

Indoor Air Quality Guideline

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California Environmental Protection Agency

 Air Resources Board

CHLORINATED CHEMICALS IN YOUR HOME

About this guideline

Several chlorinated chemicals can cause cancer and other serious health problems. These chemicals can come from consumer products you buy in the store, dry-cleaned clothes, and treated municipal water. Air levels of these chemicals, therefore, are generally higher in your home than outdoors. This indoor air quality guideline can help you identify possible sources of six common chlorinated chemicals in your home and understand the health problems these chemicals can cause. It will also show you ways to limit the amount of contact your family has with these chemicals.

COMMON CHLORINATED CHEMICALS

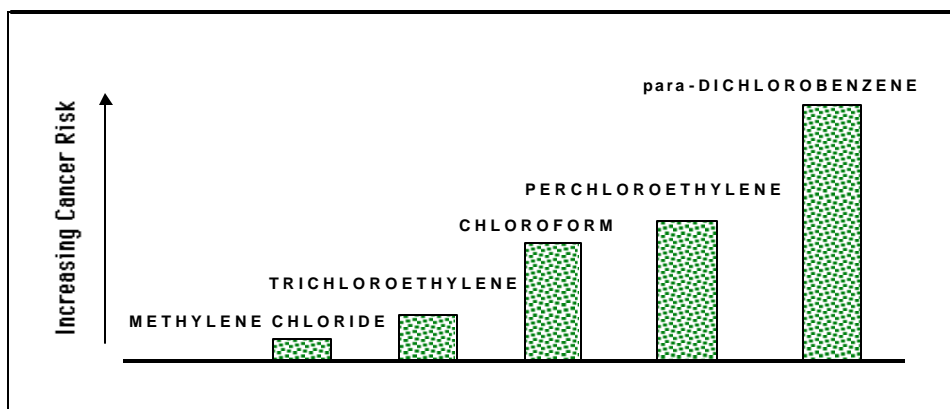
<i>chloroform</i>	<i>trichloroethylene</i>
<i>para-dichlorobenzene</i>	<i>methylene chloride</i>
<i>perchloroethylene</i>	<i>methyl chloroform (1,1,1-trichloroethane)</i>

Chlorinated chemicals and your health

CANCER

Cancer is the primary health risk for people who are exposed to certain chlorinated chemicals for long periods of time. Figure 1 shows the relative cancer risk from equal exposures to five chlorinated chemicals associated with cancer. Liver cancer is the most common type of cancer associated with exposure to chlorinated chemicals. However, the lungs and kidneys may also be affected.

Figure 1: Relative Cancer Risk of Chlorinated Chemicals



All of the chlorinated chemicals shown in Figure 1 have been identified as substances that may cause cancer by one or more formal scientific bodies, such as California's Scientific Review Panel on Toxic Air Contaminants and the World Health Organization's International Agency for Research on Cancer. These committees generally have found that there is no truly "safe" level of exposure for any of these cancer-causing agents.

OTHER HEALTH EFFECTS

Cancer is not the only health problem that can be caused by chlorinated chemicals.

If there are high levels of these chemicals in your home or where you work, you may feel tired, dizzy, or nauseous, or have a headache. Your eyes, nose, and throat may burn or feel sore and scratchy. These are warning signs and should be heeded. High levels of these chemicals can prevent your central nervous system from functioning properly. They can also cause diseases of the liver, kidneys, and lungs. In addition, exposure to methylene chloride can cause an increase in the amount of carboxyhemoglobin in the blood. When this happens, your blood cannot absorb the oxygen you need. This results in a medical condition similar to carbon monoxide poisoning.

The level of danger and the seriousness of the illnesses that may occur are determined by the amount of the chemical in the air you breathe and the length of time you breathe it. Small children can be more at risk since they are often more active and breathe more rapidly than adults; therefore, their exposure is generally greater. In some situations, people also can be exposed orally or through the skin. Exposure to very high levels of these chemicals can result in the failure of one or more major organs, such as the liver, kidneys, or lungs, and can lead to death. Table 1 summarizes the parts of the body that are most likely to be affected.

