



FORMALDEHYDE

IS IT A PROBLEM IN MY HOME?

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Is Formaldehyde From Laminate Flooring a Problem in My Home?



Recent media attention regarding emissions of formaldehyde from Chinese-made laminate flooring has led some consumers to ask if there is a risk associated with laminate flooring in their home or business.

We do not yet know if the formaldehyde emissions (also called outgassing or off-gassing) from laminate flooring as reported by the media represent a widespread or limited issue, nor do we know if the levels that have been reported are what building occupants will actually experience.

Chamber tests of flooring samples can produce accurate formaldehyde measurements, but they do not necessarily represent in-home conditions. Accurate evaluation of occupant exposure to formaldehyde emissions from laminate flooring in the home is challenging, and individual test results can be misleading without the proper context and interpretation.

This guide is intended to help you decide if you want to investigate a possible indoor formaldehyde problem that you suspect is attributable to laminate flooring. It will be important for you to:

- ▶ Decide if there is sufficient evidence of the potential for indoor formaldehyde levels of concern to warrant investigative work.
- ▶ Decide if testing, ventilation, waiting, or other remedies are needed.
- ▶ Recognize when you should seek outside help.
- ▶ Decide what expertise is required for testing or remediation.
- ▶ Select an industrial hygiene consultant if necessary.
- ▶ Determine the options to address the formaldehyde problem if one is confirmed to exist.
- ▶ Confirm that the steps taken have addressed formaldehyde emissions successfully.

What is Formaldehyde and What Are Common Sources in Indoor Air?

Formaldehyde is a volatile organic compound (VOC) or gas that is typically present indoors at low levels as the result of formaldehyde-emitting materials and human activities in the home. The indoor formaldehyde level is usually higher than outdoor levels.

Higher concentrations of formaldehyde may be detected indoors after the installation of a variety of building products and furnishings including some carpets or carpet padding, cabinets, counters, particleboard shelving, particleboard subflooring, some insulation materials, permanent press fabrics, and laminate flooring products. Formaldehyde may also be present in glues, adhesives, home furnishings, building finishes, and cigarette smoke.

In some cases, formaldehyde can be the source of a pungent, unpleasant odor in buildings. However, potentially harmful levels of formaldehyde can be present without a detectable odor.

Usually, the major source of formaldehyde in homes is composite wood products, also called pressed wood products, made with urea-formaldehyde resins. These include particleboard, interior hardwood plywood, and medium density fiberboard (MDF), which has the highest concentration of urea-formaldehyde of any composite wood product. Laminate flooring is most often constructed with a core of MDF.

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FORMALDEHYDE

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What is Formaldehyde and What Are Common Sources in Indoor Air?

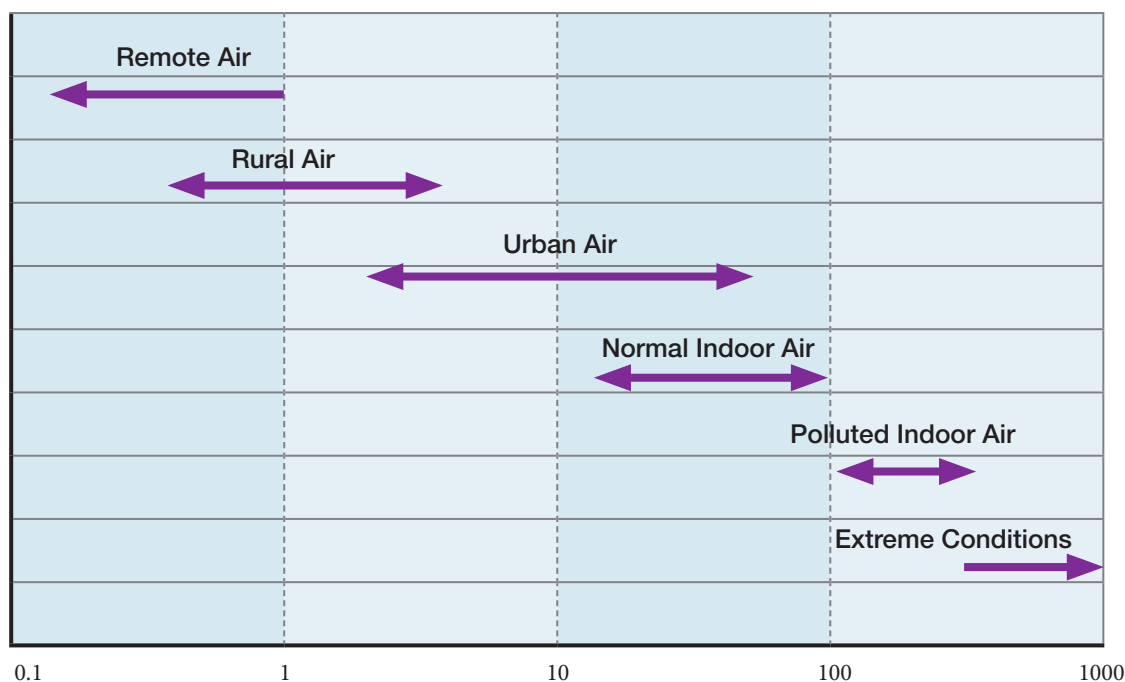
The core material in the laminate flooring from some manufacturers in China described in the media is MDF. Formaldehyde emission rate tests conducted in 2014 and 2015 show that most of the laminate flooring manufactured in China has core MDF that substantially exceeds the California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM) guidelines.

