



Regulation Update – Methylene Chloride

Occupational Health and Environmental Safety Division

Number 20, April 1997

OSHA Regulation: 29 CFR 1910.1052; 1915.1052; 1926.1152

On January 10, 1997, The Occupational Safety and Health Administration (OSHA) issued a final rule for occupational exposure to methylene chloride (MC). The standard was published in the *Federal Register*, 62 *Fed. Reg.* 1494. The standard applies to general industry, shipyards, and construction.

This summary of the MC standard was prepared by 3M OH&ESD and focuses primarily on the respiratory protection aspects of the standard. It does not represent an official nor legal nor necessarily complete interpretation of the standard. If specific questions arise, the standard itself should be reviewed and relied on, rather than this summary.

I. Methylene Chloride

Methylene chloride is used in various processes in many industries. These include paint stripping, pharmaceutical manufacturing, paint remover manufacturing, metal cleaning and degreasing, adhesives manufacturing and use, polyurethane foam production, film base manufacturing, polycarbonate resin production, and distribution and formulation of solvents.

A. Physical data: methylene chloride CAS# 75-09-2

Molecular weight: 84.9

Appearance: Colorless liquid with a chloroform-like odor

Boiling point: 39.8°C (760 mm Hg)

Specific gravity(water=1): 1.3

Vapor density(air=1): 2.9

Vapor pressure: 350 mm Hg @ 20°C

Odor threshold: 25 - 320 ppm,

Synonyms: MC, dichloromethane, methylene dichloride, methylene bichloride, methane dichloride

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B. Potential health effects

MC is primarily an inhalation hazard. Exposure to and through the skin is also important. The principal acute hazardous effects are the depressant action on the central nervous system (CNS), possible cardiac toxicity and possible liver toxicity. Inhaling MC vapor causes mental confusion, light headedness, nausea, vomiting and headache. With acute or short-term exposure, MC acts as an anesthetic. These high exposures can lead to staggering, unconsciousness, and even death. High concentrations of the vapors may cause eye and respiratory tract irritation and aggravate the symptoms of angina. Cardiac toxicity is due to the metabolism of MC to carbon monoxide, and the effects of carbon monoxide on heart tissue. Carbon monoxide displaces oxygen in the blood, decreases the oxygen available to heart tissue, increasing the risk of damage to the heart, which may result in heart attacks in susceptible individuals. Skin contact with liquid MC causes irritation and burns. Splashing MC into the eyes causes irritation.

Based on epidemiological studies, OSHA has concluded that there is suggestive evidence of increased cancer risk in MC-related worker populations OSHA considers MC as a suspected human carcinogen.

II. Dates

Effective Date: April 10, 1997

Start-up dates:

Standard provision	Employer	Time period
Initial monitoring	with less than 20 employees	within 300 days of effective date
	polyurethane mfrs. With 20-99 employees	within 210 days of effective date
	all other employers	within 120 days of effective date
Engineering controls	with less than 20 employees	within 3 years of effective date
	polyurethane mfrs. With 20-99 employees	within 2 years of effective date
	all other employers	within 1 year of effective date
All other requirements	with less than 20 employees	within 1 year of effective date
	polyurethane mfrs. With 20-99 employees	within 270 days of effective date
	all other employers	within 180 days of effective date

III. Scope and Application

This standard applies to all occupational exposures to MC in general industry, construction and shipyard employment.

IV. Definitions

The following is a partial list of definitions used in the MC standard. These definitions were included because the terms are used in this document.

Action level means a concentration of airborne MC of 12.5 parts per million (ppm) calculated as an eight (8)-hour time-weighted average (TWA).

Emergency means any occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which results, or is likely to result in an uncontrolled release of MC. If an incidental release of MC can be controlled by employees such as maintenance personnel at the time of release and in accordance with the leak/spill provisions required by this standard, it is not considered an emergency as defined by this standard.

Employee exposure means exposure to airborne MC which occurs or would occur if the employee were not using respiratory protection.

Physician or other licensed health care professional is an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by this standard.

Symptom means central nervous system effects such as headaches, disorientation, dizziness, fatigue, and decreased attention span; skin effects such as chapping, erythema, cracked skin, or skin burns; and cardiac effects such as chest pain or shortness of breath.

V. Permissible Exposure Limits (PELs)

1. Time-weighted average (TWA). The employer shall ensure that no employee is exposed to an airborne concentration of MC in excess of twenty-five parts of MC per million parts of air (25 ppm) as an 8-hour TWA.
1. Short-term exposure limit (STEL). The employer shall ensure that no employee is exposed to an airborne concentration of MC in excess of one hundred and twenty-five parts of MC per million parts of air (125 ppm) as determined over a sampling period of fifteen minutes.