Table 1: Primary Target Organs or Systems Affected

	NERVOUS SYSTEM	LIVER	KIDNEYS	LUNGS	BLOOD
para-Dichlorobenzene	✓	0 ✓	0 ✓		
Perchloroethylene	✓	0 ✓			0
Chloroform	✓	0 ✓	0 ✓		
Trichloroethylene	✓	0 ✓	0 ✓	✓	
Methylene Chloride	✓	0 ✓		0	✓
Methyl Chloroform	✓		✓		

0 -- Cancer

✓ -- Other health effects besides cancer

Major indoor sources of chlorinated chemicals

CONSUMER PRODUCTS

Many commonly used consumer products contain chlorinated chemical solvents, such as trichloroethylene, methyl chloroform, perchloroethylene, and methylene chloride. These products include glues, spot removers, spray cleaners, water repellents, spray paints, paint strippers, and automotive products. Para-dichlorobenzene is the main ingredient in mothballs and some bathroom deodorizers.

Products are not necessarily safe just because they do not list any chlorinated chemicals as ingredients on the label. Sometimes these chemicals are produced when the products are used. For example, toilet and bathroom cleansers, bleaches, and detergents that contain liquid chlorine or crystallized chlorine chemicals can react with other substances to form chloroform gas.

Most of the time, you or your family will come in contact with chlorinated chemicals when you are using products that contain or produce them. When you use solvents, adhesives, caulks, and sealants indoors or in an enclosed space without opening windows and turning on exhaust fans, you may inhale a large amount of the chemical in a very short time, and the chemical may remain in the air for a long time after you have finished using the product. It is generally quite easy to remember to air out your house if you are using a strong smelling paint or solvent, but it is just as important to do so when using a spray spot remover on your carpet, helping your child with a school craft project, or using products with chlorine bleach to wash your dishes or clothes.

Mothballs or moth crystals used to protect clothing are mostly para-dichlorobenzene. These products kill moth larvae by evaporating and filling the air in the drawers and closets with very high levels of this chlorinated chemical. These areas, as well as other parts of your home, such as adjoining bedrooms, may have excessive amounts of this chemical in the air.

Sometimes, you may breathe air contaminated with these chemicals without even realizing it; you can be exposed when you aren't even using the product. If stored spray cans or containers are defective or corroded, or if the lids are not tight, these chemicals can evaporate into the air. You can also be exposed to chlorinated chemicals if the businesses you visit use or sell these products. For example, there may be high levels of methylene chloride, trichloroethylene, and methyl chloroform present in furniture refinishing, woodworking, and metalworking shops.

DRY-CLEANED MATERIALS

Chlorinated chemicals are also used in the dry-cleaning process. Perchloroethylene is the primary solvent used to dry-clean clothing and fabrics, but methyl chloroform is also used to some extent. Both of these chemicals are also used by many services that clean carpets, drapes, and upholstered furniture in your home.

When fabric is dry-cleaned, it is “washed” in a chemical solution instead of water. When the process is completed, a small amount of the chemicals remains in the fabric. All of the remaining solvents (perchloroethylene and methyl chloroform) in the dry-cleaned material will eventually evaporate - most of it into the air in our homes.

High levels of solvents can be present in or near dry-cleaning facilities or anywhere freshly dry-cleaned fabrics or garments are stored, including closets, cabinets, or drawers. You can be exposed to these chemicals when you visit the dry cleaners or laundromats that have dry-cleaning facilities. Drivers and passengers are exposed when fabrics that have been dry-cleaned are carried home in the car. You may also be exposed to these chemicals when you wear clothing immediately after it has been cleaned.

DOMESTIC WATER

Most cities and counties use chlorination to disinfect their water supply. As a result, when the water (especially hot water) comes out of your faucet or is heated, chloroform vaporizes into the surrounding air. You can be exposed to chloroform when cooking, washing dishes or clothes, bathing, or even opening the dishwasher. Taking a long, hot shower in a typical small shower stall can substantially increase your exposure to chloroform. If you use indoor spas, hot tubs, or swimming pools, you are also likely to be exposed to high levels of chloroform.

How you can reduce your exposures to chlorinated chemicals

SELECT AND USE CONSUMER PRODUCTS WISELY

Read the ingredients on the label. Avoid buying products containing chlorinated chemicals, if at all possible. If you must use the product and all brands contain one or more of these chemicals, choose the brand that has the lowest amount.

Avoid buying extra quantities of products that contain chlorinated compounds; buy only as much as you will use right away. For partially-used products, make sure the tops are tight and store them as far as possible from living spaces of your home, such as in a detached garage or storage shed, **out of the reach of children**



BE CAREFUL WHEN USING THESE PRODUCTS!