The emissions of formaldehyde from composite wood products are highest after initial installation and decrease over time. The half-life — the time for the formaldehyde emissions to decrease by half — can range from a few months to a few years, depending on the specific product.

The following figure shows a range of formaldehyde concentrations in indoor and outdoor air (Salthammer, 2010).

It would be unusual to find concentrations of formaldehyde below 4 parts per billion (ppb) in most homes. Indoor concentrations of formaldehyde above 100 ppb are also unusual and may warrant additional investigation.

A California study of indoor air quality in recently built homes (three to five years old) found a similar range: indoor concentration of formaldehyde ranged from 4 ppb to 120 ppb, with a median of 29 ppb (i.e. half of the homes had higher indoor concentrations). The outdoor formaldehyde concentrations ranged from less than 1 ppb to 6.5 ppb with a median of 1.7 ppb (Offermann, 2009).



Is Formaldehyde From Laminate Flooring a Possible Health Concern?

If significant indoor levels of formaldehyde are found from flooring or from some other source, action may be appropriate.

Formaldehyde can cause eye, nose, and throat irritation and has been identified as a human cancer-causing agent (IARC, 2009).

As of May 2015, the level of formaldehyde in homes is not federally regulated in the United States except in mobile homes.

The CARB Formaldehyde Air Toxics Control Measure (ATCM) regulates the emissions of formaldehyde from hardwood plywood, particleboard, and MDF.

According to the Centers for Disease Control and Prevention (CDC), the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA) and other US agencies, at present, there is no generally agreed-upon standard for formaldehyde concentrations in residential settings. Several different governmental agencies and other organizations have established occupational definitions and levels for formaldehyde. Regulatory levels differ significantly among agencies (CDC, 2008).

The Canadian Residential Indoor Air Quality Guidelines for formaldehydes specify two concentration levels depending on the duration of exposure: a one-hour exposure recommended limit of 100 ppb (the level at which eye irritation may occur) and an eight-hour exposure recommended limit of 40 ppb (the level at which respiratory symptoms may occur in children).



FORMALDEHYDE



What Can a Homeowner or Building Occupant Do About Possible Laminate Flooring Formaldehyde Outgassing?

Decide if testing is appropriate

If the flooring in your home is not a recently manufactured Chinese-made wood laminate product such as the flooring identified in recent media reports, it is not a likely candidate for formaldehyde testing. Testing to date has focused on Chinese-manufactured flooring and confirmed the presence of formaldehyde while similar testing has not been reported for similar products from other countries.

If occupants of a building have health-related complaints that seem to occur or worsen after spending time in the building and that diminish when spending time out of the building, it is possible that something within the building may be causing or contributing to those complaints.

Building-related complaints of watery eyes; burning sensation in the eyes, nose, or throat; headaches; complaints of respiratory distress or chemical odors; or advice from a doctor are all valid reasons to investigate indoor air quality or testing for formaldehyde (or for other substances).

Beware of inadequate testing

Surges in media attention and public concern regarding environmental risks often produce opportunists hoping to profit from your inexperience and your desire for a healthy environment. Although many environmental test kits or tools can be useful, using them without expertise or guidance can also lead to incorrect, expensive, and even unsafe conclusions.

