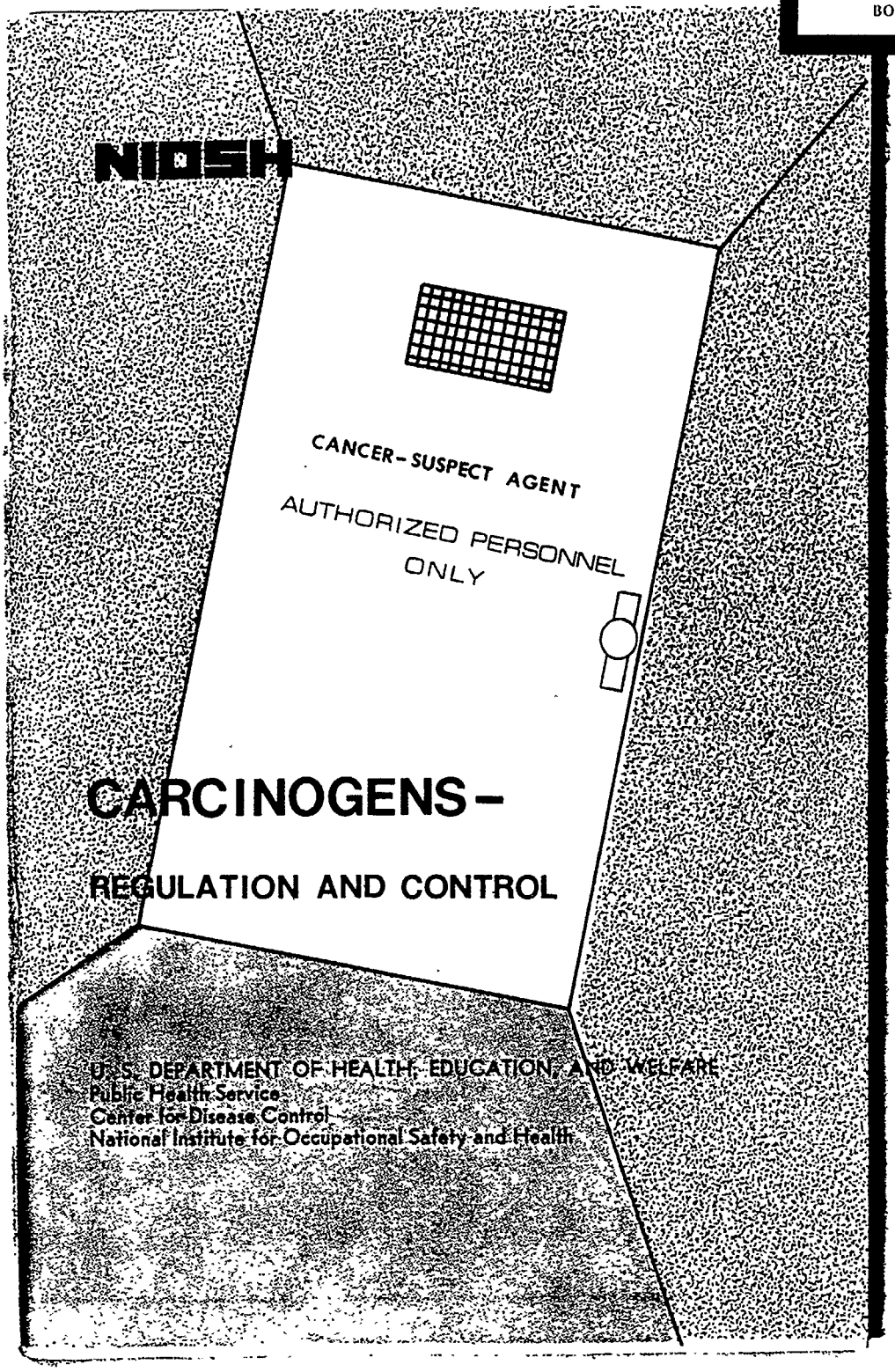

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CARCINOGENS — Regulation and Control

A MANAGEMENT GUIDE TO CARCINOGENS— Regulation and Control

DHEW Publication No. (NIOSH) 77-205

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
Division of Technical Services
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WORKING WITH CARCINOGENS
A Guide to Good Health Practices

INTRODUCTION

The Occupational Safety and Health Act of 1970 was passed "To assure safe and healthful working conditions for working men and women . . ." This Act established the National Institute for Occupational Safety and Health (NIOSH) in the Department of Health, Education, and Welfare and the Occupational Safety and Health Administration (OSHA) in the Department of Labor. The Act provides for research, information, education, and training in the field of occupational safety and health and authorizes enforcement of the standards. As part of these activities, NIOSH has surveyed small businesses to determine the most common health and safety problems.

One great concern is the possibility of cancer being contracted from exposure to carcinogens in the workplace. This booklet was developed as an introduction to occupational carcinogenesis programs. The first section "Working with Carcinogens—A Guide to Good Health Practices" NIOSH Pub. No. 206 is a nontechnical discussion of cancer, carcinogens, and requirements of the OSHA standards for 14 carcinogens promulgated in 1974. It is available as a separate publication and is meant to inform production workers and first-line supervisory and other nontechnical management personnel of the provisions of these standards. The second section "A Management Guide to Carcinogens" is a more detailed discussion of the requirements of these standards and includes recommendations to the technical management for compliance.

The state-of-art for determination of, and protection against, exposure to occupational carcinogens is rapidly expanding as government, industry, and academia dedicate more time and effort to this activity. Many new standards will be promulgated

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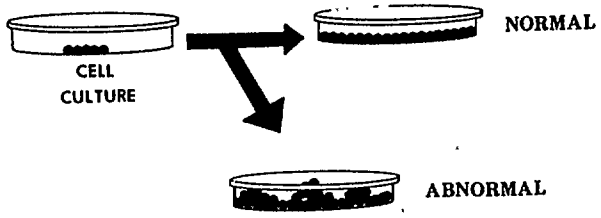
as the investigations reach completion. *The standards discussed in this publication are general in nature. They also represent minimal conditions that should be observed from the time a substance is identified as a human cancer-suspect agent until specific standards are promulgated.*

Although the aim of this booklet is to assist in providing a safe and healthful workplace, the scope is restricted to preventing employee exposure to carcinogens. Words such as "must," "shall," "required," and "necessary" indicate requirements under the Federal Regulations. Procedures indicated by "should," "may," "suggested," and "recommended" constitute generally accepted good practices.

CANCER

Cancer is a term used to describe a certain type of disease. Like influenza, it is not one specific disease, but many diseases, each with its own history and characteristics. In general, however, ***cancer is characterized by an uncontrolled growth of abnormal cells.***



Normal vs abnormal cell division

The body is composed of millions and millions of cells, each having a specific function. When cells are damaged or become old, they are replaced by new cells by an orderly process of cell division. Only the kinds and amounts of cells needed are produced. A substance within each cell called DNA (deoxyribonucleic acid) serves as the control center and directs the activities of the cells. A change in the structure of the DNA will cause the cell to function abnormally. This change may occur spontaneously (with no apparent outside influence), or it may be caused by the reaction of the DNA with an external factor. In all cases of cancer, this change is characterized by uncontrolled cell division or reproduction and frequently as a mass of tissue called a **tumor.**

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Tumors can originate in many different organs and tissues within the body. When the tumors are self-contained, they are called **benign** tumors. They may endanger life, however, by causing bleeding, crowding, interference in the functions of vital organs, or unregulated hormone production. Benign tumors can be removed surgically and usually do not grow back. Certain types of benign tumors may represent an early stage in the development of malignant tumors.

Cells from a **malignant** tumor separate and travel through the blood stream or lymph channels to other parts of the body and establish satellite tumors called metastases. Although they intrude into normal tissues made up of other types of cells, they maintain their own characteristics, continue abnormal growth, and continue to send out "seed" cells. This is how cancer spreads rapidly throughout the body. Cancer cells seem to be able to grow anywhere in the body. Different kinds of cancers grow at different rates and respond to different treatments. All produce abnormal tissue that displaces normal cells, prevents them from getting proper nourishment, and eventually destroys them.

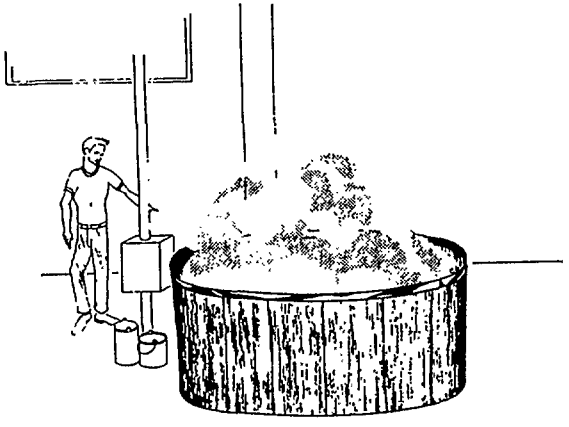
There is no scientific evidence that cancer is contagious—that it can be "caught" from a person who has it. However, the hereditary make-up of an individual has some influence upon the chances of getting cancer. More cancer is found in persons who are related to others who have or have had cancer. Some 1% or 2% of all cancers occur in people who are essentially destined to die of cancer as a result of inherited factors. Another 20% to 25% of cancers result from spontaneous changes or mutations. Other cancers result from environmental agents such as sunlight, man-made or natural radiation, viruses, or chemicals (again, both natural and man-made) in food, water, air, or drugs. These agents are called carcinogens.

CARCINOGENS

This booklet is concerned with chemical carcinogens, and more specifically, with chemical carcinogens which may be found in the workplace. Chemical carcinogens may enter the body through the skin, through the lungs while breathing, or through the digestive system if they are accidentally or intentionally eaten. They may be either direct acting or indirect acting.

A ***direct acting carcinogen*** usually causes cancer at the site of exposure. For example, bis(chloromethyl) ether (BCME) when inhaled, causes cancer of the lungs; skin contact with certain coke oven emissions causes skin cancer.

Indirect acting carcinogens are chemically changed by digestion or utilization by the body (metabolization) into other substances called metabolites. Benzidine compounds, for instance, may enter the body through the skin or through the lungs but they do not cause lung or skin cancer. Instead, metabolites of these compounds are eliminated from the body in the urine. These metabolites may cause changes in the lining of the urinary bladder which can result in bladder tumors and bladder cancer.



The most frequently found cancer in workers handling textile dyes and printing agents is cancer of the urinary bladder.

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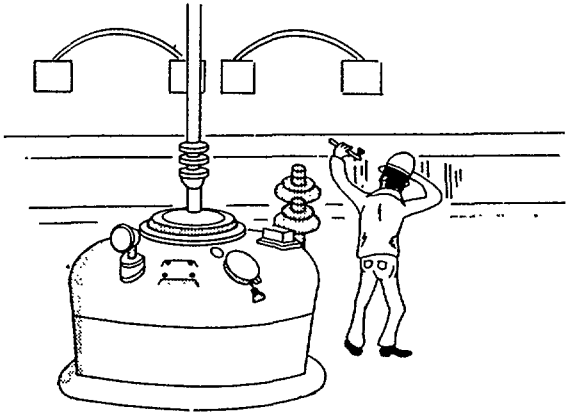
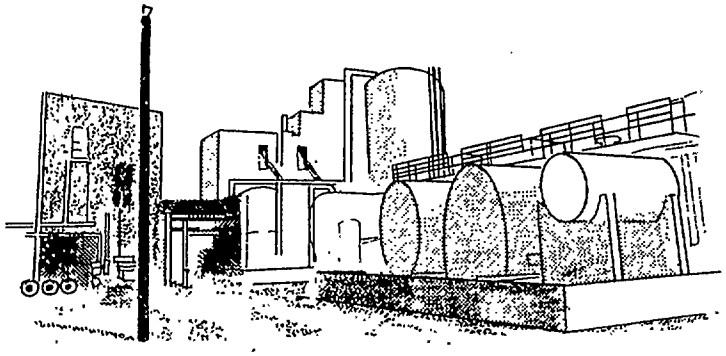
Carcinogens differ in the length of time it takes for cancer to develop after sufficient exposure has occurred. This is called a **"latent" effect,** and the length of time is called the "latency period." Although some cancers may develop within a year or so after exposure, bladder cancer from benzidine may not be evident until twenty to forty years after exposure. Workers who may have started their careers but only worked a short time as dyemakers may develop bladder cancer fifteen or more years after their last contact with the dyemaking chemicals.



