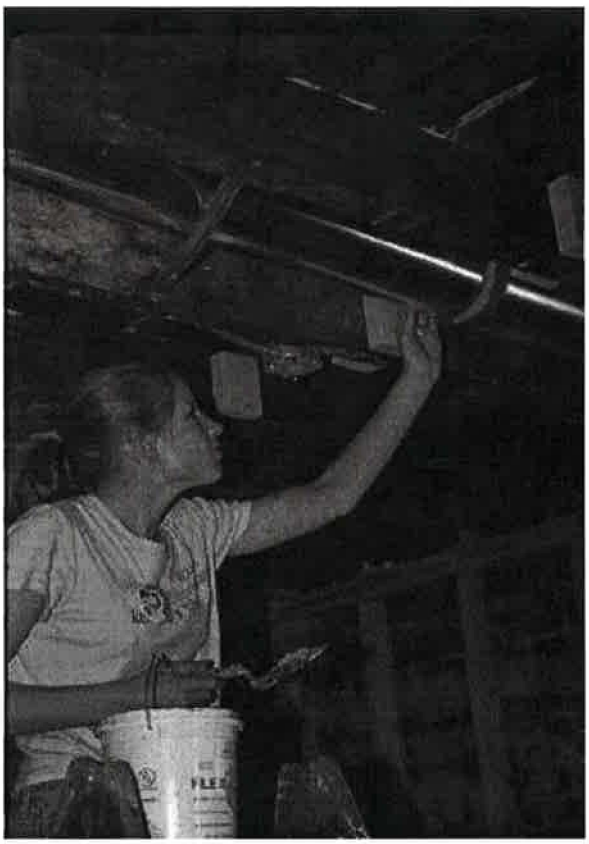
Those Wild Ducts in Your Walls

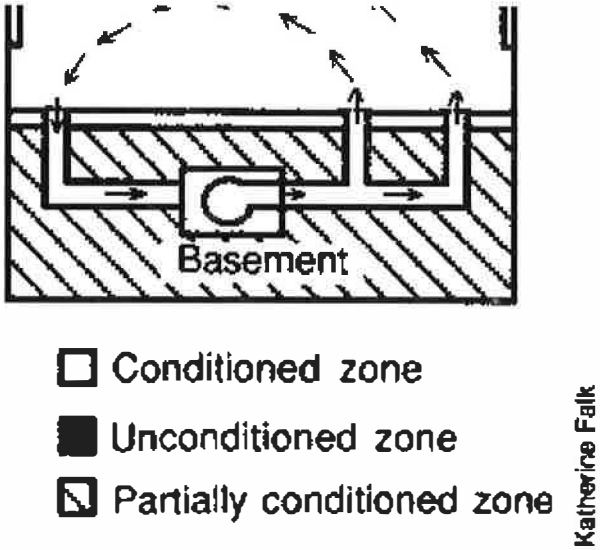
home energy

Home Energy's Homepage



More than three-fifths of the households in the U.S. heat or cool their homes with ducted forced air systems, so chances are good that air ducts are lurking within your walls, floors, or ceilings. These air ducts move conditioned air to warm and cool your family. They can be a great source of comfort–but more likely they are wasting energy and costing you money. Typical duct systems lose 25 to 40 percent of the heating or cooling energy put out by the central furnace, heat pump, or air conditioner. What that means is that it is likely that more than a quarter - and perhaps almost half - of the money you spend to heat and cool your home literally could be vanishing into thin air.