Air monitoring devices are available for measuring formaldehyde in homes. However, the accuracy and sensitivity of the devices vary significantly. The use of some testing devices requires specific training and analysis by a qualified laboratory. Passive samplers that use 2,4-dinitrophenylhydrazine (commonly known as DNPH) often have good accuracy and sensitivity for measuring formaldehyde concentrations in homes.

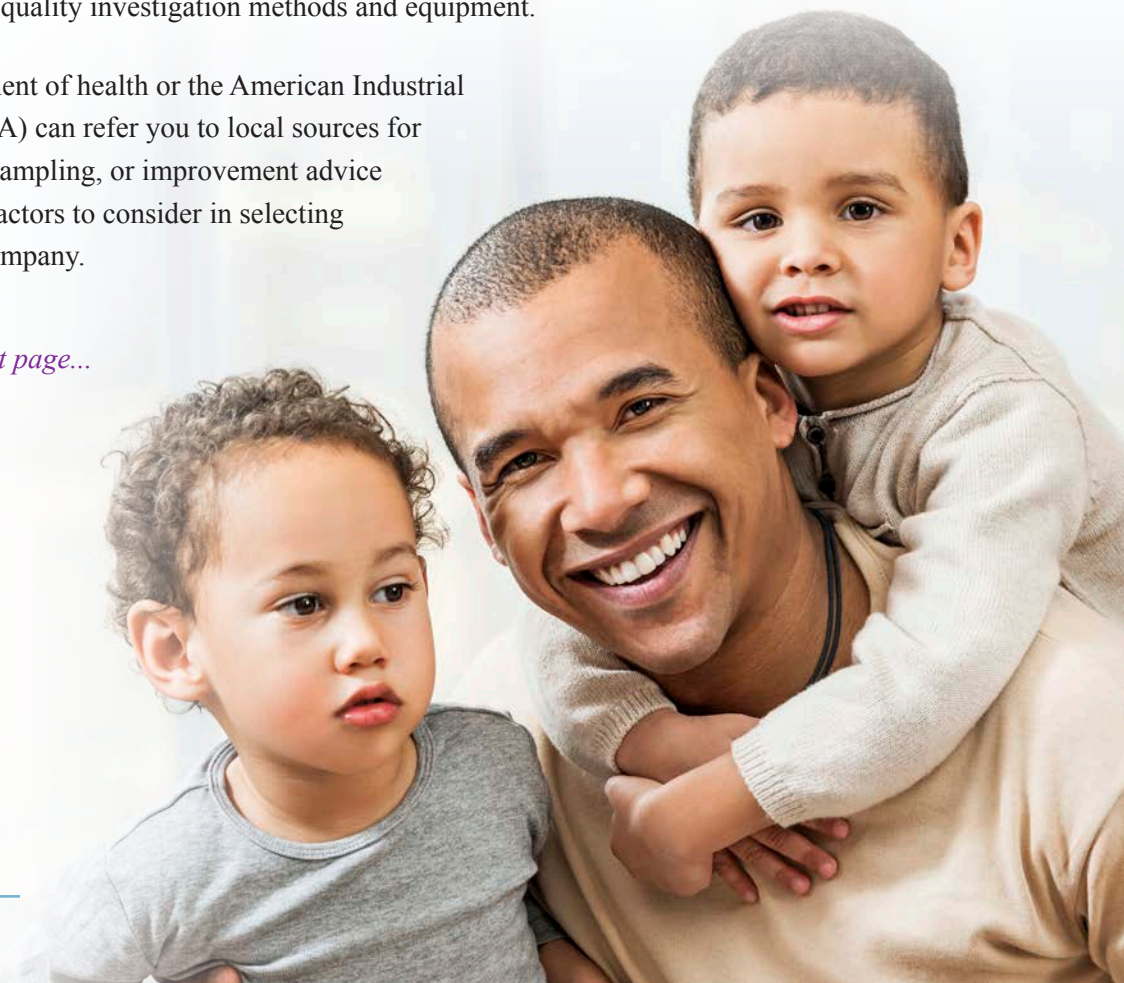
However, without a testing strategy and the appropriate expertise, even a highly precise test for formaldehyde can give misleading results, either indicating a problem where there is none or missing a problem that actually exists.