Cancer in dyestuff workers develops 20 to 40 years after the first exposure to benzidine, magenta, auramine, etc.

Combinations of certain agents sometimes have what is known as a **"synergistic"** effect—the effect of the combination is greater than that which would be expected from the sum of the individual components. In other words, if a cup of detergent can clean 15 pounds of clothing and a cup of a different detergent can clean 10 pounds, then it would be expected that a cup of each detergent in the same washer would clean 25 pounds of clothing. If, however, the combination of detergents actually cleans 30 pounds, they are called synergistic. This same effect has been found with carcinogens; that is, certain combinations of agents are found to induce a greater than anticipated incidence of cancer or to reduce the latency period. In addition, exposure to some carcinogens and certain normally noncarcinogenic agents (either together or at different times) may shorten the latency period or increase the incidence of cancer.

Carcinogens may have other health effects. They may cause dermatitis, chemical skin burns, eye and skin irritation, damage to lungs and other organs, etc. These symptoms are usually the result of exposure to high concentrations of the materials and usually occur quite soon or immediately after exposure. Some carcinogens may also affect the reproductive systems of exposed workers. There is evidence that wives of workers exposed to vinyl chloride monomer have a higher than normal number of miscarriages. This may be due to abnormal sperm cells produced by their husbands. Experiments have also shown that pregnant animals exposed to some carcinogens develop cancer in both the mother and fetus.



Wives of vinyl chloride workers have a higher than average rate of miscarriage.

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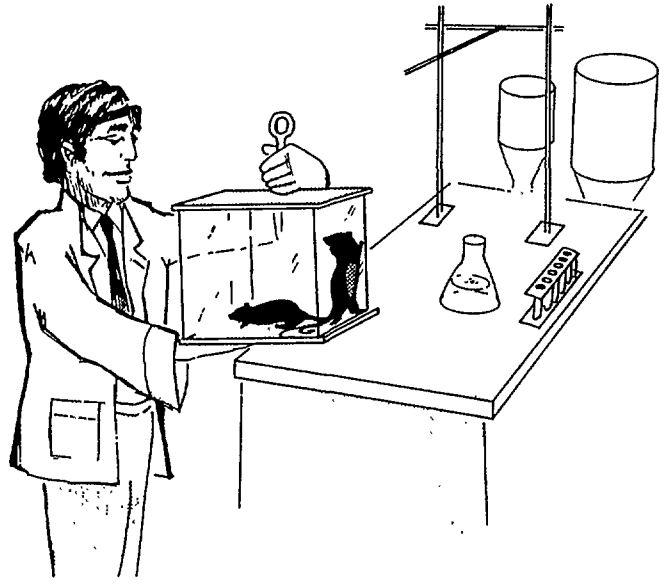
RECOGNITION OF OCCUPATIONAL CARCINOGENS

There is no simple method to determine which chemicals are carcinogens. Several occupational carcinogens that are known to produce cancers in humans were discovered by "epidemiologic studies" of workers who had contracted the disease. If cancer is found more frequently in persons working with certain materials than in persons having far less or no exposure, these materials are assumed to be carcinogens. To make this comparison, a group of workers are carefully matched with others (usually from the general population) as to age, race, sex, smoking habits, and the specific time period of the workers' exposure. This is called a "cohort" study. Many other factors and studies must be considered before a substance is definitely proved carcinogenic. Sometimes the occurrence of a rare form of cancer will help pinpoint workers at risk. This is true for vinyl chloride which causes "angiosarcoma" in the liver and for bis(chloromethyl) ether which causes "oat cell" cancer in the lungs.

Since the average time lapse for the development of chemically induced cancer is about 20 years, measures must be taken to prevent further human exposure as soon as a carcinogen becomes known. Even so, such measures may not be effective for those who already had previous contact with the substance but not enough time has elapsed for symptoms of the disease to develop. Furthermore, in our society workers move frequently, especially in their early years, and employment records are often lost or destroyed, making it very difficult to locate many who have had previous exposure.

There are thousands of chemicals in common use, and an estimated 500 to 1000 new compounds are introduced into the environment every year. It is impossible to make thorough studies of the carcinogenic potential of each one of them. The 1976 NIOSH Registry of Toxic Effects of Chemical Substances contains over 22,000 substances which have been cited as producing some form of toxic effect on animal life. These include over

1900 for which at least one positive test result for carcinogenicity has been obtained. These are mostly results of the traditional screening methods which expose laboratory animals, usually rats or mice, to whatever substance is being tested.



Animal testing is used for early detection of cancer hazards.

In almost all cases (arsenic is one exception) chemicals shown to be carcinogenic in man through epidemiologic studies have also been found to be carcinogenic in animals by appropriate tests. This does not mean that all compounds which are carcinogenic for animals are also human carcinogens; however, such materials should be considered as potential carcinogens for man. All evidence must be carefully weighed on an individual basis before concluding that a given chemical is a carcinogenic hazard to man. Since the time lapse for induction of cancer in small rodents is one to three years, animal testing may be useful for early detection of a cancer hazard. Data on cancer in experimental animals has been used to establish several occupational health regulations in the United States.

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New screening methods are being developed which require only a few days or weeks to provide preliminary results. These are called "in vitro" or "short term" tests. Various types of cells growing in laboratory cultures are treated with a carcinogen-suspect agent to determine if subsequent growth is normal or abnormal. Early evidence shows that nearly 90% of chemicals found to be carcinogens by animal and/or human data give positive results (abnormal growth) in one or more short term tests. One of the most studied tests of this type is called the Ames Salmonella mutagenesis system, or simply, the Ames test. At present, none of these short term tests can be used to establish conclusively whether a compound will or will not be carcinogenic in humans or animals. Positive results suggest that extensive testing of the chemical be done in long-term animal studies. Negative results suggest, but do not prove, the safety of the compound.

Although there is much controversy as to the precise scientific definition of a carcinogen, the term must be defined for regulatory purposes. Therefore, based on general (but not unanimous) agreement among scientists, OSHA considers a chemical to be a carcinogen if properly designed studies show that exposure to the chemical causes cancer in:

humans
two different animal (mammal) species
one animal species if the results are duplicated in separate studies
one animal species if the results are supported by multi-test evidence of mutagenicity

The expression "multi-test evidence of mutagenicity" refers to the short term tests discussed in the previous paragraph.

EXPOSURE LIMITATIONS

The American Conference of Governmental Industrial Hygienists has established a "Threshold Limit Value" (TLV) for over 400 substances. These values refer to levels of airborne concentrations of substances which represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. The threshold limits are based on the best available information from industrial experience, from human and animal experimental studies, and when possible, from a combination of all three. The values are reviewed annually for additions and revision as new information becomes available. The values assigned in 1968 were those promulgated by OSHA as a Federal standard in 1971 (presently 29CFR 1910.1000) to limit the maximum allowable exposure of employees to these compounds.

There is a great difference of opinion among scientists with regard to how much exposure to a given carcinogen is required to cause cancer. Some believe that a single asbestos fiber, much smaller than the eye can perceive, can initiate a cancerous growth in the lung. Others have observed that vinyl chloride reacts with a noncellular substance which is produced and secreted in the body and that vinyl chloride will not attack the cells until this substance is totally used up. Therefore, a worker would not incur cancer as long as the exposure to vinyl chloride was below a certain threshold: the level required to deplete this substance from the body. It may well be that both opinions are correct. Nonetheless, at present, there is no established scientific method to determine threshold levels for chemical carcinogens, even if such thresholds do exist.

To add further complications, we are exposed to many carcinogenic agents, not only in the workplace, but also away from work in the air we breathe, the food we eat, and the water we drink. Because the agents in the environment and those in the workplace (and these can be different chemicals) may attack the same cells, it is possible that many persons have already received doses greater than any presumed threshold for any single carcinogen. This is especially true for people who are heavy smokers. Consequently, any small exposure to a chemical carcinogen in the workplace could result in an increased risk of cancer. In consideration of this, the National Institute for Occupational Safety and Health strongly maintains the position that it is not currently possible to demonstrate safe levels of exposure to chemical carcinogens. Therefore, **exposure to any known or suspected carcinogen must be reduced to the lowest level possible by whatever means available.**

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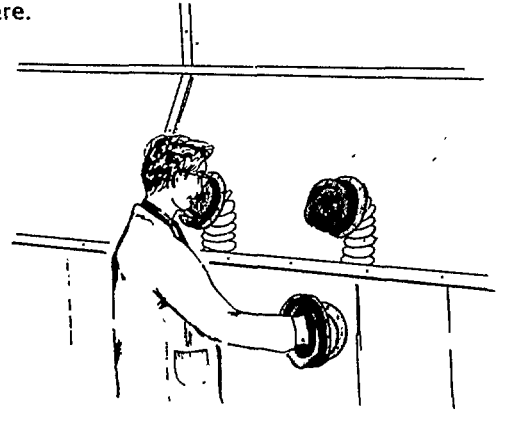
PROTECTION FROM EXPOSURE TO CARCINOGENS

There are four basic methods of limiting employee exposure, and none of these is a simple management decision.

The ***use of an alternative noncarcinogenic material*** is the best method. Changes in product performance, processing, availability of materials, economics, by-products, etc. must be considered. However, more critical, unless the toxic effects of the alternative have been thoroughly evaluated, a seemingly safe replacement, after many years of use, may be found to induce other serious health effects.

Containment or ***isolation of the process*** is the second method preferred. Here, noncarcinogenic chemicals are charged to processing equipment, reacted to form a carcinogen, which is further reacted with other materials to form noncarcinogenic end products, all within the closed system of the process equipment. Local ventilation (hoods or suction lines) should be used to ensure that possible leaks, such as from packing glands or seals of stirrers and pumps, do not allow the carcinogen to enter the environment. Another method is to maintain the process equipment at a slight vacuum so that any leakage is that of external air into the equipment. A variation of this is to enclose (isolate) the process equipment in an enclosure or room which is at a lower pressure than the outside atmosphere.



A glove box is one way to isolate a process.

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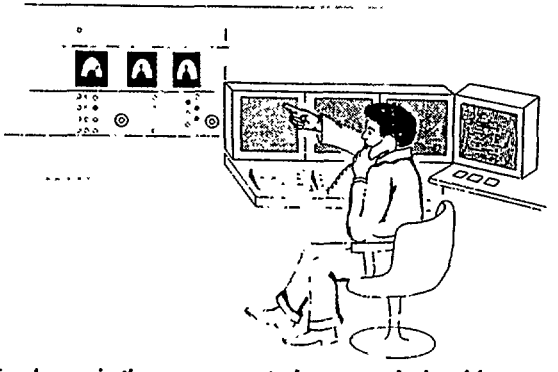
A third alternative is the ***isolation of employees.*** It frequently involves the use of automated equipment operated by personnel observing from a closed control booth or room. The control room is maintained at a greater air pressure than that surrounding the process equipment so that air flow is out of, rather than into, the room.