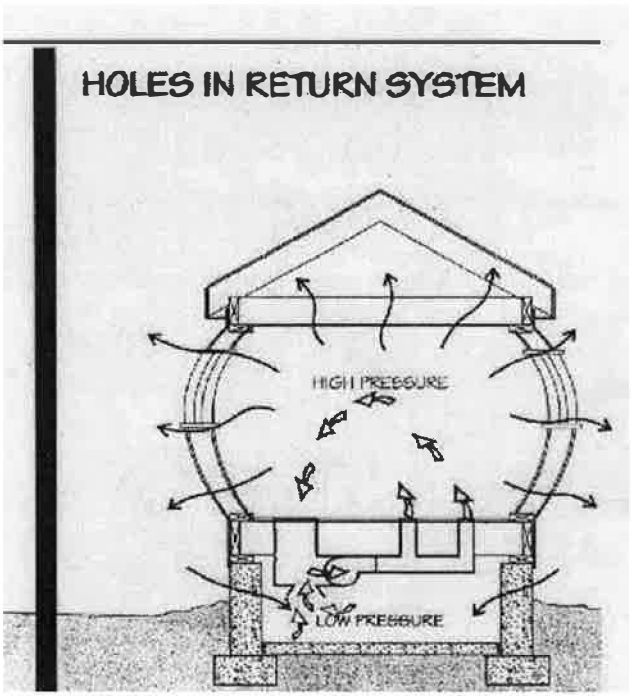
The typical forced air system uses supply ducts to deliver warmed or cooled air from the furnace, heat pump, or central air conditioner to rooms around your home. Return ducts are used to pull back air from those same rooms so that it can be heated or cooled again. The diagram below shows how this works. A fan in the furnace, heat pump, or air conditioner pushes air through supply ducts (on the right) into the living space. The conditioned air heats or cools the rooms. The conditioned air will lose heat through the walls and ceiling of the house if it is warmer than the temperature outside of the house, and it will gain heat if the outside temperature is warmer than the temperature indoors. In either case, the room air is pulled back through return ducts (on the left) by the fan to be reconditioned by traveling again through the furnace, heat pump, or air conditioner.



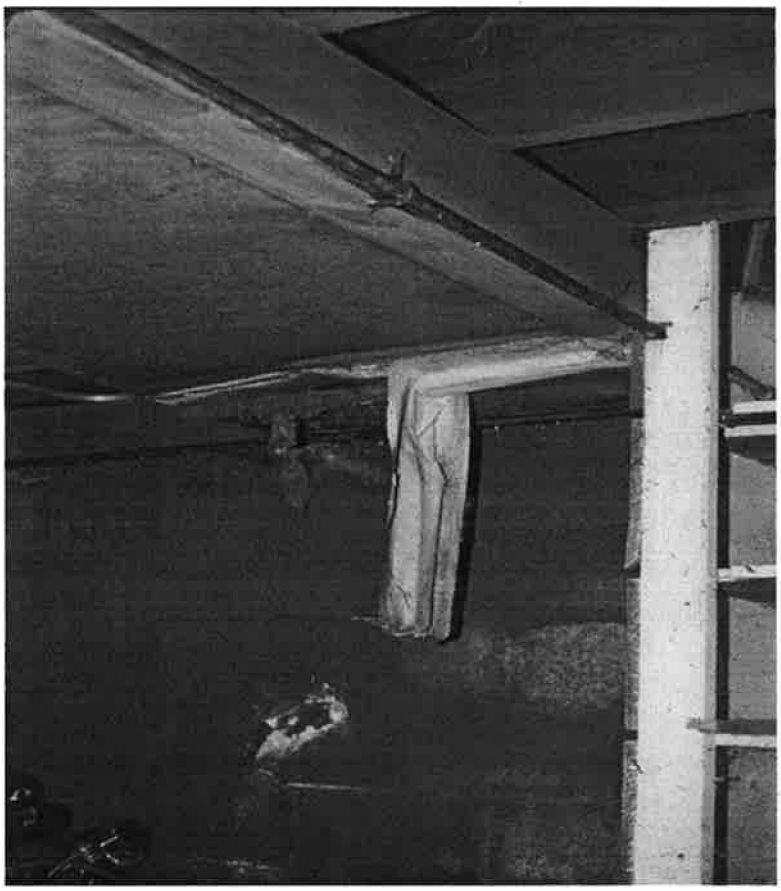
When operating properly the ducts in your house can be a very clean and efficient part of the heating and air conditioning system. Ideally, they can supply conditioned air with minor temperature losses along the way to the places where you want it, and the ducts can remain dust and bacteria free for years without cleaning. But the ideal often does not happen. Ducts almost always leak the conditioned air that you've spent money to heat or cool, and if your ducts are not properly insulated, you're also wasting energy and losing money. Let's look at these two problems and how you can deal with them.

More Holes Than You Want

Many people would not want to live in their basements, furnace rooms, crawlspaces, or attics. If you have as much dusty old junk in your basement waiting to be thrown out as I do, you wouldn't be comfortable sleeping in its midst. But if you have gaps and holes in the return ducts passing directly over the piles waiting for a yard sale, you are probably breathing air pulled from those dusty piles. The figure below shows how holes in the return ducts can pull in air from unwanted places, like your basement or crawlspace.

