

# Is your *attached* garage polluting your indoor air?

An attached garage can be a huge convenience in a home. It's a luxury to climb into a warm car in the winter, and have a place to work on projects and store equipment. However, attached garages often contain harmful pollutants that can find their way into the home. While they're not visible, pollutants from vehicle exhaust, combustion heating appliances, and fumes from stored paints and cleaning products could be there nonetheless. They can leak into the living space through an open interior door, via small holes or cracks in the wall, through shared ductwork, or even through a common attic or crawlspace. Negative air pressure between the house with respect to the garage, which can be caused by thermal conditions in the two spaces, wind, or mechanical appliance operation, only exacerbates the issue.

In Alaska, current building technique calls for the shared wall between the garage and home to be treated the same as a typical exterior wall: air-sealed using an air/vapor barrier such as 6-mil polyethylene. While this helps prevent some transfer of pollutants, it doesn't block them entirely. Furthermore, many older homes don't even have an air/vapor barrier in the shared wall, leaving occupants further exposed to unhealthy air.

The connection between attached garages and poor indoor air quality is well demonstrated. In Canada, a study of 50 homes showed that stored paint, gasoline solvents, and gasoline-powered vehicles in attached garages caused an increase in volatile organic compounds (VOCs) inside the home (Bari, et. al., 2015). A study in Michigan showed a similar effect (Batterman, Jia, & Hatzivasilis, 2007). Emmerich, et. al. 2003 summarizes 12 other research papers indicating attached garages can negatively impact indoor air quality. Dodson, et. al. 2008 found that approximately 20-40% of chemicals found in homes such as benzene, toluene, MBTE, and others could be attributed to an attached garage. Within Alaska, two separate studies identified garages as a source of benzene in homes (George, et. al., 2002) (Gordian, 2009) and another study found carbon monoxide and benzene had leaked from the garage into homes in Anchorage (Freeman, 2005).

While the increased risk of attached garages is well demonstrated, that doesn't mean every house with an attached garage will suffer from poor indoor air quality. See the reverse side for steps to minimize the transfer of pollutants from the garage to the home.



Pollutant	Sources	Health effects
Carbon monoxide	In exhaust gases from combustion appliances such as automobile engines, combustion heating devices, fireplaces, generators, and gas ranges	- In high doses, CO causes death - Short-term, low exposure causes flu-like symptoms, including headache, dizziness, vomiting, chest pain, and confusion - Long-term, low-dose exposure can lead to symptoms such as headaches, fatigue, trouble concentrating, numbness
Benzene	In fumes from gasoline, paint and glue; in automobile exhaust and cigarette smoke	- Short-term exposure can cause drowsiness, headaches, confusion, tremors, and unconsciousness; irritates skin, eyes, and throat if inhaled; causes vomiting and other problems if swallowed - Prolonged exposure can lead to leukemia and other cancers
Particulate matter	Consists of solid particles and liquid droplets less than 10 micrometers in diameter; includes contaminants such as dust, soot, smoke	- Short-term exposure can cause irritation to eyes and respiratory tract, and shortness of breath - Prolonged exposure can lead to heart disease, heart attacks, aggravated asthma, decreased lung function, and premature death
Formaldehyde	Off-gassing from products such as pressed-wood furniture, glue, and nail polish; in automobile exhaust and cigarette smoke	- Short-term exposure can cause irritation to eyes, skin, and respiratory tract -Prolonged exposure can lead to increased risk of cancer
Toluene	In fumes from gasoline, antifreeze, paint, fingernail polish, and adhesives; in automobile emissions and cigarette smoke	-Short-term exposure can lead to headaches, dizziness, nausea; irritation of skin, eyes, and nose -Long-term exposure can damage the nervous system and cause cognitive impairment, vision and hearing loss. High exposure during pregnancy can cause birth defects

# Prevent your attached garage from polluting your indoor air

If you have an attached garage, there are many steps you can take to mitigate the effects on your indoor air quality.

**Ensure your home has working smoke and carbon monoxide (CO) alarms.** CO is not detectable by humans and is extremely dangerous. If you already have a CO alarm, check that the batteries are working and that it hasn't expired. Many models expire after 5-7 years because the detector component is no longer effective.

## Reduce the amount of contaminants inside the garage:

- Minimize how long the car runs inside the garage.
- Read labels on any substances you plan to store in the garage and follow instructions, such as storing in a well-ventilated area or out of reach of children. Consider using an outdoor shed to store fuels and noxious chemicals, and buying certified cleaners and other products with lower emissions, such as EPA Safer Choice: <https://www.epa.gov/saferchoice>

**Heating appliances should be sealed-combustion.** Unlike natural draft appliances, they have little risk of backdrafting dangerous exhaust gases. **Heating appliances should be serviced annually, and be supplied with adequate make-up combustion air**, which helps them run more efficiently and safely all year. An annual service also can identify if exhaust gases are leaking from the combustion chamber or flue.

**Ensure your home has adequate ventilation.** In Alaska, over half of homes are at risk of indoor air quality issues because they are relatively airtight and lack mechanical ventilation (Wiltse & Madden, 2018). This means that if pollutants get into the living space, through the garage or other means, their concentration can reach high levels. Air intakes for ventilation systems should be located at least 15 feet from the garage entry to prevent garage air entering through the ventilation system (ASHRAE, 2016).

**Shared surfaces between the home and the garage should be sealed with an air/vapor barrier such as 6-mil polyethylene.** This includes any shared walls between an attic or crawlspace and the garage. While air-sealing will not necessarily keep all pollutants out, it can limit them substantially (Merrin et. al., 2018). Any penetrations in the wall, such as electrical outlets, ducts, and pipes, should also be air-sealed. The door to the house should be metal, close automatically, be fire-rated, and have a weather seal. For further details on air-sealing the shared wall, visit the following links:

- U.S. Department of Energy: <https://bascc.pnnl.gov/resource-guides/air-sealing-attached-garage>
- Southface Institute: [https://www.eiec.org/wp-content/uploads/2014/11/attached\\_garages\\_041614.pdf](https://www.eiec.org/wp-content/uploads/2014/11/attached_garages_041614.pdf)

**If possible, locate all ventilation equipment inside the house** instead of in the garage. When it is in the garage, it offers a pathway for contaminants to enter a house via the ductwork or any wall penetrations not properly air-sealed.

Are you planning an attached garage on your new home? If so, consider a detached garage instead. While attached garages are convenient and often cheaper to build, it is difficult to ensure they will not negatively impact indoor air quality. A detached garage removes the pathway for contaminants in the garage to enter the house. If that isn't an option, consider building the garage next to the house, and minimizing the amount of shared wall. "Tuck-under" garages are problematic in Alaska, because the stack effect caused by the warm building interior and cold outdoor temperatures creates a pressure difference that pulls air upwards from the garage into the home interior.

**Finally, consider installing dedicated ventilation in the garage.** Mallach, et. al., 2016 showed that mechanical exhaust ventilation reduced indoor air concentrations of pollutants from the attached garage in a study of 33 Canadian homes. Another study identified mechanical exhaust ventilation as the most universally effective option in reducing contaminant transport in five Illinois homes (Merrin, et. al. 2018). Unfortunately, there is not an established standard for garage ventilation (for example, air exchange volume, run times, heat recovery) especially in cold climates where homeowners want to minimize heat loss to the outdoors. Consult a contractor and consider the garage and its uses when choosing a ventilation system. Homeowners with natural draft combustion systems in their garages should NOT employ exhaust only ventilation, as it could backdraft the appliance and draw exhaust pollutants into the garage.

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