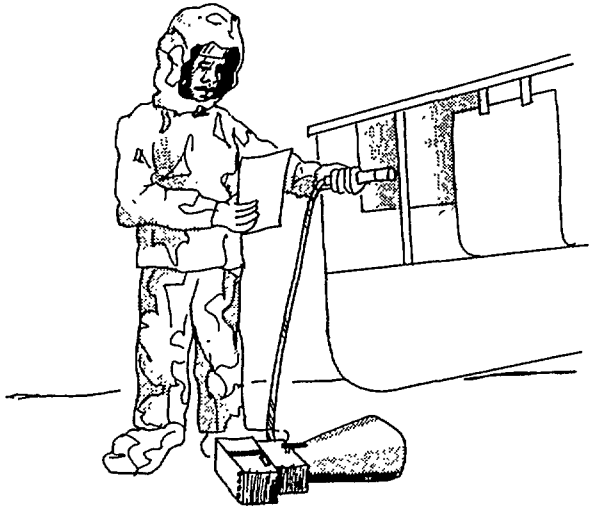
Employees in the process control room are isolated from a harmful environment and exposure to toxic chemicals.

The least preferred method is the use of ***personal protective equipment.*** This equipment—respirators, goggles, gloves, barrier creams, air-supplied suits, etc.—should not be used as the only means to prevent exposure during routine operations. The use of personal protective equipment is **required:**

where a leak develops
when a spill occurs
while control mechanisms are being tested, installed, repaired, or are not yet available
where local exhaust at a process equipment opening is insufficient to completely control the escaping substance
while charging carcinogens into otherwise closed systems and where splashing or release of dusts or vapors is likely to occur
when portions of a closed system are impossible to decontaminate prior to opening for maintenance operations
where a breakdown of local controls could result in a serious health hazard
where engineering controls are impossible or inadequate, such as demolition work involving asbestos products

Even though engineering controls are in use, personal protective equipment may be recommended or required as further protection to prevent exposure which may occur from an unknown leak or failure of the control devices. This is especially true where the level of airborne contaminants is not monitored.

Routine surveys should be made by competent industrial hygiene and engineering personnel to ensure that controls are effective. Routine air sampling and swipe samples of work surfaces in and near regulated areas should be used to monitor the effectiveness of controls and work practices in preventing dispersion of the carcinogens. For some substances, analysis of the blood, sputum, urine, or specific body tissues may show when workers have been exposed to conditions which allowed carcinogens to enter the body.



Routine environmental sampling determines whether harmful amounts of chemicals are present.

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REGULATED SUBSTANCES

Since the original standards promulgated by the Occupational Safety and Health Administration in 1971, only 17 new health standards have been completed. All are concerned with chemical carcinogens. The first new standard was for asbestos, and while the issue of lung cancer was not stressed, it did focus on the carcinogenic potential of asbestos exposure. In 1974, standards for 14 recognized carcinogens were adopted; in 1975, the standard for vinyl chloride was adopted; and, in 1976, the standard for coke oven emissions was adopted. Standards for two other compounds, beryllium and arsenic are now in the rulemaking process. This shows OSHA's great concern for health effects related to exposure to occupational carcinogens.

The table at the end of this section contains the names, synonyms, descriptions, principal use, and health effects of the 14 compounds first regulated in 1974. Organic chemicals have complicated, strange, and frequently long, almost unpronounceable names. They also have many synonyms and common names based on how the chemical is used or how it was discovered. The synonyms for the regulated materials are those listed in the "NIOSH Registry of Toxic Effects for Chemical Substances." In addition, some of these materials may be marketed under other trade names, or are given proprietary code names in establishments where they are used.

SUMMARY OF THE STANDARDS

The following discussion is based on OSHA standards issued in 1974 for 14 chemical carcinogens. These standards which are very similar include minimum requirements to prevent the exposure of employees to carcinogens. The complete standards first appeared in the Federal Register, Part III, Vol. 39, No. 20, January 29, 1974. A fairly comprehensive discussion of the standards (pp 3756-3760) precedes the formal presentation. The following is general information only and should not be considered as a substitute for any provisions of the Occupational Safety and Health Act or for any rules or regulations issued by the Occupational Safety and Health Administration.

At present, the standard (29CFR 1910.1005, Subpart Z) for MOCA has been remanded by the courts due to an error which occurred in the manner by which the standard was processed. This means that employers cannot be cited for violation of the standard itself. However, the health effects are known, and employers are obligated by the general duty clause of the OSH Act to maintain workplaces "... free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees. . ." Furthermore, many states have adopted this standard as part of their occupational safety and health codes, and violations are cited by the state authorities. It is the intent of OSHA to institute proper proceedings to make this standard enforceable; therefore, it is advisable for industries to operate in compliance with it.

These standards apply to all areas in which the compounds are manufactured, processed, repackaged, released, handled, or stored. Except for labeling requirements, they do not apply to transshipment of these materials.

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The regulations do not apply to liquid or solid compositions which contain **less than 1.0%** by weight or volume of:

alpha-Naphthylamine	1-NA
4,4'-Methylenebis(2-chloroaniline)	MOCA
3,3'-Dichlorobenzidine (and its salts)	DCB
beta-Propiolactone	BPL
Ethyleneimine	EI
2-Acetylaminofluorene	2-AAF
4-Dimethylaminoazobenzene	DAB
N-Nitrosodimethylamine	DMN

The regulations also do not apply to compositions containing **less than 0.1%** by weight or volume of:

Methyl chloromethyl ether	CMME
bis(chloromethyl) ether	BCME
Benzidine	
beta-Naphthylamine	2-NA
4-Aminodiphenyl	4-ADP
4-Nitrobiphenyl	4-NBP

Note: Since it is impossible to completely remove these compounds from many commercial compositions, these limits were adopted as a matter of convenience and not from a consideration of the health hazards. The risk to health from exposure to dilute compositions is less than that of a more concentrated composition, but they are not free from hazard. For example, an employee splashed by a quart of one of the above nonregulated mixtures would be exposed to more of the carcinogen than from a few drops of the pure carcinogen.

The coke oven emissions standard contains regulations concerning the release of alpha- and beta-naphthalene as a result of coking operations.

REGULATED AREAS

A "Regulated Area" must be established by an employer wherever carcinogens are manufactured, processed, used, repackaged, released, handled, or stored. Regulated areas are defined as ***areas where entry and exit is restricted and controlled.*** Only **authorized employees** are allowed in such areas. A daily roster of employees entering regulated areas must be maintained. The rosters, or a summary of the rosters, must be kept for 20 years. If the employer goes out of business without a successor, these rosters must be sent by registered mail to the Director of NIOSH.

Entrances to regulated areas must be posted with signs stating:

CANCER-SUSPECT AGENT
AUTHORIZED PERSONNEL ONLY

Signs and instructions informing employees of the procedures that must be followed in entering and leaving a regulated area must be posted at the entrance to, and exit from, regulated areas.

The standards **prohibit** the following in regulated areas:

drinking beverages or storage of beverage containers
eating or storage of food
use or storage of cosmetics
smoking or storage of smoking materials
chewing of tobacco or other products for chewing or storage of such products.



These are all forbidden in regulated areas.

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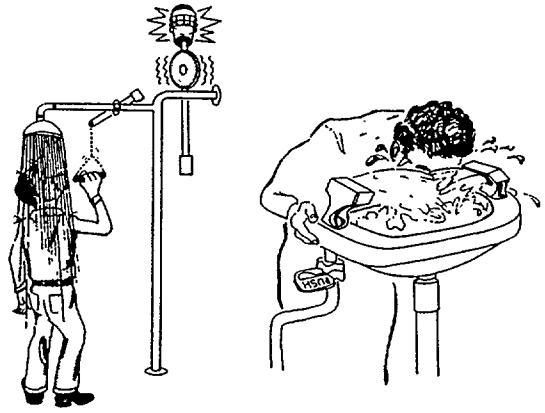
Where employees are required to wear protective clothing and wash or shower, the employer must provide clean change rooms and washing and shower facilities. It is especially important that employees use these facilities before leaving at the end of the work shift. Toilets in regulated areas must be in a separate room.

Except for outdoor systems, regulated areas must be maintained at a lower atmospheric pressure than the surrounding nonregulated areas. In other words, ventilation must be such that air cannot move from the regulated area into nonregulated areas. Equipment, materials, or other items taken into, or removed from, a regulated area must be moved in such a manner that the nonregulated areas do not become contaminated by the carcinogens. Procedures for decontamination of materials, equipment, and the decontamination accessories must be developed and used. Except in areas where BCME, CCME, BPL, and EI are used, dry mopping and sweeping are prohibited.

Emergency deluge showers and eyewash fountains supplied with potable water must be located near, within sight of, and on the same level as locations where a direct exposure to carcinogens having corrosive or highly irritating properties (BPL and EI) would most likely occur as a result of equipment failure or from improper work practices.



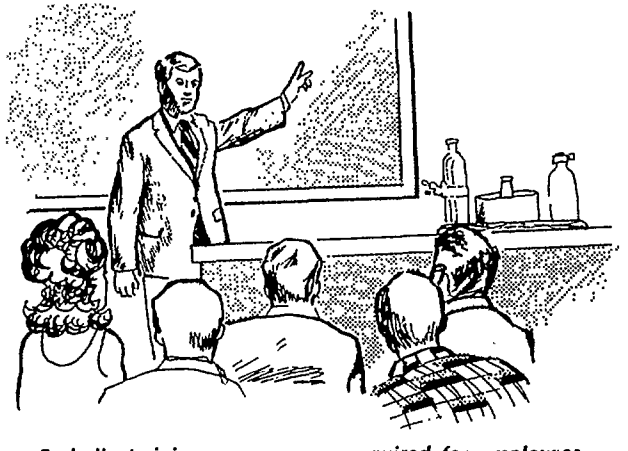
Emergency shower and eye wash facilities must be present where corrosive or highly toxic chemicals are used.

AUTHORIZED PERSONNEL

Authorized personnel are those employees who have been ***specifically assigned*** by the employer with ***duties which require them to work in regulated areas. Before being allowed to enter a regulated area, an employee must have proper training.*** This training must include at least the following topics:

an explanation of the carcinogenic hazards and other toxic effects the compound may cause
operations which could result in exposure to the carcinogen
information to help recognize and estimate conditions which might result in the release of the carcinogen
emergency practices and procedures, including the specific role of the employee in these procedures
decontamination practices and procedures
the purpose for the medical surveillance program, the scope of the examination, and the meaning of the results, and any appropriate methods of self-examination
the purpose and use of specific first aid procedures

This information must be reviewed at least once a year after the first indoctrination. Emergency procedures must be posted, and employees must become familiar with the terms used and must practice the actions to be taken.



Periodic training programs are required for employees working in regulated areas.

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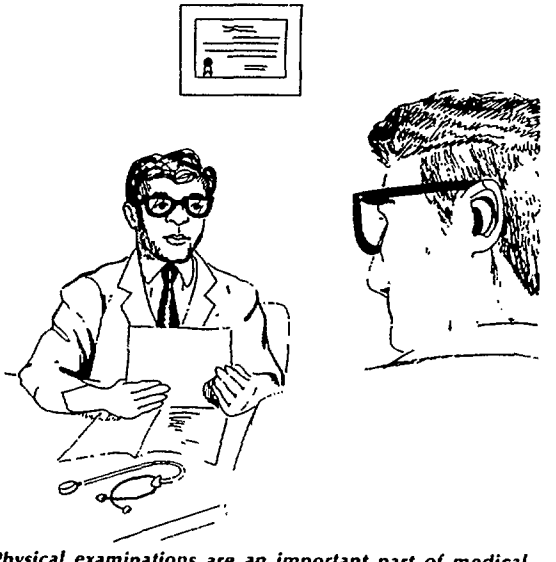
In addition to training, personnel assigned to a regulated area must have a pre-assignment **physical examination** and must be enrolled in a **medical surveillance program** (at no cost to the employee). This examination must include consideration of the history of the employee and the employee's family, the employee's occupational background, genetic factors, and other significant information concerning the employee's environment and lifestyle. This information must be included in the employee's medical record file. From this background and other medical tests the examining physician must consider if there are conditions which may increase the susceptibility to cancer. The physician is required to furnish the employer a statement of the employee's suitability for employment where there is possible exposure to carcinogens and other hazardous substances. The medical examination must be repeated at least once a year. Complete records of these medical examinations must be maintained by the employer for the duration of the employee's employment. Upon termination of such employment, or in the event that the employer goes out of business without a successor, the records (or notarized copies) must be forwarded to the Director of NIOSH. Records must be provided upon request of an employee or former employee, to a physician designated by the employee or to a new employer.