Tests indicating that formaldehyde is present will not necessarily indicate the source of formaldehyde emissions. You may have to pay twice: once to have a test performed and again to have an expert give advice on what actions to take based on more diagnostic test results.

Industrial hygiene experts performing field investigations are informed about valid and useful indoor air quality investigation methods and equipment.

Your local or state department of health or the American Industrial Hygiene Association (AIHA) can refer you to local sources for indoor air quality testing, sampling, or improvement advice and provide guidance for factors to consider in selecting a qualified individual or company.

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What Can a Homeowner or Building Occupant Do About Possible Laminate Flooring Formaldehyde Outgasing?

Ventilate to reduce indoor air contaminant levels

For some indoor contaminants, adding or increasing outdoor air ventilation of a building can make substantial improvements in indoor air quality, assuming there is a clean source of outdoor air. Combined with balanced ventilation design or a heat-exchanger fresh air system and filtration, this approach can address many indoor air quality issues.

A study of 100 homes in Canada (Gilbert, 2008) and a study of 108 homes in California (Offermann, 2009) both showed that higher ventilation rates are associated with lower concentrations of formaldehyde in homes with new off-gassing sources. However, increasing building ventilation may increase building heating and cooling costs, and, for older homes that already have a high air exchange rate, adding ventilation may not produce as much air quality improvement as anticipated. Offermann (2012) found that in a home where laminate flooring or other materials were emitting formaldehyde, the net improvement in indoor air quality was about 60 percent of the anticipated improvement.

Wait for outgassing to subside

How long will it take for formaldehyde outgassing from laminate flooring to subside? The rate of outgassing — as well as the level of indoor formaldehyde attributed to a specific source such as laminate flooring — depends on a number of variables. These variables include the initial formaldehyde levels, the type of laminate flooring and its constituents, the amount of formaldehyde used in the original product, the product's manufacturing process, building temperature, the building's outdoor air ventilation rate and humidity level, and the age of the material when it was installed.

For some furnishings and building materials, the formaldehyde outgassing level can drop by as much as 50 percent within a few months. But this may not be the case with laminate flooring because its surfaces are sealed with a laminate layer. Depending on the type of laminate flooring and its installation, outgassing, particularly if initially at a high level, may continue over a long period. The half-life of formaldehyde outgassing from these flooring products has not been established.

The length of time required for outgassing to subside depends on the initial formaldehyde levels and the desired final level. If a “wait” strategy is to be used, these factors should be determined in advance and a mechanism should be specified to determine when the process is complete.

It has been proposed that some formaldehyde outgassing materials could be sealed with a low-VOC sealant — a step that in theory would slow the outgassing process and thus reduce the formaldehyde levels substantially, assuming that ventilation remains constant. However, this approach may not be practical for laminate flooring that already has been installed.

Remove the source of formaldehyde outgassing?

In most situations, it is not practical to remove formaldehyde outgassing flooring, cabinets, subflooring, or similar materials. However, inspection and testing by an industrial hygienist or indoor air quality expert might discover exceptions to this view or may provide other practical strategies. Other sources of indoor formaldehyde such as indoor furnishings may be candidates for removal.

Inappropriate methods for reducing indoor formaldehyde outgassing

“Bake-out” efforts may temporarily increase indoor formaldehyde levels, may not reduce long-term formaldehyde levels and should not be attempted in occupied buildings.

Ozone generators are not recommended for dealing with formaldehyde because they are generally ineffective and can cause additional indoor air quality problems. Air cleaners and air purifiers are also not recommended because they are generally ineffective.