VI. Exposure Monitoring

A. Characterization of employee exposure

The employer shall determine each employee's exposure by either taking a personal breathing zone air sample of each employee's exposure or air samples that are *representative* of each employee's exposure. The personal breathing zone air samples are considered to be *representative* of employee exposures when they are taken as follows:

1. 8-hour TWA. The employer has taken one or more personal breathing zone air samples for at least one employee in each job classification in a work area during every work shift, and the employee sampled is expected to have the highest MC exposure.
2. Short-term exposure limit. The employer has taken one or more personal breathing zone air samples that indicate the highest likely 15-minute exposures during such operations for at least one employee in each job classification in the work area during every work shift, and the employee sampled is expected to have the highest MC exposure.

Personal breathing zone air samples taken during one work shift may be used to represent employee exposures on other work shifts where the employer can document that the tasks performed and conditions in the workplace are similar across shifts.

B. Accuracy of monitoring

The employer has the obligation of selecting a monitoring method which meets the accuracy of the standard. The standard requires that the monitoring methods used produce results that are accurate to a confidence level of 95 percent, and are within plus or minus 25 percent for MC concentrations above the 8-hour TWA or STEL PEL and within plus or minus 35 percent for MC concentrations at or above the action level but at or below the 8-hour TWA PEL. The 3M Organic Vapor Monitors 3520/3530 meet this accuracy requirement for air sampling of methylene chloride. More details on the use of these monitors for MC can be found in 3M Technical Data Bulletin #131.

C. Initial monitoring

All employers must initially monitor employee exposure to accurately determine the airborne concentrations of MC. Initial monitoring can be waived under the following conditions:

1. Where *objective data* demonstrate that MC cannot be released in the workplace in airborne concentrations at or above the action level or above the STEL. The *objective data* shall represent the highest MC exposures likely to occur under reasonably foreseeable conditions of processing, use, or handling;
2. Where the employer has performed exposure monitoring within 12 months prior to April 10, 1997 and the monitoring satisfies all other requirements of this standard; or
3. Where employees are exposed to MC on fewer than 30 days per year (e.g., on a construction site), and the employer uses direct-reading instruments which give immediate results (such as a detector tube) and provides sufficient information to determine what control measures are necessary to reduce exposures to acceptable levels.

D. Periodic monitoring

Where the initial monitoring shows employee exposures at or above the action level or above the STEL, the employer shall establish an exposure monitoring program for periodic monitoring of employee exposure to MC in accordance with Table 1.

Table 1. -- Six Initial Determination Exposure Scenarios and Their Associated Monitoring Frequencies

Exposure scenario			Required monitoring activity
>Action level	>8-hr TWA	>STEL	
No	No	No	No 8-hour TWA or STEL monitoring required.
No	No	Yes	No 8-hour TWA monitoring required; monitor STEL exposures every three months.
Yes	No	No	Monitor 8-hour TWA exposures every six months.
Yes	No	Yes	Monitor 8-hour TWA exposures every six months and monitor STEL exposures every three months.
Yes	Yes	No	Monitor 8-hour TWA exposures every three months.
Yes	Yes	Yes	Monitor 8-hour TWA exposures and STEL exposures every three months.

The employer may decrease the frequency of exposure monitoring to every six months when at least 2 consecutive measurements taken at least 7 days apart show exposures to be at or below the 8-hour TWA PEL. The employer may discontinue the periodic 8-hour TWA monitoring for employees where at least two consecutive measurements taken at least 7 days apart are below the action level. The employer may discontinue the periodic STEL monitoring for employees where at least two consecutive measurements taken at least 7 days apart are at or below the STEL.

E. Additional monitoring

The employer must perform additional monitoring when a change in workplace conditions indicates that employee exposure may have increased. Examples of these situations include changes in production, process, control equipment, or work practices, or a leak, rupture, or other breakdown.

VII. Regulated Areas

The employer shall establish a regulated area wherever an employee's exposure to airborne concentrations of MC exceeds or can reasonably be expected to exceed either the 8-hour TWA or STEL PEL. The employer shall supply a respirator, selected in accordance with this standard, to each person who enters a regulated area and shall require each affected employee to use that respirator whenever MC exposures are likely to exceed the 8-hour TWA or STEL PEL. Where MC exposure can be reliably predicted to exceed the 8-hour TWA or STEL PEL only on certain days (for example, because of work or process schedule) the employer would need to have affected employees use respirators in that regulated area only on those days. The employer shall ensure that while employees are wearing respirators, they do not engage in activities (such as taking medication or chewing gum or tobacco) which interfere with respirator seal or performance.