Avoid using mothballs. Moths damage fabrics made of natural fibers, such as silk, wool, fur, or feathers. Avoid storing soiled clothing. Clean fabrics and store them in clean, airtight containers, such as plastic bags or boxes. Herbal sachets and cedar may be used to discourage moths.

Avoid using air fresheners made of para-dichlorobenzene. Regular cleaning and adequate ventilation will generally reduce or eliminate most

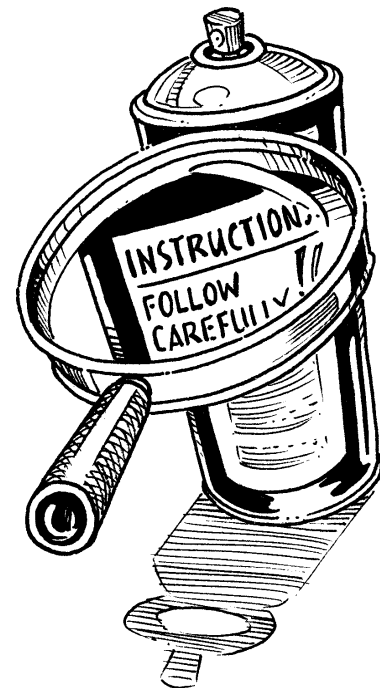
unpleasant odors. Natural fragrances, such as herbs and spices, pine, or citrus, are also excellent alternatives to chemical deodorizers.

Always read the directions on the label every time, before using the product. Use only as directed; do not use any more of the product than is necessary. Be sure you understand what you have read. If you have any questions, ask at the store where you bought the product or call the company that made it. An information number should be on the package or bottle.

Do not use outdoor products inside the home.

Use chlorinated products in a well ventilated area. When using household cleaning products (or any product containing chlorinated chemicals) in a confined space, make sure the windows and doors are open and an exhaust fan is on nearby. You should also leave the room as soon as you finish and continue to ventilate the area until all surfaces are dry and any odors or fumes are gone. It is safer to use automotive products outdoors rather than inside the garage, even with the garage door open.

Protect yourself. Wear a mask with charcoal canister filters and solvent-resistant gloves if you use these products frequently or are working on a long-term project, such as refinishing furniture. Proper masks are relatively inexpensive and can be found at a local hardware, home improvement, or industrial supply store. Be sure to ask for help when you buy a mask; it will only protect you if it is the right kind and fits correctly.



Properly dispose of empty, old, and almost-empty containers. Check with your local city or county hazardous waste department to see if there are any special requirements BEFORE you throw it away. Check your cupboards (including under the bathroom and kitchen sinks), laundry room closets, and storage areas in your garage or shed for old and out-of-date products.



AVOID EXPOSURE TO CHLORINATED DRY-CLEANING SOLVENTS

Buy clothes that do not require dry-cleaning. Dry-clean those that require it only when really necessary.

Open your car windows whenever possible when carrying dry-cleaned materials.

Air freshly dry-cleaned garments without the plastic covers for a day or so. They can be aired on a covered porch or in the garage, if they might get dirty outdoors. However, if aired in an attached garage, some of the vapors may seep into the house. If aired on an attached porch, close any adjoining windows or doors.

Dry-clean drapes or blinds during fair and warm weather. This will allow you to open the windows to air the drapes and blinds after they are re-hung. Avoid in-home dry cleaning of drapes, upholstery, or carpet. If dry cleaning must be done in the home, insist on non-chlorinated chemicals.



HANDLE WITH CARE !

Make fewer and shorter visits to trade shops known to use chlorinated chemicals. This includes dry cleaners, furniture refinishers, and auto repair shops. Limit the time you stay inside these businesses: make appointments. If it will be some time before your job is finished, wait outside or come back later; call ahead to make sure your merchandise is ready to be picked up. Whenever possible, have the shop pick up and deliver for you.

REDUCE DOMESTIC HOT WATER CONSUMPTION

Chlorination of water, a common method of water sanitization, serves an important role in killing water-borne bacteria that can cause serious diseases. However, chlorination can produce chloroform as a by-product. If your home receives water from a municipality (city or county), call to find out if the water is chlorinated. You can ask the municipal water department to send a water quality report to you and to place your name on a mailing list to be notified of any major changes in water treatment for your area. The amount of chloroform in your water supply should be listed in the report. If the municipal water is chlorinated or chloroform is present, or if you use well water that you know or suspect is treated or contaminated with chlorinated chemicals, you should take the following actions:

Install water flow restrictors in shower heads, reduce the temperature of the shower water, and decrease showering time. All these actions will reduce your exposure to chloroform while showering, and save energy and water, too!