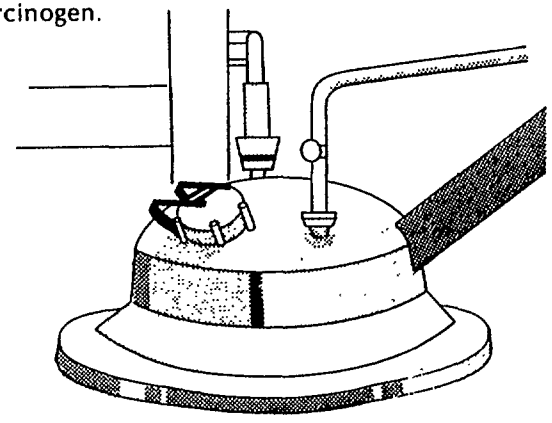


Physical examinations are an important part of medical surveillance programs.

REGULATED SYSTEMS

Specific regulations apply to closed, isolated, and open vessel system operations.

Closed system operations are those in which the walls of the tanks, pipes, reactors, or other equipment prevent the release of a carcinogen.



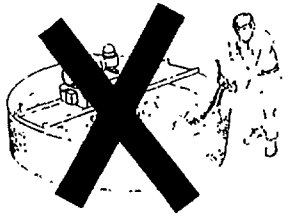
A closed system — reactor vessel.

An ***isolated system*** is one which is fully enclosed in a structure such as a closed room, a glove box, or a laboratory hood which would prevent the carcinogen from entering the environment if the container in which it is held should leak or spill.



A laboratory hood is one isolated system.

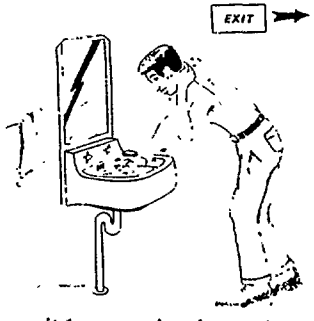
An ***open vessel system*** is one in which the carcinogen is in an open container and not in an isolated system nor in any other system which will prevent the carcinogen from entering the atmosphere. **Operations in open vessel systems are prohibited.**



Open vessel operations are forbidden.

Employees working with a carcinogen in an isolated system, such as a glove box, must wash their hands and arms at the end of the assigned task and before starting other duties not associated with the isolated system.

If authorized employees enter a regulated area where carcinogens are stored in sealed containers or are contained in a closed system with all sample ports or openings closed, they are required to wash hands, forearms, face, and neck each time they leave the regulated area and before engaging in other activities. The wash station must be located near the point of exit. Because BPL and EI evaporate very rapidly, washing on exit after exposure, though recommended, is not required.



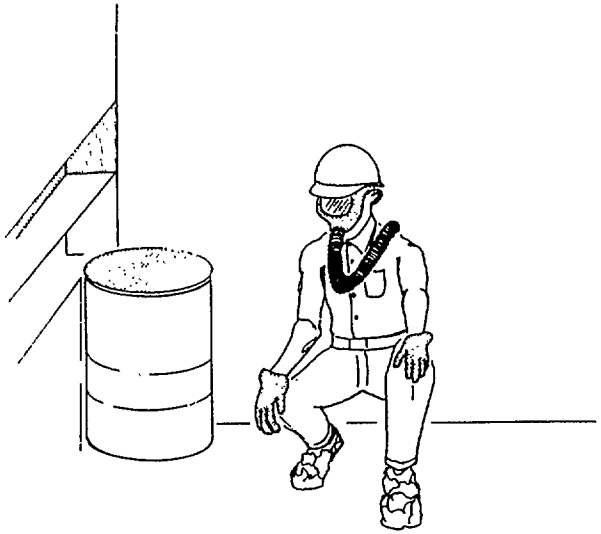
Washing on exit from regulated areas is required.

BON - 03242

In operations involving laboratory type hoods or in locations where carcinogens are transferred, charged, or discharged from one normally closed system to another, the following are required:

Each operation must be provided with continuous **local exhaust ventilation** so that the air movement is always from ordinary work areas and toward the operation.

Before entering the regulated area where transfer operations occur, employees must be wearing **full body protective equipment,** such as smocks, coveralls, or long-sleeved shirts and pants, shoe covers, and gloves. Hair coverings and soft, bump, or hard hats, as appropriate, are also recommended. Protective clothing should be worn in the most effective manner to prevent exposure; i.e., sleeves rolled down and shirts, smocks, or coveralls completely buttoned, snapped, or zipped.



Protective clothing and equipment must be worn properly if it is to be effective.

BON - 03243

Respiratory protection is required for employees performing carcinogen transfer. Where the carcinogen is normally solid at room temperature, has a negligible vapor pressure, and has no acute health affects, half-face, filter type respirators for dusts, mists, and fumes are required for minimum protection. Required protection for volatile carcinogens which are corrosive or irritating to the skin, eyes, or mucous membranes (BCME, CCME, BPL, and EI) is a full face, supplied-air respirator of the continuous flow or pressure-demand type.

Whenever employees leave the regulated area, they must remove and leave their protective equipment and clothing in the change room at the point of exit. At the last exit of the day, the used protective clothing and equipment must be placed in impervious containers at the point of exit for subsequent decontamination or disposal. The containers must be properly labeled as discussed later under "Identification of Container Contents."

Employees must wash their hands, forearms, face, and neck at a place close to the exit whenever they leave a regulated area, and before starting other activities. At the last exit of the day, employees must shower. Where employees are working with volatile carcinogens (BCME, CMME, BPL, or EI), washing and showering are not required, but are recommended.

Drinking fountains are prohibited in regulated areas where transfer operations are performed.



Vacuums with high-efficiency filters are recommended for cleanup.

EMERGENCIES

In case of an emergency, where due to unforeseen circumstances a release of and exposure to a carcinogen may occur, all areas which may be affected must be evacuated and emergency procedures started immediately. Hazardous conditions created by the emergency must be eliminated and all possibly affected areas must be decontaminated before normal operations are resumed.

Special medical surveillance by a physician must be started within 24 hours for all employees present in the potentially affected area at the time of the emergency. Any employee known to have contact with the carcinogen must shower as soon as possible unless this is inadvisable because of physical injuries.

A report of the incident must be made to the nearest OSHA Area Director with 24 hours, and a written, detailed report must be filed within 15 days at the same office.

BON - 03244

MAINTENANCE AND DECONTAMINATION

In areas where direct contact with carcinogens may occur, such as where leaks or spills are cleaned up, or where contaminated systems or equipment are repaired or maintained, employees must wear clean, impervious garments, including gloves, boots, and continuous air-supplied hoods.

Entrances to areas where such work is performed must be posted with signs stating:

CANCER-SUSPECT AGENT EXPOSED IN THIS AREA
IMPERVIOUS SUIT INCLUDING GLOVES, BOOTS, AND AIR-SUPPLIED HOOD REQUIRED AT ALL TIMES
AUTHORIZED PERSONNEL ONLY

The protective garments and hoods must be decontaminated **before** they are removed, and employees must shower after removing them.

IDENTIFICATION OF CONTAINER CONTENTS

The contents of containers holding carcinogens or materials or equipment contaminated by carcinogens and which are only accessible to, or handled by, authorized or properly trained employees may be identified by names or codes for the carcinogen familiar to the employee and the amount (percent) contained. If the container is to be accessible to, or handled by, nonauthorized or untrained personnel, the carcinogen must be identified by the full chemical name and the Chemical Abstracts Service Registry number. Containers must have the warning "CANCER-SUSPECT AGENT" directly under or next to the contents identification. If the carcinogen has any other health hazards, such as corrosive or irritating properties, these must be indicated on the label. If appropriate, the label must also state which parts of the body are particularly sensitive or likely to be affected.

BON - 03245

OTHER STANDARDS

As stated earlier, the requirements of these standards are quite general, but are designed to control the carcinogens so that employees will be protected as much as possible from exposure to cancer-suspect agents. As ongoing research discloses other cancer-suspect materials, it is recommended that precautions similar to these standards be utilized to prevent employee exposure. The two subsequent standards promulgated by OSHA for vinyl chloride and coke oven emissions are very specific and too detailed for discussion in this booklet.

FURTHER INFORMATION

NIOSH "Current Intelligence Bulletins" will be issued whenever human cancer-suspect agents are confirmed. These Bulletins, as well as other information about the health effects of the materials, may be obtained from Regional Offices of NIOSH and OSHA. Addresses of these offices are printed below.

Other agencies from which information about cancer and carcinogens may be obtained are:

The American Cancer Association
777 Third Ave.
New York, N.Y. 10017
(or your local chapter)

The National Institutes for Health
The National Cancer Institute
Bethesda, Maryland 20014

REGULATED CARCINOGENS

Listed in order of appearance in the Code of Federal Regulations (CFR) with Chemical Abstracts Service (CAS) numbers.

Asbestos (CAS 1332214) (29 CFR 1910.1001)

Synonyms: Actinolite, Amianthus, Amosite, Amphibole, Anthrophyllite, Ascarite, Chrysotile, Crocidolite, Tremolite

Description: Fibrous minerals having heat and chemical resistance.

Route of Entry: Inhalation.

Use: Long fibers: Fireproof garments, curtains, shields, clutch facings, and brake linings; filter media.

Short fibers: Insulating boards, shingles, pipe coverings, molded products, reinforcement of plastics, and cements.

Health Hazard: Causes asbestosis, lung and intestinal cancer, and mesothelioma.

Exposure Limits: 2 fibers (longer than 5 micrometers) per cubic centimeter of air.

BON - 03246

4-Nitrobiphenyl (CAS 92933) (29 CFR 1910.1003)

Synonyms: 4-NBP, p-nitrobiphenyl, p-nitrobiphenyl, 4-nitrodiphenyl, 4-nitrodiphenyl, 4-phenyl-nitrobenzene, PNB

Description: White, needle-like crystals.

Route of Entry: Inhalation and skin absorption.

Use: Not in current production or use except in cancer research laboratories.

Health Hazard: May induce bladder tumors in humans. Workers simultaneously exposed to 4-NBP and 4-ADP have developed bladder tumors. Tumors have also been induced in dogs.

Exposure Limits: Solid or liquid mixtures containing more than 0.1% by weight or volume.

alpha-Naphthylamine (CAS 134327) (29 CFR 1910.1004)

Synonyms:
1-NA
naphthalidam
naphthalidine
naphthylamine
1-naphthylamine
1-aminonaphthalene
Antioxidant - MB
C.I. Azoic Diazo Component 114
Fast Garnet Base B

Description: White, needle-shaped crystals, having an unpleasant odor.

Route of Entry: Inhalation, skin absorption, ingestion.

Use: Preparation of dyes and antioxidant for rubber, paint, plastics, and petroleum. Also used in manufacture of herbicides.

Health Hazard: Normally contaminated with 2-NA. Suspected to induce bladder tumors in humans; several metabolites have been shown to induce tumors in rats and mice.

Exposure Limits: Solid or liquid mixtures containing more than 1.0% by weight or volume.