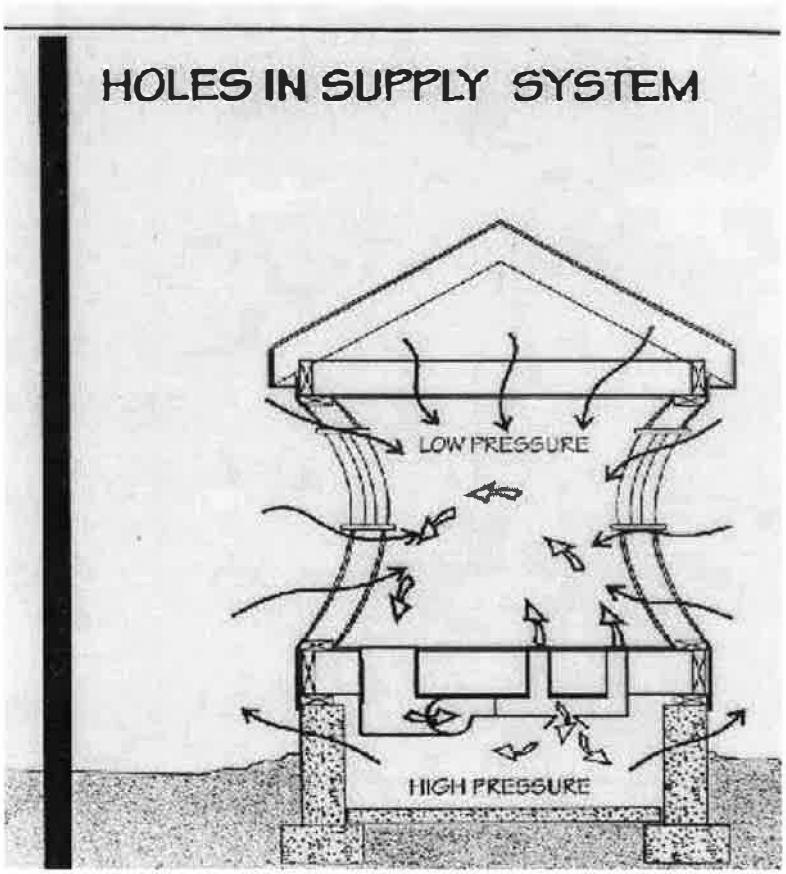


In addition to pulling in dust, dirt, and unwanted biological material, holes in the return ducts of a forced air system can waste energy. For instance, if your return ducts run through your attic, holes and gaps can suck in air that may be below freezing in winter and more than 130 degrees-F in mid-summer. Your furnace, heat pump, or air conditioner will be taxed to bring that additional cold or hot air to the comfortable temperature that you have set on your thermostat. If your return ducts travel through a crawlspace, garage, or partially conditioned basement, the temperature of the air pulled in may be less extreme but the result will still be that your heating or air conditioning equipment will need to work harder than necessary.



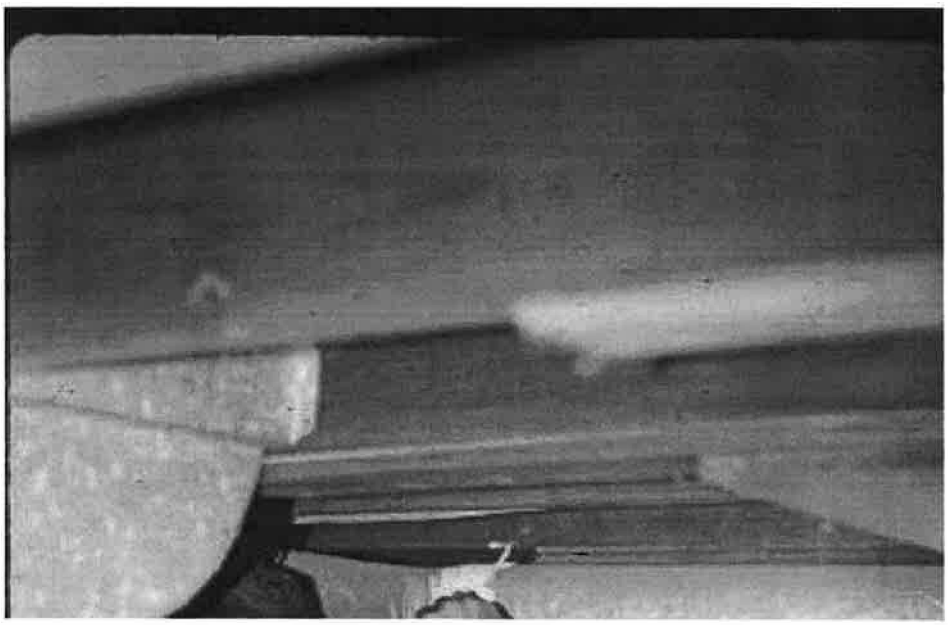
The picture above is an example of loose duct tape on a return duct in a basement leaving a sizeable hole for unconditioned air and dust to enter the forced air system