Additional Information about Formaldehyde and Laminate Flooring

- ▶ American Industrial Hygiene Association (AIHA) can provide an industrial hygiene consultants list. (703) 849-8888 or www.aiha.org.
- ▶ AIHA: “Guidelines for Selecting an Indoor Air Quality Consultant.” Available at <http://air.ky.gov/SiteCollectionDocuments/GuidelinesforSelectingAnIndoorAirQualityConsultant.pdf>
- ▶ AIHA: “Is Air Quality a Problem in My Home?” Available at [www.aiha.org/about-aiha/Press/ConsumerBrochures/Is Air Quality a Problem in My Home.pdf](http://www.aiha.org/about-aiha/Press/ConsumerBrochures/IsAirQualityaProbleminMyHome.pdf)
- ▶ AIHA: “Laminate Flooring Outgassing: Technical Guidance.” Available at <https://www.aiha.org/government-affairs/Pages/Position-Statements-and-White-Papers.aspx>
- ▶ California Air Resources Board and the Office of Environmental Health Hazard Assessment: “Air Toxicology and Epidemiology.” Available at <http://oehha.ca.gov/air/allrels.html>
- ▶ California Air Resources Board: Composite Wood Products Airborne Toxic Control Measures(2008). Final regulation as approved. Available at www.arb.ca.gov/regact/2007/compwood07/fro-final.pdf and www.arb.ca.gov/toxics/compwood/compwood.htm
- ▶ Canadian Department of Health (Health Canada): “Formaldehyde in Indoor Air.” Available at www.hc-sc.gc.ca/ewh-semt/pubs/air/formaldehyde/fact-info-eng.php
- ▶ Centers for Disease Control and Prevention: “Formaldehyde and Your Health.” Available at www.cdc.gov/nceh/formaldehyde/
- ▶ U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, U.S. Department of Homeland Security, and Federal Emergency Management Agency: “Formaldehyde Exposures in Homes: A Reference for State Health Officials to Use in Decision-making.” Available at www.cdc.gov/nceh/ehhe/trailerstudy/pdfs/08_118152_compendium-for-states.pdf
- ▶ Gilbert, N. L., Guay, M., Gauvin, D., Dietz, R. N., Chan, C. C., & Lévesque, B. “Air change rate and concentration of formaldehyde in residential indoor air.” *Atmospheric Environment*, 42(10), 2424-2428 (2008). Available at <http://www.sciencedirect.com/science/article/pii/S1352231007011466>

IS IT A PROBLEM IN MY HOME?

- ▶ International Agency for Research on Cancer: “ (2009). IARC classifies formaldehyde as carcinogenic to humans.” Press release no.153. Available at www.iarc.fr/en/media-centre/pr/2004/pr153.html
- ▶ National Institute for Occupational Safety and Health: “Formaldehyde.” Available at www.cdc.gov/niosh/topics/formaldehyde/
- ▶ Offermann, F. J. “Ventilation and Indoor Air Quality in New Homes.” California Air Resources Board and California Energy Commission, PIER Energy-Related Environmental Research Program. Collaborative report. CEC-500-2009-085 (2009). Available at www.arb.ca.gov/research/apr/past/04-310.pdf
- ▶ Offermann, F.J., Maddalena, R., Offermann, J.C., Singer, B.C., and Wilhelm, H., “The Impact of Ventilation on the Emission Rates of Volatile Organic Compounds in Residences.” Proceedings of Healthy Buildings 2912, Brisbane, Australia, (2012)
- ▶ Salthammer, T., S. Mentese, and R. Marutzky: “Formaldehyde in the indoor environment.” Chemical Reviews 110.4:2536–2572 (2010). Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2855181/>
- ▶ U.S. Consumer Product Safety Commission: “An Update on Formaldehyde” (2013). Available at [www.cpsc.gov/PageFiles/121919/AN UPDATE ON FORMALDEHYDE final 0113.pdf](http://www.cpsc.gov/PageFiles/121919/AN_UPDATE_ON_FORMALDEHYDE_final_0113.pdf)
- ▶ U.S. Environmental Protection Agency (EPA): “Formaldehyde.” Available at <http://www2.epa.gov/formaldehyde>.
- ▶ U.S. EPA and National Institute for Occupational Safety and Health: “Building Air Quality: A Guide for Building Owners and Facility Managers” (December 1991). NIOSH publication 91-114 (U.S. Government Printing Office). Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2855181/>.

The approximately 10,000 members of the American Industrial Hygiene Association (AIHA) serve in the occupational and environmental health and safety profession, practicing industrial hygiene in industry, government, labor, academic institutions, and independent organizations, primarily in the United States and Canada. AIHA is a knowledgeable authority on all aspects of the profession. AIHA technical committees endeavor to ensure that reliable information is provided to anyone concerned with the health and safety of people in the workplace and, in some cases, homes. This consumer guide was written by the AIHA Indoor Environmental Quality Committee’s Task Force on Laminate Flooring Formaldehyde Outgassing.