BON - 03247

4,4'-Methylenebis(2-chloroaniline) (CAS 101144)

(Note: 29 CFR 1910.1005 revoked 20 August 1976)

Synonyms:
MOCA
DACPM
di-(4-amino-3-chlorophenyl)methane
methylene-4,4'-bis(o-chloroaniline)
p,p'-methylenebis(alpha-chloroaniline)
p,p'-methylenebis(o-chloroaniline)
3,3'-dichloro-4,4'-diaminodiphenylmethane
4,4'-diamino-3,3'-dichlorodiphenylmethane
4,4'-methylene(bis)chloroaniline
4,4'-methylenebis(o-chloroaniline)
Curalin M
Curene 442
Cyanaset

Description: Yellow or light tan solid usually in pellets or small clumps or powder form.

Route of Entry: Inhalation and skin absorption.

Use: Used widely as curing agent for urethane liquid-castable elastomers and foams; also as curing agent for epoxy and epoxy-urethane resins.

Health Hazard: Induces cancer in mice and rats though not conclusively proven carcinogenic for humans.

Exposure Limits: Solid or liquid mixtures containing more than 1.0% by weight or volume.

Methyl chloromethyl ether (CAS 107302)
(29 CFR 1910.1006)

Synonyms: CMME
chloromethyl methyl ether
dimethyl chloroether

Description: Colorless corrosive liquid. Vapors smell of hydrogen chloride and formaldehyde.

Route of Entry: Inhalation and skin absorption.

Use: Ion exchange resins, manufacture of polymers, sugar purification, gelatin production, bactericides, drug to lower cholesterol, as analytical standard.

Health Hazard: Induces lung cancer in humans. May cause coughing and nausea. Skin contact can cause burns, chapping, and dehydration. Normally contaminated with BCME in commercial product. Produced neoplasms and cancer in mice.

Exposure Limits: Solid or liquir mixtures containing more than 0.1% by weight or volume.

BON - 03248

3,3'-Dichlorobenzidine (and its salts) (CAS 91941)
(29 CFR 1910.1007)

Synonyms: DCB
4,4'-diamino-3,3'-dichlorodiphenyl
0,0'-dichlorobenzidine
dichlorobenzidine base
3,3'-dichloro-4,4'-biphenyldiamine
3,3'-dichlorobiphenyl-4,4'-diamine
3,3'-dichloro-4,4'-diaminobipheny
C.I. 23060

Description: Crystalline solid varying in color from gray to purple.

Route of Entry: Skin absorption.

Use: Preparation of yellow pigments for printing inks, textile dyes, plastics, crayons (dyes are non-toxic); curing agent for urethane plastics.

Health Hazard: Causes cancer of liver, bladder, and breast in rats, mice, hamsters, and dogs. No documented human experience since workers usually are exposed to other carcinogens as well. Is found in urine of workers with minimal exposure.

Exposure Limits: Solid or liquid mixtures containing more than 1.0% by weight or volume.

bis-Chloromethyl ether (CAS 542881) (29 CFR 1910.1008)

Synonyms: BCME; bis-CME; chloro(cholromethoxy)methane; chloromethyl ether; dimethyl-1,1-dichloroether; sym-dichloro-dimethyl ether; sym-dichloromethyl ether

Description: Colorless liquid with a suffocating odor.

Route of Entry: Inhalation

Use: Alkylating agent. May form spontaneously from reaction of hydrochloric acid and formaldehyde; therefore, traces may be found in cotton finishing operations, and in manufacture of flameproofing agents, insecticides, bactericides, antibiotics, dispersing agents, water repellants, and rubber. NOTE: Normally present as a contaminant in methyl chloromethyl ether.

Health Hazard: Induces lung cancer in humans, rats, and mice.

Exposure Limits: Solid or liquid mixtures containing more than 0.1% by weight or volume.

BON - 03249

beta-Naphthylamine (CAS 91598) (29 CFR 1910.1009)

Synonyms: 2-NA; 2-aminonaphthalene; 2-naphthalamine; 2-naphthalenamine; C.I. 37270; Fast Scarlet Base B

Description: White, sometimes reddish solid.

Route of Entry: Inhalation, ingestion, and skin absorption.

Use: Previously widely used as rubber antioxidant and dye intermediate. Not in current use.

Health Hazard: Produces bladder tumors in humans. Also induces cancer in rats, mice, dogs, monkeys, and hamsters. Is usually a contaminant in 1-NA.

Exposure Limits: Solid or liquid mixtures containing more than 0.1% by weight or volume.

Benzidine (CAS 92875) (29 CFR 1910.1010)

Synonyms: 2-amino diphenyl
4,4'-diaminobiphenyl
4,4'-diaminodiphenyl
4,4'-diphenylenediamine
p-diaminodiphenyl
C.I. Azoic Diazo Component 112
Fast Corinth Base B
4,4'-biphenyldiamine

Description: White or reddish-gray solid occuring as crystals, flakes, or powder.

Route of Entry: Skin absorption.

Use: Intermediate in production of sulfur, azo, and aniline dyes; clinical detection of blood; security printing; and quantitative analysis.

Health Hazard: Induces bladder tumors in humans primarily by absorption through the skin. Also carcinogenic to rats and mice.

Exposure Limits: Solid or liquid mixtures containing more than 0.1% by weight or volume.

BON - 03250

4-Aminodiphenyl (CAS 92671) (29 CFR 1910.1011)

Synonyms: 4-ADP
biphenylamine
biphenyline
p-aminobiphenyl
p-aminodiphenyl
p-biphenylamine
p-phenylaniline
xenylamine
(1,1'-biphenyl)-4-amine
4-aminobiphenyl
PAB

Description: Colorless crystals darken to yellowish-brown when exposed to air.

Route of Entry: Ingestion, inhalation, and skin absorption.

Use: Not in production or use since 1955.

Health Hazard: Induces bladder tumors in humans. Also causes cancer in rats, mice, and dogs. Traces are found as contaminant in diphenylamine.

Exposure Limits: Solid or liquid mixtures containing more than 0.1% by weight or volume.

Ethyleneimine (CAS 151564) (29 CFR 1910.1012)

Synonyms: EI
aminoethylene
azacyclopropane
azirane
aziridine
dihydro-1H-azirine
dihydroazirine
dimethyleneimine
dimethylenimine
ethylenimine

Description: Colorless liquid with very strong ammonia odor.

Route of Entry: Inhalation and skin absorption.

Use: Production of rocket and jet fuel; flameproofing, shrinkproofing, stiffening, and waterproofing textiles; production of paper; manufacture of pesticides, resins, and drugs; stabilizer for chlorine-containing resins

Health Hazard: Causes cancer in rats and mice. It is extremely toxic to humans and causes severe skin burns. Inhalation may result in vomiting, inflamation of mucous membranes, or death. Symptoms may be delayed.

Exposure Limits: Solid or liquid mixtures containing more than 1% by weight or volume.

BON - 03251

beta-Propiolactone (CAS 57578) (29 CFR 1910.1013)

Synonyms: BPL
beta-propionolactone
B-Lactone
hydracylic acid, beta lactone
propanolide
Propiolactone
2-oxetanone
3-hydroxypropionic acid lactone
Betaprone

Description: Colorless liquid with a pungent odor.

Route of Entry: Inhalation and skin absorption.

Use: Intermediate in production of acrylic acids, plastics, and esters; used in sterilizing blood plasma, vaccines, tissue grafts, and surgical instruments; used as vapor phase disinfectant.

Health Hazard: Produces tumors in rats, mice, quinea pigs, and hamsters. Readily absorbed through skin.

Exposure Limits: Solid or liquid mixtures containing more than 1% by weight or volume.

2-Acetylaminofluorene (CAS 53963) (29 CFR 1910.1014)

Synonyms: AAF
FAA
2-AAF
2-FAA
2-acetamidofluorene
N-2-fluorenylacetamide

Description: Light tan crystal or powder.

Route of Entry: Inhalation and skin absorption.

Use: Currently used only in laboratories as known carcinogen.

Health Hazard: Metabolites induce cancer in rats, mice, dogs, rabbits, and hamsters; the same metabolite is found in humans exposed to 2-AAF.

Exposure Limits: Solid or liquid mixtures containing more than 1.0% by weight or volume.

BON - 03252

4-Dimenthylaminoazobenzene (CAS 60117) (29 CFR 1910.1015)

Synonyms: DAB
benzeneazodimethylaniline
dimethyl yellow
methyl yellow
N,N-dimethyl-4-aminoazobenzene
N,N-dimethyl-p-phenylazoaniline
p-dimethylaminobenzene
4-dimethylaminoazobenzol
4-dimethylaminophenylazobenzene
4-(N,N-dimethylamino)azobenzene

Description: Flaky, yellow crystal.

Route of Entry: Ingestion, inhalation, and skin absorption.

Use: Has been used as dye and food colorant. Currently used only in cancer research laboratories.

Health Hazard: Has been shown to cause cancer in dogs, rats, mice, and fish.

Exposure Limits: Solid or liquid mixtures containing more than 1.0% by weight or volume.

N-Nitrosodimethylamine (CAS 62759) (29 CFR 1910.1016)

Synonyms:

DMN	nitrous dimethylamide
DMNA	N,N-dimethylnitrosamine
dimethylnitramine	N,N-dimethylnitrosoamine
dimethylnitrosamine	

Description: Yellow Liquid.

Route of Entry: Inhalation and skin absorption.

Use: Was used as solvent and rocket fuel intermediate. Currently used only in cancer research laboratories.

Health Hazard: Produces cancer in rats, mice, rabbits, guinea pigs, hamsters, and fish.

Exposure Limits: Solid or liquid mixtures containing more than 1.0% by weight or volume.

BON - 03253

Vinyl chloride (CAS 75104) (29 CFR 1910.1017)

Synonyms:

chloroethylene	monochloroethylene
chlorethene	Trovidur
chlorethylene	VC
chloroethene	VCM
monochloroethene	Vinyl C monomer

Description: Sweet smelling gas

Route of Entry:: Inhalation.

Use: Raw material for production of plastics.

Health Hazard: Causes cancer of the liver and, less frequently, other organs. Exposure is essentially from inhalation.

Exposure Limits: 1 ppm as 8-hour time weighted average (TWA).

Coke oven emissions (No CAS number) (29 CFR 1910.1029)

Synonym: Coal tar, aerosol.
Description: Usually black heavy smoke emitted by coke ovens.

Route of Entry: Inhalation and skin absorption.

Use: Byproduct of process to produce coke from coal. Used as raw material for various chemicals and as a source of fuel.

Health Hazard: Causes skin, lung, kidney, and bladder cancer.

Exposure Limits: 150 micrograms per cubic meter (ug/M³) benzene solubles averaged over any-8-hour period.

BON - 03254

A MANAGEMENT GUIDE TO CARCINOGENS — Regulation and Control

INTRODUCTION

Ongoing cancer research is certain to identify additional carcinogens which will be subject to regulatory procedures. Prudent management policies require constant attention and review of the possibility that chemicals being utilized in any phase of the operations may be found to be carcinogens. This means the composition of all materials entering or produced in your facilities must be known. Where chemicals are being manufactured or used, the impurities of the process chemicals are important, but the intermediates and by-products formed must also be examined. Auxiliary materials such as water treatment compounds, lubricating and cooling compounds, flow control and viscosity regulators, filter media, and analytical reagents are materials which may introduce carcinogens into your establishment. Even janitorial supplies, detergents, sweeping compounds, pesticides, etc. should be considered. These materials should be examined not only to discover ingredients believed to be carcinogens, but those which may have other health hazards as well. Insist that your suppliers provide Material Safety Data Sheets or other technical data describing health and safety properties of the materials you purchase. This is especially true of new or experimental materials which do not have a history of safe use.