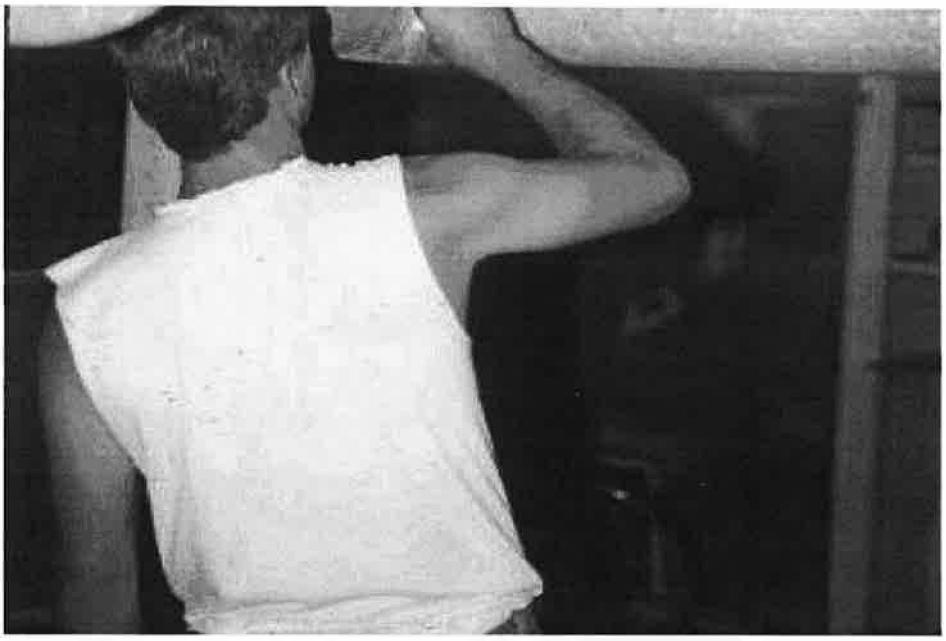
Holes in the return ducts are not the only source of wasted energy from leaky ducts. If you have holes or gaps in your supply ducts, some of that nice warm or cool air is being blown out into the basement or crawlspace and other places you don't want it to go. That means less air is being pushed into the living space than is being pulled out of the living space through the return ducts. Since Nature abhors a vacuum, air from outside the house is pulled through cracks and other openings in the house's walls. In other words, you will be creating a pressure imbalance in your living space that sucks in cold or hot air from outside your house. That outside air will be cold in the winter and hot in the summer - reducing your comfort and making your heating or cooling equipment work harder than necessary. The figure below depicts this somewhat complicated phenomena. The hole on the supply side (the right of the drawing) of the duct system pushes conditioned air out into the crawlspace or basement.



Seal Those Leaks

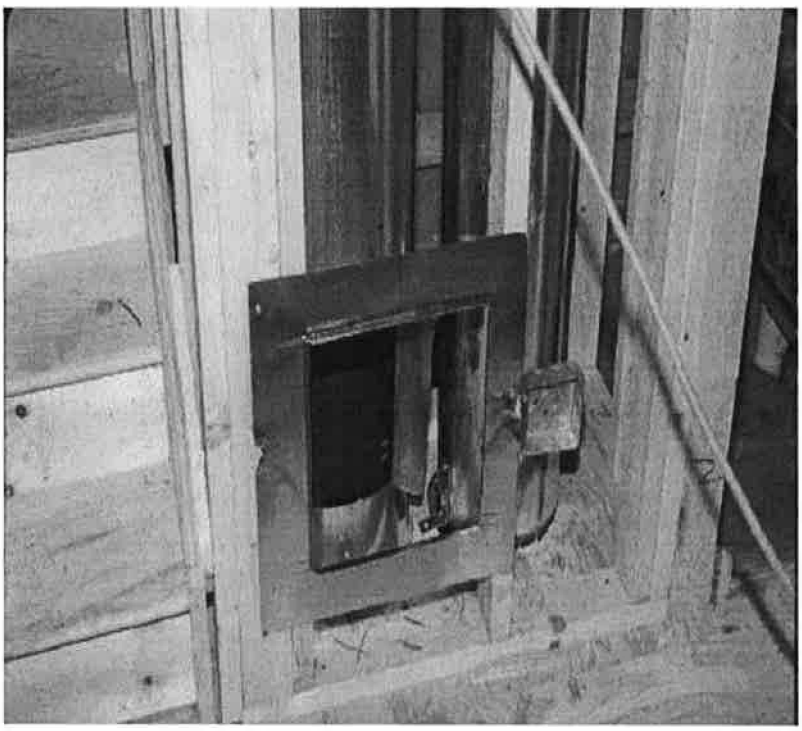
The best way to eliminate the air leakage in your duct system is to close the openings with mastic (a type of caulk), mechanical fastners, additional lengths of ducts, or special tape–but not duct tape. Ironically, duct tape may have many uses; however, sealing heating ducts is not one of them. As it turns out, the adhesives used on standard plastic duct tape dries out quickly and ceases to hold. If you want to use tape, choose butyl tape, foil tape, or fiberglass tape. Look for one that is approved for use on hot surfaces. Even a better idea is to combine fiberglass tape with a layer of mastic or a mechanical fastner. Smearing on mastic can be a messy job, but it is very effective in stopping air leaks.