VII. Methods of compliance

The employer shall institute and maintain the effectiveness of engineering controls and work practices to reduce employee exposure to or below the PELs except to the extent that the employer can demonstrate that such controls are not feasible. Wherever the feasible engineering controls and work practices which can be instituted are not sufficient to reduce employee exposure to or below the 8-hour TWA PEL or STEL PEL, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of this standard.

VIII. Respiratory Protection

A. General requirements

The employer shall provide a respirator that complies with the requirements of this standard, at no cost to each affected employee, and ensure that each affected employee uses such respirator where appropriate. Respirators shall be used in the following circumstances:

1. Whenever an employee's exposure to MC exceeds or can reasonably be expected to exceed the 8-hour TWA PEL or the STEL (such as where an employee is using MC in a regulated area);
2. During the time interval necessary to install or implement feasible engineering and work practice controls;
3. In a few work operations, such as some maintenance operations and repair activities, for which the employer demonstrates that engineering and work practice controls are infeasible;
4. Where feasible engineering and work practice controls are not sufficient to reduce exposures to or below the PELs; or
5. In emergencies.

B. Medical evaluation

Before having any employee use a supplied-air respirator in the negative pressure mode, or a gas mask with organic vapor canister for emergency escape, the employer shall have a physician or other licensed health care professional ascertain each affected employee's ability to use such respiratory protection. The physician or other licensed health care professional shall provide his or her findings to the affected employee and the employer in a written opinion.

C. Respirator selection

The appropriate atmosphere-supplying respirators, as specified in Table 2, shall be selected from those approved by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR Part 84, "Respiratory Protective Devices." When employers elect to provide gas masks with organic vapor canisters for use in emergency escape, the organic vapor canisters shall bear the approval of NIOSH.

Table 2.--Minimum Requirements for Respiratory Protection for Airborne Methylene Chloride

Methylene chloride airborne concentration (ppm) or condition of use	Minimum respirator required ¹	3M Suggested Respirator
Up to 625 ppm (25 X PEL)	(1) Continuous flow supplied-air respirator, hood or helmet.	(1) Whitecap II Series, Snapcap Series, Hardcap and Airhat continuous flow airline respirators.
Up to 1250 ppm (50 X 8 hr-TWA PEL)	(1) Full facepiece supplied-air respirator operated in negative pressure (demand) mode. (2) Full facepiece self-contained breathing apparatus (SCBA) operated in negative pressure (demand) mode.	(1) None available from 3M. (2) None available from 3M.
Up to 5000 ppm (200 X 8 hr - TWA PEL)	(1) Continuous flow supplied-air respirator, full facepiece. (2) Pressure demand supplied-air respirator, full facepiece. (3) Positive pressure full facepiece SCBA.	(1) 6000 or 7800 Series Full Facepiece continuous flow airline respirators. (2) 7800 Full Facepiece pressure demand airline respirator. (3) None available from 3M.
Unknown concentration, or above 5000 ppm (Greater than 200 X 8 hr-TWA PEL).	(1) Positive pressure full facepiece SCBA. (2) Full facepiece pressure demand supplied-air respirator with an auxiliary self-contained air supply.	(1) None available from 3M. (2) 7800 Full Facepiece Pressure Demand Combination Airline/5-minute Escape SCBA (a.k.a. 5 Minute Escape System).

Fire fighting	Positive pressure full facepiece SCBA	None available from 3M.
Emergency escape	(1) Any continuous flow or pressure demand SCBA. (2) Gas mask with organic vapor canister.	(1) None available from 3M. (2) None available from 3M

¹ Respirators assigned for higher airborne concentrations may be used at lower concentrations.

D. Respirator program

Where respiratory protection is required by this standard, the employer shall institute a respirator program in accordance with 29 CFR 1910.134.

E. Permission to leave area

The employer shall permit employees who wear respirators to leave the regulated area to readjust the facepieces to their faces to achieve a proper fit, and to wash their faces and respirator facepieces as necessary in order to prevent skin irritation associated with respirator use.

F. Filter [Canister] respirators

Employers who provide gas masks with organic vapor canisters for the purpose of emergency escape shall replace those canisters after any emergency use before those gas masks are returned to service.

G. Respirator fit testing

The employer shall ensure that each respirator issued to the employee is properly fitted and exhibits the least possible facepiece leakage from among the facepieces tested. The employer shall perform qualitative or quantitative fit tests at the time of initial fitting and at least annually thereafter for each employee wearing a negative pressure respirator, including those employees for whom emergency escape respirators are provided. [Note: The only supplied-air respirators to which this provision would apply are SCBA in negative pressure mode and full facepiece supplied-air respirators operated in negative pressure mode. The small business compliance guides will contain examples of protocols for qualitative and quantitative fit testing.]