Employers must be aware of the consequences of inadvertent or intentional combinations of materials. Two examples involving carcinogen formation are:

Under certain conditions of heat and humidity, hydrochloric acid fumes and formaldehyde vapors will com-

bine to form bis(chloromethyl) ether. Potential for this may exist in laboratories and textile operations.

Mixing cutting oils where one contains inorganic nitrate or nitrite preservatives and the other is stabilized with organic amines may lead to the formation of nitrosoamines. Some nitrosoamines are carcinogens.

This discussion is similar to that in Section I, but is more comprehensive, details the management responsibilities required by the standards, and recommends methods of compliance. These recommendations are, of necessity, quite general. Engineering controls and work practices should be designed specifically for each work situation by competent engineering and industrial hygiene personnel. The philosophy and intent of the carcinogen standards were discussed in an introduction to the publication of the standards. It may be found in the Federal Register, Part III, Vol. 39, No. 29, January 29, 1974.

BON - 03255

REGULATED AREAS

Regulated areas must be established wherever carcinogens are manufactured, processed, used, repackaged, released, handled, or stored. Within 15 days from the establishment of, or change in, a regulated area, a written report must be filed with the nearest OSHA Area Director. This report must include:

a brief description and inplant location of the area(s) regulated and the address of each regulated area

the name(s) and other identifying information as to the presence of carcinogen(s) in each regulated area

the number of employees in each regulated area during normal operations, including maintenance activities

the manner in which the carcinogen(s) are present in each regulated area; e.g., whether it is manufactured, processed, used, repackaged, released, stored, or otherwise handled

Only authorized personnel are permitted to enter regulated areas. A daily roster of employees entering regulated areas must be established and maintained. The rosters or a summary of the rosters must be retained for at least 20 years. These rosters and/or summaries must be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, and the Director of NIOSH or the Secretary of Health, Education, and Welfare. If the employer ceases business without a successor, rosters must be forwarded to the Director of NIOSH by registered mail.

Entrances to regulated areas must be posted with signs bearing the statements:

CANCER-SUSPECT AGENT
AUTHORIZED PERSONNEL ONLY

Signs must also be posted at the entrance to and exit from regulated areas, informing employees of the procedures that must be followed in entering and leaving a regulated area. Lettering

on instructions and signs must be a minimum of 2" in height. Statements appearing on or near a required sign or instructions that contradict or detract from their intended effect are prohibited.

Where carcinogens are routinely handled on a day-to-day basis, it is preferable that regulated areas be separate rooms or buildings with controlled entry. Where carcinogens are used only occasionally or in multi-purpose equipment, however, barricades, curtains, or other means may be used to prevent access and exposure of unauthorized personnel to carcinogens. Except for outdoor systems, regulated areas must be at a negative pressure with respect to nonregulated areas. This may be accomplished by the use of local ventilation. Clean makeup air in equal volume must be used to replace air removed.

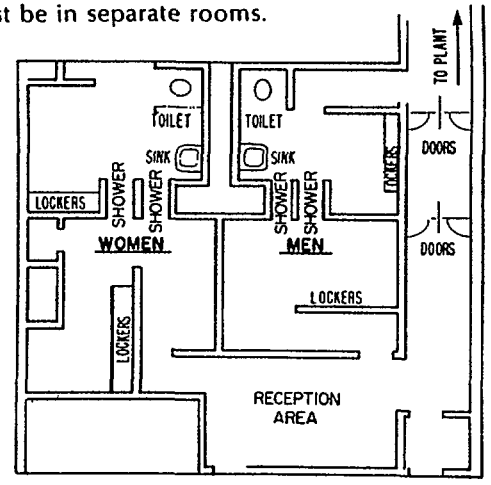
Eating, drinking, smoking, chewing tobacco, and the use of cosmetics are forbidden in regulated areas, as well as the storage of food, beverage containers, cosmetics, and smoking or chewing materials. Equipment, materials, or other items transferred to or from a regulated area must be moved in a manner which does not cause contamination of areas external to the regulated area. Decontamination procedures must be established and followed to remove the carcinogens from the surfaces of materials, equipment, and the decontamination accessories. Except where normally liquid carcinogens (BCME, CCME, BPL, and EI) are handled, dry mopping or sweeping is prohibited. The use of vacuum cleaning equipment is recommended wherever possible.



BON - 03256

For certain operations, authorized personnel are required to wash or shower and change clothing at the point of exit from a regulated area. Washing and shower facilities must comply with section 1910.141(d). In general, this section requires that these facilities must be provided with hot and cold running water (lavoratories may be supplied with tepid running water), cleansing agents, and towels or warm air driers. Receptacles for used towels convenient to the facilities must also be furnished. Washing facilities must be kept in a sanitary condition.

Clean change rooms must be provided in accordance with section 1910.141(e) when protective clothing is required. This section requires that separate storage facilities for street clothes and protective clothing must be furnished. Toilets in regulated areas must be in separate rooms.



Clean change rooms must be maintained to prevent cross-contamination.

Exhaust air from regulated areas must be decontaminated before release into the external environment. Recirculation of decontaminated air into regulated and nonregulated areas is permissible but not recommended unless continuous monitoring and failsafe controls are used to ensure that decontamination is complete. There should be no direct connection between regulated areas and other areas through the ventilation system. Decontamination may be accomplished by use of high-efficiency scrubbers, disposable absolute filters, incineration, etc.

AUTHORIZED PERSONNEL

An "authorized employee" is an employee to whom the employer has assigned specific duties which must be performed in a regulated area. Before entering the regulated area employees must be trained and receive an indoctrination program which will prepare them for these duties. The program must be repeated at least annually and must include but should not be limited to defining:

the nature of the carcinogenic hazards and other toxic effects the compound may cause

the specific operations which could result in exposure to the carcinogen

specific information to aid in the recognition and evaluation of conditions which might result in the release of the carcinogen

emergency practices and procedures, including the specific role of the employee in these procedures

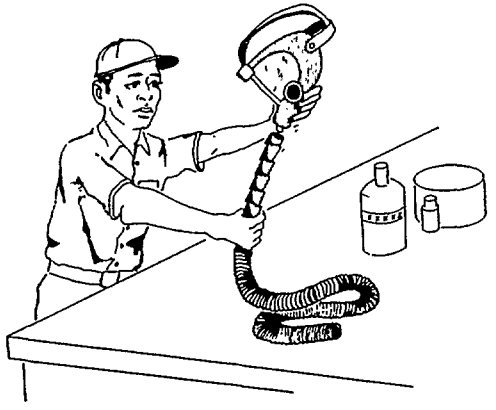
decontamination practices and procedures

the purpose for and application of the medical surveillance program, including any appropriate methods of self-examination

the purpose and use of specific first aid procedures

BON - 03257

Where respirators are required, a respirator program in compliance with section 1910.134 must be established. A detailed discussion of respiratory protection may be found in "A Guide to Industrial Respiratory Protection," HEW Publication No. (NIOSH) 76-189. Eye and face protection must be in compliance with section 1910.133. The employer is responsible for ensuring the adequacy, including proper maintenance and sanitation, of all personal protective equipment whether furnished by the employee or employer. Employees should be instructed in the proper use, care, and limitations of personal protective equipment. All training and indoctrination must be repeated at least annually.



Routine cleaning and maintenance are one part of an effective respirator program.

Emergency procedures must be developed and posted in appropriate areas. Each employee must know and be rehearsed in the specific actions to be performed. In developing emergency procedures it is recommended that, when applicable, local police, fire, or other emergency agencies be consulted and used to the best advantage.

Upon request, all materials pertaining to these programs must be made available to authorized representatives of OSHA or NIOSH.

Medical surveillance is required for all authorized employees including a preassignment physical examination by a physician. The surveillance program should be developed by competent medical personel and must include the recording and consideration of the history of the employee and the employee's family, the employee's occupational background, and any significant genetic and environmental factors. In evaluating the existence of increased risk, the examining physician must consider reduced immunological competence, ongoing treatment with steroids or cytotoxic agents, pregnancy, and cigarette smoking. Any physician who conducts these examinations must furnish the employer a statement of the employee's suitability for employment in the specific exposure.

Complete records of all medical examinations must be maintained for the duration of the employee's employment. When the employee's employment ends, including retirement or death, or in the event that the employer ceases business without a successor, records or notarized true copies must be forwarded to the Director of NIOSH by registered mail. At the request of an employee or former employee, copies of medical records must be furnished to a physician designated by the employee or to a new employer.

BON - 03258

REGULATED OPERATIONS

The standards regulate three types of systems:

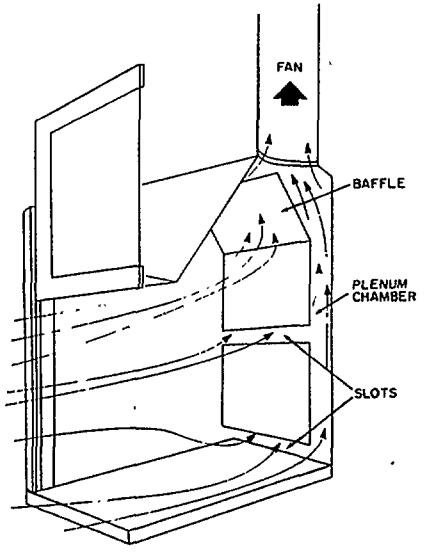
> ***"Open vessel systems"*** are those where carcinogens are contained in an open vessel which is not in an isolated system, a laboratory type hood, nor in any other system affording equivalent protection to prevent the carcinogen from entering regulated areas, nonregulated areas, or the external environment. These operations are prohibited.
>
> ***"Isolated systems"*** are those which consist of fully enclosed structures which prevent entry of carcinogens into regulated areas, nonregulated areas, or the external environment. A glove box is an example of this type of system. Employees working in a glove box or similar structure must wash their hands and arms after completion of the assigned task and before engaging in other activities not associated with the isolated system.
>
> ***"Closed systems"*** are those in which the carcinogen is held in a closed container or processing equipment and the walls of the container or process vessels and piping prevent contamination of regulated areas, nonregulated areas, or the external environment. At each exit from a regulated area containing a closed system, employees must wash hands, forearms, and neck close to the point of exit and before engaging in other activities. Where carcinogens are so volatile that evaporation would occur before routine washing would be effective (i.e., BPL and EI), such washing, though recommended, is not required.

There are specific regulations for operations involving transfer from a closed system, charging or discharging from or to normally closed containers or otherwise opening a closed system. Each operation must be provided with continuous local exhaust so that air movement is from ordinary work areas to the point of operation. This may be accomplished by maintaining the system being charged at a pressure negative to the room pressure, by a permanent local exhaust at the discharge or charge port opening, by a temporary flexible duct (elephant truck) vacuum line, or other appropriate ventilation. Clean

makeup air must be supplied in sufficient volume to maintain the operation of the local exhaust.

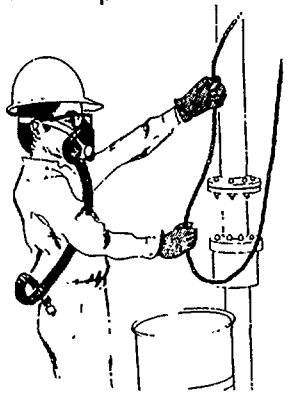
The operation may be performed in a laboratory type hood or similar structure closed on three sides and the top and bottom. It must be designed and maintained so as to draw air inward at an average face velocity of 150 feet per minute with a minimum of 125 feet per minute and constructed in such a manner that an operation involving a carcinogen within the hood does not require the insertion of any portion of the body other than the hands and arms.

Full body protective clothing (smocks, coveralls, or long-sleeved shirts and pants), shoe covers, and gloves must be worn.



BON - 03259

Respirators must be used. If the carcinogen is normally a solid, a half-face, filter-type respirator for dusts, mists, and fumes, or a respirator that provides a higher level of protection must be used. For carcinogens which are normally liquids at room temperature or are corrosive or irritating to the skin, eyes, or lungs (BCME, CMME, BPL, and EI) a full-face, supplied air respirator, of the continuous flow or pressure-demand type is required.