Openings frequently occur at the joints of duct segments. By applying generous amounts of mastic around all of the joints, you can stop the flows of air out from the supply ducts and into the returns. In the photograph above, a weatherization specialist is applying mastic with a brush to the joints of a supply duct.

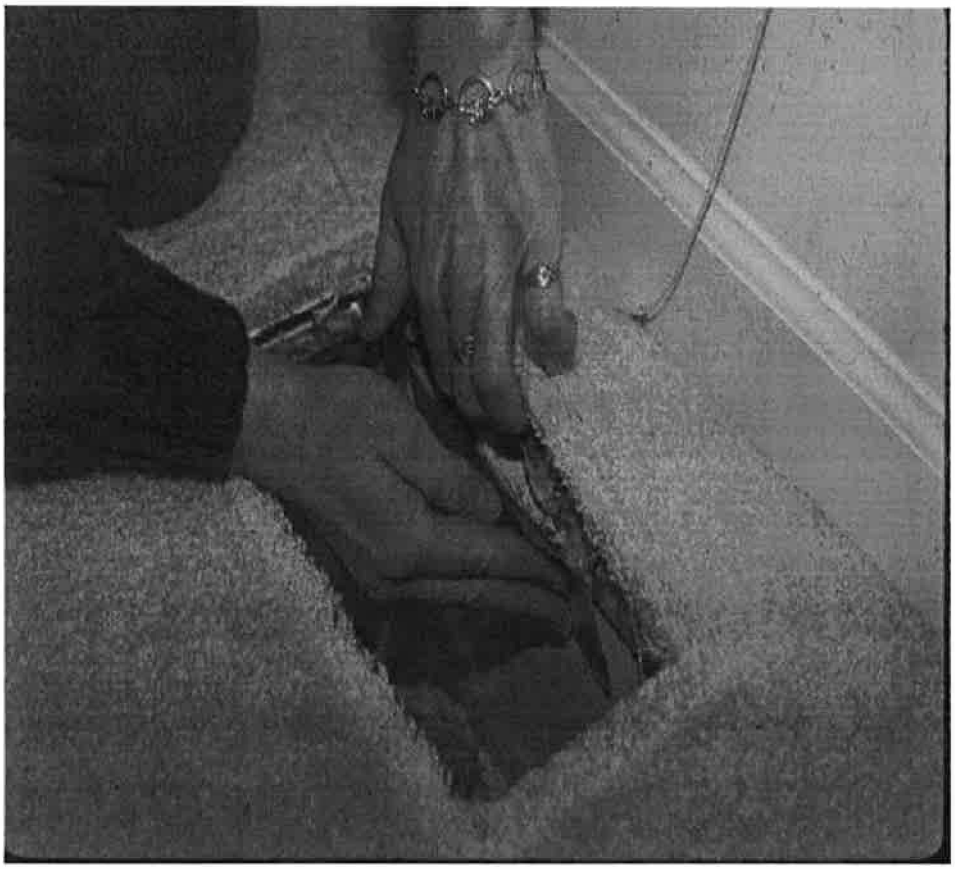
By the way, you need to know that not all leaks will be easy to reach. A hole or gap in an air duct deep in your wall may be quite costly to mend. Since the wall cavities in your house may be partially or entirely open to your attic, crawlspace, basement, or garage, sealing those openings could be very productive of energy savings. Of course the only time to do this sort of duct sealing is likely to be when the walls are open during construction or rehab. One innovative solution to small or moderate sized holes or cracks is to seal with an aerosol-based mastic. This must be done by a trained contractor, but it may be the only option short of ripping open the walls. (For more information on aerosol duct sealing, click here.) Larger opening must be sealed mechanically. Below is a major air bypass that almost was not caught before the walls were closed up.