Open the windows or turn on the exhaust fan when warm water is used for showering, bathing, washing dishes or clothes, and enjoying indoor spas.

Locate the clothes washer in the garage, if possible, rather than in the kitchen or utility room adjacent to the living areas.

Allow dishes to dry in the automatic dishwasher with the door closed; this is possible with or without operating the “Dry” cycle. If you open the dishwasher immediately after the wash cycle, turn on the kitchen fan and open windows to allow the steam to escape. Avoid breathing the steam as it comes out of the unit.



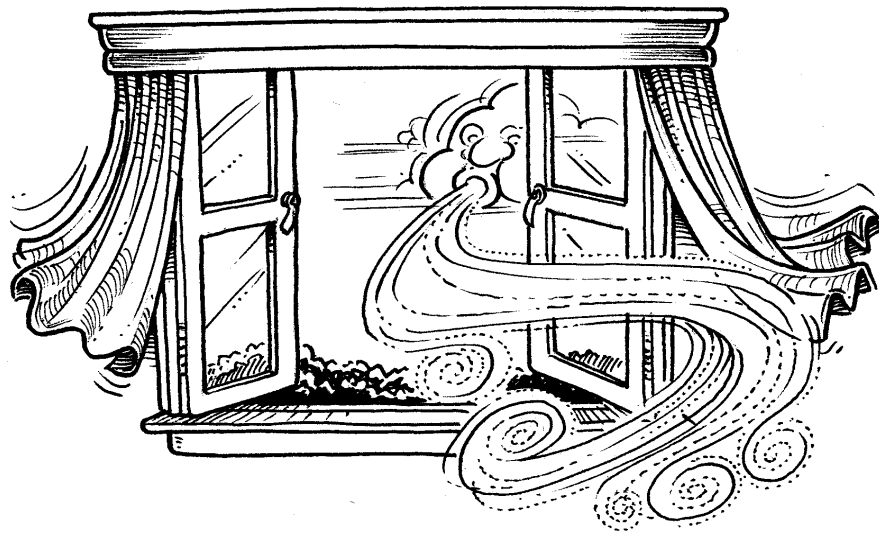
VENTILATE YOUR HOME FREQUENTLY

Open windows and doors as often as possible, especially those in the bathroom, kitchen, laundry room, or any other area where household cleaning products may be stored or used, or where steam accumulates. Consider installing a roof vent, turbine ventilator, or exhaust fan for any garage where automotive cleaning or repair products are used or stored, especially if it is an attached garage.

Install high flow rate exhaust fans when building or remodeling your home, especially in high use areas, such as the kitchen, bathrooms, and laundry room. Make sure they are properly vented to the outdoors — not into the attic. Whole house fans will also decrease the levels of chemicals inside your home and, if you live in a hot area, will help cool your house by drawing in the cooler evening air.

A Special Note for People Who Suffer from Hay Fever, Allergies, or Asthma

Chlorinated chemicals can cause irritation of the eyes, nose, throat, and bronchial tissue, but people with sensitivities to dust, pollen, and other outdoor pollution may need to keep their windows and doors closed most of the time. Stand-alone indoor air cleaners with high-efficiency particle filters and with pre-filters embedded with activated carbon are commercially available; however, their effectiveness is generally limited to cleaning one room, and they require regular maintenance. Stand-alone units are available in many hardware stores, department stores, home stores, and drug stores. For more information on indoor air filters and cleaners, please request ARB's fact sheet on "Residential Air Cleaning Devices," (see below under "For More Information").



Indoor levels of chlorinated chemicals

TYPICAL INDOOR LEVELS

The ARB and the U.S. Environmental Protection Agency have measured the levels of chlorinated chemicals in more than 450 California homes—at many different locations throughout the State during different seasons. Generally, indoor levels of

these chemicals were consistently higher than levels measured at nearby outdoor locations. Also, indoor levels were usually higher in winter than in summer.

Table 2 shows the range of median concentrations measured in these studies. The median concentration is the level at which half of the measured homes had higher concentrations while the other half had lower concentrations. Thus, Table 2 shows what might be considered typical levels of these chemicals in California homes. However, because of product reformulations and process changes in recent years, these levels may have decreased since the studies were conducted.