Respirators of the proper type must be used.

The protective equipment and clothing must be removed at the point of exit each time an employee leaves the regulated area. At the last exit of the day, the clothing and equipment must be placed in impervious containers for decontamination or disposal. The containers must be labeled "CANCER-SUSPECT AGENT" and include the name of the carcinogen involved. If there are other known health hazards, the label must include a warning of these hazards and, if appropriate, the parts of the body which are particularly sensitive or affected.

Employees must wash hands, forearms, face, and neck at a place close to the point of exit each time they leave the regulated area and before engaging in other activities. They must shower after the last exit of the day from the regulated area. Where employees work with BCME, CMME, BPL, or EI, washing and showering, though recommended, are not required.

Drinking fountains are prohibited in areas regulated for carcinogens.

EMERGENCIES

When an unforeseen circumstance or set of circumstances results in a release of and possible employee exposure to or contact with a carcinogen, the potentially affected area must be evacuated as soon as the emergency is discovered. Emergency procedures should be started immediately. Any employee known to have contacted the carcinogen must shower as soon as possible unless physical injuries prevent such action. Special medical surveillance by a physician must be started within 24 hours for all employees present in the potentially affected area at the time of the emergency.

The occurrence of any such incident must be reported to the nearest OSHA Area Director within 24 hours. This report should include all facts available at the time, including any medical treatment of affected employees. Within 15 days a written report must be filed with the same office and must include:

the amount of material released, the length of time involved, and how these figures were determined

a description of the area involved and the extent of the contaminated area

the number of employees known to have been exposed or possibly exposed to the carcinogen

any medical treatment given to affected employees and any medical surveillance program implemented

an analysis of the circumstances of the incident and measures taken to prevent future similar releases. When repairs or proposed changes are not completed, a schedule for the completion dates for those actions must be included.

BON - 03260

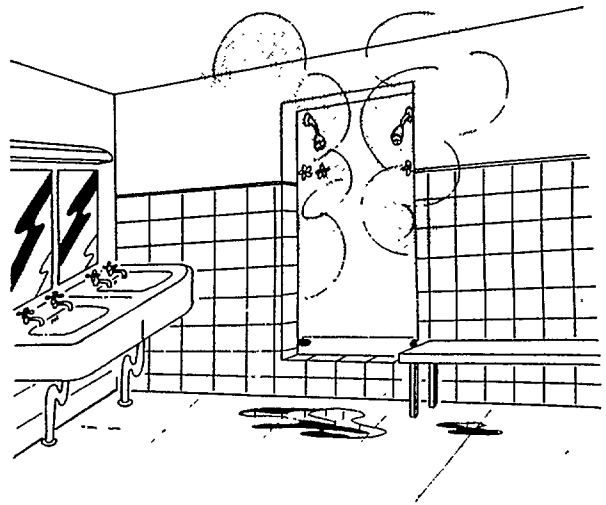
MAINTENANCE AND DECONTAMINATION

For any operation involving work where direct contact with carcinogens is possible, employees must be provided and required to wear clean, impervious gloves, boots, and continuous air-supplied hoods. Such operations include cleanup of leaks or spills and maintenance or repair of contaminated systems or equipment. The respiratory protective equipment and auxiliaries must be in accordance with section 1910.134 (a) through (f).

Entrances to regulated areas where these operations are occurring must be marked:

CANCER-SUSPECT AGENT EXPOSED IN THIS AREA
IMPERVIOUS SUIT INCLUDING GLOVES, BOOTS, AND AIR-SUPPLIED HOOD REQUIRED AT ALL TIMES
AUTHORIZED PERSONNEL ONLY

The protective garments and hoods must be decontaminated before the employee removes them. After removing the garments, the employee must shower.



IDENTIFICATION OF CONTENTS OF CONTAINERS

All containers enclosing carcinogens or materials or equipment contaminated with carcinogens must be properly labelled.

If the containers are accessible to or handled by only authorized or properly trained employees, the contents may be identified by the generic or proprietary name or code for the carcinogen and the approximate amount (percent). When containers are accessible to or handled by untrained and unauthorized personnel, the contents must be identified by the full chemical name and the Chemical Abstracts System Registry Number. All containers must bear the warning "CANCER-SUSPECT AGENT" immediately under or next to the contents identification. If the carcinogen or other components in the container are corrosive or irritating to the body, a warning of such hazard and, if appropriate, the portions of the body particularly sensitive or affected must be stated. Although no required lettering need be more than 1 inch high, it should not be less than 1/2 the size of the largest lettering on the label, but not less than 8 point type in any instance. (The captions for the illustrations in this book are set in 8 point type.) Statements appearing on or near any required label which contradict or detract from the effect of the required warning or information are prohibited.

BON - 03261

RECOMMENDED CONTROLS AND PRACTICES

The most positive method to eliminate exposure to carcinogens in the workplace is to use alternative noncarcinogenic materials. This is not without risk, however, since all the toxicological properties of most chemicals are not known. Exposure to a new, seemingly safe material may later prove to have chronic effects which are detrimental to the health of the worker. If the choice must be made between a carcinogen and a compound which has not been thoroughly tested, it is probably better to utilize equipment and work practices to protect workers against exposure to known hazards.

NIOSH is currently engaged in a major research project to determine methods and controls whereby worker exposure to carcinogens may be reduced or eliminated from specific work situations. The results of this will be published in the form of technical reports as the information becomes available. The following general recommendations are not specifically required by the standards but may be used as good practices in the processing of carcinogenic materials.

Environment

Meticulous housekeeping should be maintained. Frequent vacuum cleaning of the area, including rafters or beams, will prevent accumulation of dusts which may contain or absorb carcinogens. Walls, floors, ceilings, furniture, and other equipment should have nonporous surfaces, or be covered with disposable or easily cleaned material. Areas should be routinely decontaminated.

Where feasible, air contamination should be continuously monitored. Swipe sampling of surfaces should be done routinely. Personal sampling is recommended at frequent intervals to ensure that area monitoring is effective.



Personal sampling is used to determine individual exposures.

BON - 03262

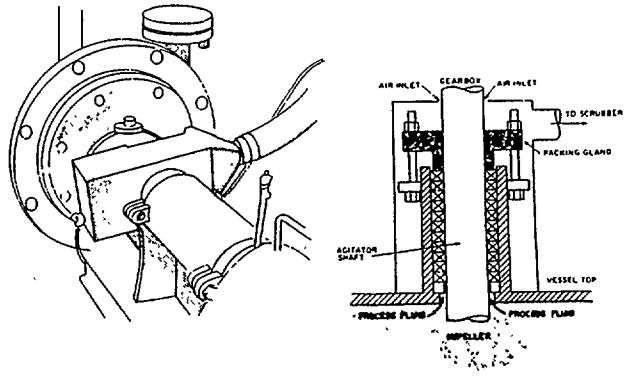
Floor drains should lead directly to a decontamination facility so that drainage can be decontaminated before being mixed with other plant wastes.

Processing

Piping entering and leaving the restricted area should be double valved. Check valves are also recommended to prevent backflow of contaminated materials if a malfunction should occur. Relief valves and tank vents should be connected to high efficiency scrubbers or other closed system components. Overflow outlets should discharge either to a holding tank for recycling or decontamination or directly to a decontamination facility.

Self-priming and/or sealless pumps should be used where possible. It is preferable to operate process equipment under negative pressure to prevent contamination of the restricted areas.

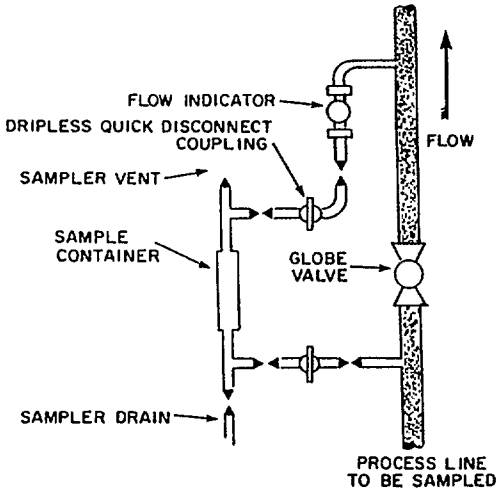
Agitator and other movable or rotating shafts entering the process equipment should be sealed with leak resistant glands. Further protection is afforded where the glands, pump seals, etc. are shrouded and provided with local exhaust ventilation.



Shrouded packing glands provide further protection.

Separations should be made in closed systems. Where possible, vacuum filtration or centrifuging with a Byrd type centrifuge is preferable. If a press is necessary it should be isolated in a separate room under negative pressure. Control of liquid/liquid separations may be possible by in-line sensing of density or conductance differences.

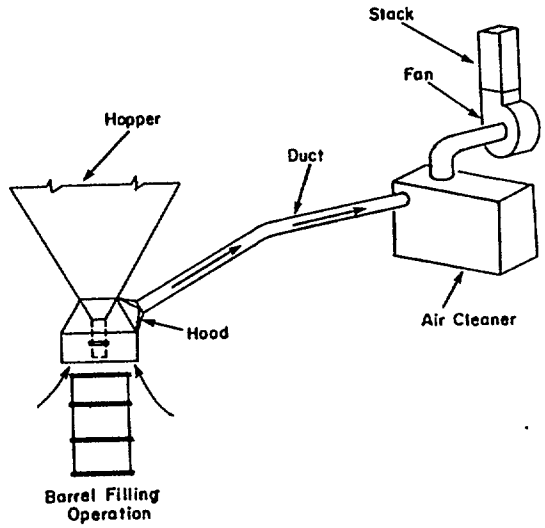
Remote control of processes in regulated areas is desirable. Sampling may be avoided if other properties such as density, color, conductance, pH, or viscosity can be used by in-line sensing devices to follow the progress of the reaction. If samples are required, use of a side arm sampler in a glove box or ventilated hood will reduce exposure. Sample containers should be enclosed in impervious containers while they are being transported for analysis. Alternatively, samples may be completely reacted to noncarcinogenic derivatives before removal from the glove box or hood and, therefore, not need special handling.



Sidearm sampling in glove boxes or hoods reduces exposure.

BON - 03263

In packaging areas, glove box or hood arrangements should be used to reduce exposure. Ventilated covers at drum filling operations are recommended.



Drum covers should be vented.

A standby generator which will maintain the operation of process equipment, scrubbers, and ventilation systems until an orderly shut down can be accomplished in case of a power failure or "brown-out" should be considered.

Whereas much of the foregoing is applicable to both continuous and batch operations, there are special precautions for batch operations, especially those carried out only occasionally in multi-purpose equipment. When an area is designated "regulated" only at times when carcinogens are being processed, greater vigilance must be exercised to ensure that nonauthorized personel do not enter the normally nonregulated area. Decontamination must be thorough and complete before removing the "regulated area" designation.

When a carcinogen is charged from storage containers into a system, the accumulation of partially filled containers and the prolonged exposure required for weighing can be eliminated if the batch is calculated to use only full drums. Calculation of the batch size should be based on the amount of carcinogen used and adjustments made using other noncarcinogenic components.