The photograph above shows that the opening for the grill of the return duct is not directly connected to the duct opening. Instead it is open to the wall cavity and the garage (not seen) behind.

A less difficult spot to look for air leaks is where the ductwork connects to the registers. This is called the "boot", because it often makes a sharp turn up from below the floor or out from inside the wall cavity. One frequently finds that the boot is not well sealed to the floor or wall, thus allowing air to escape from the supply duct into the wall or under the floor. The photograph below shows a boot that is separated by nearly 3 inches from the floor of the room that it is meant to deliver conditioned air.

It is often rather easy to remedy this problem; pull the boot up to the floor and attach it securely or extend the sheetmetal to meet the floor. In either case, one must then seal the boot so that the air that the fan blows is actually delivered to the room. The picture below show a boot being sealed to the floor.



Insulation of Ducts

Another important source of energy loss in forced air systems is through uninsulated ductwork. Whenever you have ducts traveling through crawlspaces, garages, attics, or basements, an uninsulated air duct will deliver the heat or cool from the furnace, heat pump, or air conditioner to the surrounding air--even if there are no air leaks. What happens is that the heated air moving through an uninsulated duct warms the ductwork, which in turn warms the air surrounding the ductwork, through a process known as conduction. (Conduction is the transfer of heat through a solid material, which you can experience when you touch the metal handle of a skillet that is sitting over an open flame.)

The best way to counteract the process of conduction is to insulate with material that is a poor heat conductor. Semi-rigid duct insulation - usually one or two inches thick - can greatly reduce the heat that moves from within the ducts to cool outer air in the winter or from the warm outer air into the ducts during a hot summer's day. Flexible batt insulation can also effectively reduce energy waste through conduction. The photo below shows round ducts that are manufactured with insulation already attached so that they can be installed easily.

You should be aware that you only need to insulate ducts that are in unconditioned or partially conditioned spaces. These areas include: attics, garages, basements, and crawlspaces.

It should be obvious from the discussion above that before you insulate ducts in unconditioned space you need to seal them with mastic or heat-resistant tape (not duct tape). One other point to mention is that ducts to be used for moving cool air should have a vapor barrier on the outside of the insulation so that moisture will not migrate to the cold surface and condense.

Duct Cleaning

Before wrapping up this topic, let's take up again the issue of dirty ducts. You may have been called by a firm offering to vacuum your ducts. There are several things you should be aware of in making a decision on cleaning your ducts. First, you should know that if a duct system is properly sealed along the supply and return runs of the ductwork, there is little likelihood that significant amounts of dust, dirt, and biological material will accumulate in the ducts. Ducts get dirty when holes or gaps in the ductwork permit foreign matter to enter the air ducts. That being the case, it may be wise to investigate and confront the source of this problem rather than repeatedly cleaning your ducts.

Second, you should be very careful about permitting contractors to use biocides or other chemicals in your ducts. If there is a problem of mold or vermin in your ducts, injecting harmful chemicals could affect you and your family as harshly as it does the creatures in your ducts.

Finally, you should know that the EPA does not recommend that air ducts be cleaned except on an as-needed basis. This is because of a continuing lack of evidence showing a health benefit of duct cleaning in most cases. Duct cleaning, in fact, can create a temporary asthma hazard for those who are sensitive, as the cleaning can temporarily draw large amounts of dust and biological material into the living space.

If you choose to have your ducts cleaned, make sure that you choose a reputable firm that complies with the National Air Duct Cleaners Association's standards.

Here are some interesting links relating to duct systems:

U.S. Environmental Protection Agency

- Should You Have the Air Ducts in Your Home Cleaned?
- The Inside Story - A Guide to Indoor Air Quality
- Biological Pollutants in Your Home
- Residential Air-Cleaning Devices - A Summary of Available Information
- Indoor Air Pollution - An Introduction for Health Professionals

U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy

Lawrence Berkeley National Lab.

- Ducts and Duct Sealing

Oak Ridge National Lab.

- Sealing Ducts

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