**Table 2: Levels of Chlorinated Chemicals
in California Homes**

CHEMICAL	MEDIAN CONCENTRATIONS ($\mu\text{g}/\text{m}^3$)*
para-Dichlorobenzene	0.82 - 1.81
Perchloroethylene	1 - 5
Chloroform	0.5 - 1
Trichloroethylene	0.3 - 0.8
Methylene Chloride	4 - 5
Methyl Chloroform	9 - 20

* " $\mu\text{g}/\text{m}^3$ " (micrograms of chemical per cubic meter of air) is a unit of concentration in the air; it is equivalent to one millionth of a gram (less than one-millionth of an ounce) of a chemical in a space of one cubic meter

At present, testing of indoor levels of chlorinated chemicals requires professional monitoring services that are expensive. However, such testing generally is not necessary. If you take the recommended actions discussed above, you will greatly reduce your exposures to chlorinated chemicals.

INDOOR GUIDELINE LEVELS

Currently, there are no federal or California indoor air quality standards or guidelines that specify air concentration limits for these six chlorinated chemicals in residences or public buildings. Because several of these chemicals may cause cancer or other significant health problems, and no absolutely safe levels have been identified, it makes sense to reduce your exposure to these chemicals as much as possible. Therefore, we recommend that you take actions to prevent emissions of chlorinated chemicals in your home and to reduce your exposure to the extent feasible.

Some final comments

The information and recommended actions included in this guideline can help you greatly reduce your exposure to chlorinated chemicals and other pollutants. Implementing these guidelines may take a little extra time and alternative products may initially cost a bit more or be difficult to find. However, your time and money will be well spent, resulting in much lower levels of these chemicals in your home. An excellent FIRST step is to check around your house, garage, and storage areas for any of the products mentioned above. Make sure the containers for the products you keep are in good condition and are stored properly. Safely dispose of all the others immediately.

Finally, keep in mind that many of the steps you take to reduce the levels of indoor chlorinated solvents will also reduce the levels of other indoor air pollutants as well. The improved health and safety of your family is the bonus for all your efforts.

Related reading

Residential Air Cleaning Devices, Fact Sheet, California Air Resources Board, 2000.

Reducing Indoor Air Pollution, California Air Resources Board, public information booklet.

Formaldehyde in the Home, California Air Resources Board, Indoor Air Quality Guideline No.1, September, 1991.

Combustion Pollutants in Your Home, California Air Resources Board, Indoor Air Quality Guideline No. 2, March, 1994.

EPA and Indoor Air Quality, U.S. Environmental Protection Agency, Indoor Air Facts No. 1 (Revised), Air and Radiation Division, December, 1991.

See page 11 for web sites where these documents can be found.

**For more
information**

For free copies of this brochure or other Air Resources Board documents, please contact :

California Air Resources Board
Public Information Office
1001 I Street
Sacramento, CA 95814

(916) 322-8282 (Indoor information inquiry message line)
(916) 322-2990 (Public Information Office)

IAQ guidelines: www.arb.ca.gov/research/indoor/indoor.htm
Research summaries: www.arb.ca.gov/research/indoor/resnotes.htm

Other sources of information:

U.S. Environmental Protection Agency
Indoor Air Quality Information Clearinghouse
(800) 438-4318
www.epa.gov/iaq

California Department of Health Services
Indoor Air Quality Program
(510) 540-2476
www.cal-iaq.org

Acknowledgments

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YOUR ACTION PLAN

1. Dispose of unwanted consumer products

Date performed

- a. Find unwanted products in bathroom cabinets, kitchen cabinets, utility room, desk drawers, hallway storage rooms, garage.
- b. Contact local authority in city or county hazardous waste department for proper disposal.
- c. Assure that remaining consumer products are in good condition (no leaky or corroded containers) and that containers are tightly sealed and not damaged.
- d. Remove mothballs and take alternative actions to protect clothing.

2. Lower your exposure when taking a shower

- a. Take warm showers instead of hot showers.
- b. Shorten the showering time.
- c. Use the bathroom exhaust fan or open the bathroom window when showering.
- d. Adjust the water heater thermostat to a lower temperature.
- e. Install a water flow restrictor in the shower head.

Regularly

Regularly

3. Other actions

a. _____

b. _____

c. _____