IX. Protective Work Clothing and Equipment

Where needed to prevent MC-induced skin or eye irritation, the employer shall provide clean protective clothing and equipment which is resistant to MC, at no cost to the employee, and shall ensure that each affected employee uses it.

X. Medical Surveillance

The comprehensive medical and work history shall emphasize neurological symptoms, skin conditions, history of hematologic or liver disease, signs or symptoms suggestive of heart disease (angina, coronary artery disease), risk factors for cardiac disease, MC exposures, and work practices and personal protective equipment used during such exposures.

The employer shall provide the following information, among other things, to a physician or other licensed health care professional who is involved in the diagnosis of MC-induced health effects: (1) The employee's former or current exposure levels or, for employees not yet occupationally exposed to MC, the employee's anticipated exposure levels and the frequency and exposure levels anticipated to be associated with emergencies and (2) a description of any personal protective equipment, such as respirators, used or to be used;

For each physical examination required, the employer shall ensure that the physician or other licensed health care professional provides a written medical opinion. The written medical opinion shall be limited to, among other things, any recommended limitations upon the employee's exposure to MC or upon the employee's use of protective clothing or equipment and respirators.

XI. Hazard Communication

The employer shall communicate the following hazards associated with MC on labels and in material safety data sheets in accordance with the requirements of the Hazard Communication Standard, 29 CFR 1910.1200, 29 CFR 1915.1200, or 29 CFR 1926.59, as appropriate: cancer, cardiac effects (including elevation of carboxyhemoglobin), central nervous system effects, liver effects, and skin and eye irritation.

XII. Employee Information and Training

The employer shall provide information and training for each affected employee prior to or at the time of initial assignment to a job involving potential exposure to MC. The employer shall ensure that information and training is presented in a manner that is understandable to the employees.

XIII. Recordkeeping

A. Exposure measurements

The employer shall establish and keep an accurate record of all measurements taken to monitor employee exposure to MC as prescribed in this standard. Where the employer has 20 or more employees, this record shall include at least the following information:

1. The date of measurement for each sample taken;
2. The operation involving exposure to MC which is being monitored;
3. Sampling and analytical methods used and evidence of their accuracy;
4. Number, duration, and results of samples taken;
5. Type of personal protective equipment, such as respiratory protective devices, worn, if any;

B. Medical surveillance

The employer shall establish and maintain an accurate record for each employee subject to medical surveillance under this standard. The record shall include: written medical opinions among other things. See Appendices for more information regarding their content with respect to respirators.

XIV. Appendices

The information contained in the appendices does not by itself create any additional obligations not otherwise imposed or detract from any existing obligation. Appendix B, "Medical Surveillance for Methylene Chloride" contains some information regarding respiratory protection that may be helpful and is included.

A. Physical examination

The recommendation in Appendix B is that the physical examination include "an evaluation of the advisability of the worker using a respirator, because the use of certain respirators places an additional burden on the cardiopulmonary system. It is necessary for the attending physician or other licensed health care professional to evaluate the cardiopulmonary function of these workers, in order to inform the employer in a written medical opinion of the worker's ability or fitness to work in an area requiring the use of certain types of respiratory protective equipment. The presence of facial hair or scars that might interfere with the worker's ability to wear certain types of respirators should also be noted during the examination and in the written medical opinion.

Because of the importance of lung function to workers required to wear certain types of respirators to protect themselves from MC exposure, these workers must receive an assessment of pulmonary function before they begin to wear a negative pressure respirator and at least annually thereafter. The recommended pulmonary function tests include measurement of the employee's forced vital capacity (FVC), forced expiratory volume at one second (FEV1), as well as calculation of the ratios of FEV1 to FVC, and the ratios of measured FVC and measured FEV1 to expected respective values corrected for variation due to age, sex, race, and height. Pulmonary function evaluation must be conducted by a physician or other licensed health care professional experienced in pulmonary function tests."

B. Written medical opinion

The standard requires the employer to ensure that the physician or other licensed health care professional provides a written statement to the employee and the employer. This statement should contain the physician's or licensed health care professional's opinion as to whether the employee has any medical condition placing him or her at increased risk of impaired health from exposure to MC or use of respirators, as appropriate. The physician or other licensed health care professional should also state his or her opinion regarding any restrictions that should be placed on the employee's exposure to MC or upon the use of protective clothing or equipment such as respirators. If the employee wears a respirator as a result of his or her exposure to MC, the physician or other licensed health care professional's opinion should also contain a statement regarding the suitability of the employee to wear the type of respirator assigned.