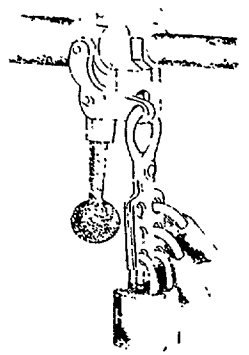
Maintenance

When it is necessary to enter isolated areas or to open closed systems for maintenance or repair, the requirements of the standard must be observed. Maintenance should not be initiated without the consent of the operating supervisor. If possible, the process should be shut down and decontaminated. All precepts of good maintenance should be followed, including:

locking out power to equipment

locking out or tagging valves closed off for maintenance purposes

BON - 03264



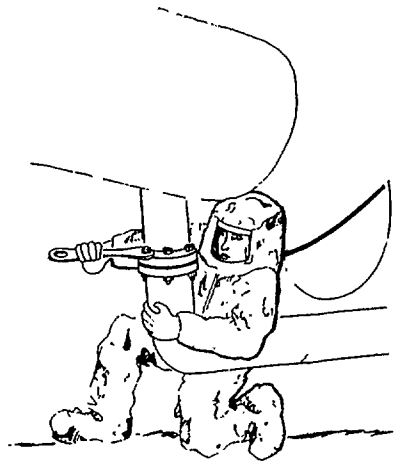
Lockout and/or tagout of equipment.

countersigning tags or duplicate lock out by process supervisors

using the buddy system, protective clothing, and proper (preferably air-supplied) respirators for tank entry

opening flanged fittings by loosening the bolts on the far side of the fitting first so that leakage will be directed away from the maintenance worker

decontaminating all tools before use in other areas



Flanged fittings should be opened so that leakage is directed away from the worker.

Decontamination and Disposal

Decontamination procedures must be designed for the specific conditions and materials encountered in the workplace. It is not possible to describe definitive methods in this booklet. Some examples of current practices are:

Charging of drums of DCB to a reactor is accomplished in an isolated room by employees using full body protective clothing and air-supplied respirators. After charging is completed and the charging port is closed, the entire room is decontaminated by spraying all surfaces with alkaline hypochlorite solution. The empty drums are also decontaminated in this manner as well as the protective clothing being worn by the employees. The room is maintained under negative pressure and exhaust air is scrubbed with hypochlorite solution before release to the atmosphere.

Spills or leaks of volatile liquids (EI, BCME, etc.) in restricted areas are allowed to evaporate and subsequently removed from the exhaust system by scrubbing with strong caustic solution.

BON - 03265

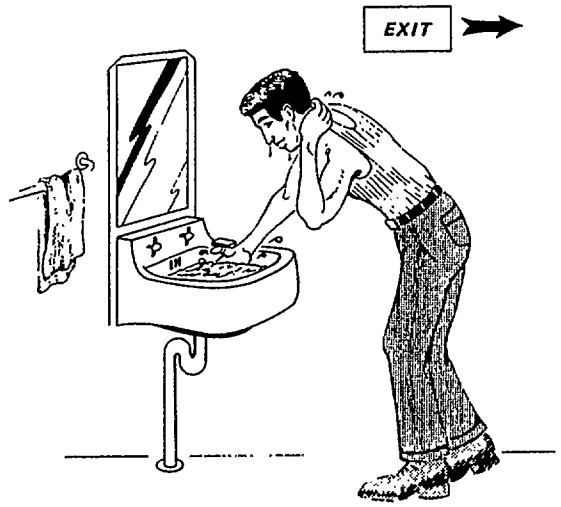
Solid carcinogens are carefully scooped up and/or removed by a vacuum system equipped with a HEPA (high-efficiency particulate air) filter backed with an activated charcoal absorbant bed. Spent filters and other contaminated equipment are either incinerated or placed in impervious containers and buried in a special landfill.

Obviously, these methods do not apply in all situations. Chemical reaction is useful in many cases; i.e., organic amines may be oxidized with hypochlorite or permanganate solutions. Note: Hypochlorite solutions must be alkaline (pH= 8 or more) to prevent the formation of explosive compounds. Reaction with other compounds may be more effective, and it may be possible to determine when decontamination is complete by means of a change in color or fluorescence by use of certain chemicals. Suppliers should be contacted and current literature reviewed to determined the most efficient methods for decontamination.

Decontamination crews must be fully protected from exposure to the carcinogen. Methods of disposal such as incineration or landfill burial must be in compliance with local and federal environmental regulations.

Hygiene and Sanitation

Personal hygiene is a critical factor in reducing exposure of employees to occupational carcinogens. Washing and showering should be thorough, not a quick rinse. Particular attention should be given to preventing dust or dirt (and contaminants) from accumulating in the hair (including facial hair) and under the fingernails. It is more important to wash before using toilet facilities than after.



Washup at the end of the shift must be emphasized.

Facilities for laundering clothing should be located in the plant. The standards require employees to place protective clothing in an impervious container at the end of the shift. The container should be partially filled with a decontaminating solution so that the garments will be as decontaminated as possible when laundry personnel are required to handle them. Although the standards are concerned only with full body protective clothing, it is recommended that underwear and socks also be provided. No clothing which has been worn in a regulated area should be taken home. Occasional inspection and sampling of the dirty clothing may also be used to ensure that work practices and engineering controls are satisfactory.

BON - 03266

SUMMARY

The standards provide for general controls that should keep employee exposure to carcinogens to a minimum. As chemicals are proven to be human cancer-suspect agents, NIOSH "Alerts" will be issued. It is recommended that the precepts of these standards be used to reduce employee exposure to the new agents.

Maintaining a safe and healthful workplace is desirable and necessary. It requires dedication and continual vigilance on the part of management to ensure that safe and healthy conditions are maintained. Workers who are properly trained to understand reasons for various controls and work practices will cooperate in their proper use. Supervisory personnel should set an example and be scrupulous in their observation of safe and healthful practices. Rewards for these policies will come in lower compensation rates, less downtime due to accidents and illnesses, and usually, a more dedicated and contented workforce.

OTHER STANDARDS

Standards for exposure to vinyl chloride and to coke oven emissions have been promulgated. These standards are quite complex and relate to specific equipment and process conditions. Both standards as published in the Federal Register include an excellent discussion of the background, need, philosophy, and intent of the regulations. Anyone interested in these standards should refer to the original Federal Register publications.

Vinyl Chloride: Part III, Vol. 39, No 194, October 4, 1974, pp. 25890-25898.

Coke Oven Emissions: Part III, Vol. 41, No. 206, October 22, 1976, pp. 46742-46790.

The existing standard for asbestos (29 CFR 1910.1001) is being reviewed for possible changes.

BON - 03267

FURTHER INFORMATION

As the possible human carcinogenic effects of other compounds are confirmed, NIOSH "Current Intelligence Bulletins" will be issued. These Bulletins, as well as other technical reports disclosing the results of NIOSH studies concerned with occupational carcinogens, may be obtained from NIOSH Regional Consultants. OSHA publications are available from OSHA Regional and Area Directors. The addresses of the NIOSH and OSHA offices are listed below.

Other sources of general information concerning cancer and carcinogens may be obtained from:

The American Cancer Society
777 Third Ave.
New York, N.Y. 10017
(or your local chapter)

The National Institutes of Health
The National Cancer Institute
Bethesda, Maryland 20014

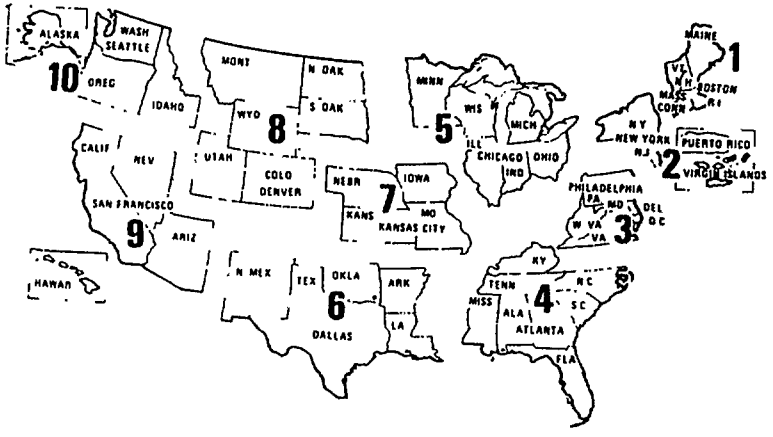
The American Association for the Advancement of Science
1515 Massachusetts Ave., N.W.
Washington, D.C. 20005

The American Chemical Society
1115 16th St., N.W.
Washington, D.C. 20036

NIOSH REGIONAL OFFICES

The following pages list NIOSH and OSHA regional offices which can provide information on the OCCUPATIONAL SAFETY AND HEALTH ACT including questions on standards interpretations, voluntary compliance information, copies of the OSHA Standards, OSHA Act, Employee Rights Posting Notice, and publications.

REGIONS



NIOSH REGIONAL OFFICES

DHEW, Region I
Government Center
(JFK Fed. Bldg.)
Boston, Massachusetts 02203
Tel.: 617/223-6668/9

DHEW, Region II
26 Federal Plaza
New York, New York 10007
Tel.: 212/264-2485/8

DHEW, Region III
3525 Market Street,
P.O. Box 13716
Philadelphia, Pennsylvania 19101
Tel.: 215/596-6716

DHEW, Region IV
50 Seventh Street, N.E.
Atlanta, Georgia 30323
Tel.: 404/881-4474

DHEW, Region V
300 South Wacker Drive
Chicago, Illinois 60607
Tel.: 312/886-3881

DHEW, Region VI
1200 Main Tower Building
Room 1700-A
Dallas, Texas 75245
Tel.: 214/655-3081

DHEW, Region VII
601 East 12th Street
Kansas City, Missouri 64106
Tel.: 816/374-5332

DHEW, Region VIII
19th & Stout Streets
9017 Federal Building
Denver, Colorado 80202
Tel.: 303/837-3979

DHEW, Region IX
50 Fulton Street (223 FOB)
San Francisco, California 94102
Tel.: 415/556-3781

DHEW, Region X
1321 Second Avenue
(Arcade Bldg.)
Seattle, Washington 98101
Tel.: 206/442-0530

BON - 03268

OSHA REGIONAL OFFICES

NOTE: For an office close to you, check your telephone directory under United States Government or dial 800-555-1212 and ask for the toll-free number of the OSHA office nearest you.

Region I
U.S. Department of Labor
Occupational Safety and Health Administration
JFK Building, Room 1804
Boston, Massachusetts 02203 ----------Telephone: 617/223-6712/3

Region II
U.S. Department of Labor
Occupational Safety and Health Administration
1515 Broadway (1 Astor Plaza), Room 3445
New York, New York 10036 ----------Telephone: 212/971-5941/2

Region III
U.S. Department of Labor
Occupational Safety and Health Administration
15220 Gateway Center, 3535 Market Street
Philadelphia, Pennsylvania 19104 ----------Telephone: 215/596-1201

Region IV
U.S. Department of Labor
Occupational Safety and Health Administration
1375 Peachtree Street, N.E., Suite 587
Atlanta, Georgia 30309 ----------Telephone: 404/526-3573/4 or 2281/2

Region V
U.S. Department of Labor
Occupational Safety and Health Administration
230 S. Dearborn, 32nd Floor
Chicago, Illinois 60604 ----------Telephone: 312/353-4716/7

Region VI
U.S. Department of Labor
Occupational Safety and Health Administration
555 Griffin Square Building, Room 602
Dallas, Texas 75202 ----------Telephone: 214/749-2477/8/9 or 2567

Region VII
U.S. Department of Labor
Occupational Safety and Health Administration
Federal Building, Room 3000, 911 Walnut Street
Kansas City, Missouri 64106 ----------Telephone: 816/374-5861

Region VIII
U.S. Department of Labor
Occupational Safety and Health Administration
Federal Building, Room 15010, 1961 Stout Street
Denver, Colorado 80202 ----------Telephone: 303/837-3883

Region IX
U.S. Department of Labor
Occupational Safety and Health Administration
9470 Federal Building, 450 Golden Gate Avenue
Post Office Box 36017
San Francisco, California 94102 ----------Telephone: 415/556-0584

Region X
U.S. Department of Labor
Occupational Safety and Health Administration
6048 Federal Office Building
909 First Avenue
Seattle, Washington 98174 ----------Telephone: 206/442-5930

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