Indoor Air Quality

By Legislative Affairs

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Background

In the past, referring to indoor air quality mostly meant referring to asbestos-related problems. As interest in the environment has grown, so has the concern over indoor air quality and the range of contaminants that it addresses. This is not surprising considering that the level of air contaminants indoors is often much higher than it is outdoors. Consider the fact that Americans spend approximately ninety percent of their time indoors and one can easily see where predominant exposure to air contaminants occurs. Indoor air quality problems generally result from inadequate ventilation, chemical contamination, or biological contamination. As indoor air quality research evolves, the assessment of adverse health effects of indoor air pollutants has ranged from minor respiratory irritation to cancer and even death.

While indoor air quality is an important concern to the United States Environmental Protection Agency (EPA), the ramifications of indoor air pollutants in the workplace has made indoor air a concern of the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the Consumer Product Safety Commission, (CPSC), the Department of Energy (DOE), the General Services Administration (GSA), the Department of Transportation (DOT) and the Centers for Disease Control (CDC). State and local governments often follow the lead of these agencies with indoor air quality legislation and ordinances.

Indoor Air Contaminants

Indoor air pollution results when gaseous or particulate contaminants are released into indoor air and are exacerbated by inadequate ventilation, high temperatures, and high humidity. Potential sources of indoor air pollution include biological contaminants, building materials and furnishings, tobacco smoke, cleaning and maintenance products, combustion sources, HVAC systems, and many outside sources.

Any "comprehensive" list of indoor air contaminants soon becomes outdated as new indoor air hazards are constantly discovered. Listed below are the currently recognized indoor air contaminants and conditions that add to indoor air quality problems followed by a brief description. For more exhaustive information on these contaminants, please refer to the sources provided at the conclusion of this briefing.

Volatile Organic Compounds (VOCs)

Contained in many building materials and furnishings, VOCs react with the sun to form ozone or smog. The term volatile means that the compounds vaporize at normal room temperature. Some VOCs at high concentrations can cause acute and chronic health effects while others are known carcinogens. They are found in many paints and stains, carpeting, cleaners, pesticides, building materials and furnishings.

Asbestos

A building material widely used from the 1950s through the 1970s for thermal insulation and fire protection and other purposes. It has since been determined to be a carcinogen. Asbestos containing material (ACM) is hazardous when it becomes friable (able to be crumbled, pulverized or reduced to powder by hand pressure.) Long term exposure to asbestos can lead to lung cancer, mesothelioma, gastrointestinal cancer, asbestosis, or other disabling and fatal diseases.

Biological Contamination

The presence of bacteria, molds and their spores, pollen, viruses, or other biological material marks biological contamination. This contamination is usually associated with HVAC systems and water damage. Biological contaminants may breed in stagnant water allowed to accumulate in humidifiers, cooling coil condensation pans, where water has collected on ceiling tiles, carpeting, insulation, internally lined duct work and behind walls. Presence of biological contamination can lead to coughing, chest tightness, fever, chills, muscle aches, and general allergic responses such as mucous

membrane irritation and upper respiratory congestion. Research is ongoing regarding exposure levels necessary to exhibit such symptoms of contamination. (See Appendix A)

Carbon Monoxide

Although identified as an indoor air contaminant, carbon monoxide is rarely at a high enough concentration to cause health problems. It is possible that an inadequate supply of outside air can compound the adverse effects of carbon monoxide which can be deposited into the air from tobacco smoke. Carbon monoxide can also be present in elevated levels if outside air intake is located in an area containing automobile exhaust.

Cleaning Solvents

A variety of chemical and substances, some of which are volatile organic compounds (VOCs) used by maintenance personnel for cleaning and disinfecting. Direct contact and exposure to fumes can cause eye, skin, and respiratory irritations. Many are hazardous and sometimes fatal to humans, especially if not used properly. The combination of some common cleaners can result in toxic or volatile chemical reactions.

Formaldehyde

Formaldehyde is a colorless, strong-smelling gas and a type of VOC which is known to cause eye, skin, and respiratory irritation. It is an important industrial chemical used to make other chemicals, building materials, and household products. It is commonly found in particle board, fiber board, plywood, carpeting, furniture, and other building materials. Urea formaldehyde foam insulation was widely used in residential construction until it was banned in 1982.

Lead

Lead is a toxin which in high levels can cause severe damage to the brain and kidneys in adults and children, abortion of fetuses, and damage to the male reproductive system and death. In lower levels it can cause mental retardation and reduced growth in children, and headaches and other health problems in adults. The most common source of lead as an indoor air contaminant is lead-based paint.

Nitrogen Dioxide

Produced by fuel consumption, usually through gas and oil furnaces, nitrogen dioxide can present an air quality problem if such furnaces are located in areas which are commonly occupied by building inhabitants.

Ozone

Ozone is a pungent gas that can cause respiratory irritation. Copy machines are a common source of ozone contamination if operated in poorly ventilated areas.

Pesticides

Pesticides are classified as a variety of chemicals and substances, some of which are VOCs, used to kill rodents and insects. Direct contact and exposure to fumes may cause eye, skin, and respiratory irritations. Many are hazardous and sometimes fatal to humans especially if not used properly and in a well-ventilated area.

Radon

Radon is a colorless, odorless and naturally occurring radioactive gas produced by the breakdown of uranium in rock and soil. It breaks down and forms solid particles which can be inhaled, linking it to lung cancer-related deaths. Radon gas escapes from the soil and seeps into buildings through cracks in the foundation or openings around pipes. It is more of a problem for single family homes and low-rise buildings.

Tobacco Smoke

Recognized as a major contributor to indoor air quality problems, tobacco smoke contains several hundred toxic substances, including carbon monoxide, nitrogen dioxide, hydrogen cyanide, formaldehyde, hydrocarbons, ammonia, benzene, hydrogen sulfide, benzapryene, tars and nicotine. Tobacco smoke can irritate the respiratory system, and in allergic or asthmatic persons, often results in eye and nasal irritation, coughing wheezing, sneezing, headache, and other sinus problems. Federal legislation banning smoking in public buildings has resulted in a proliferation of similar state and municipal legislation and private company policies to curb smoking in the workplace.

Contributing Conditions to Poor Indoor Air Quality

Many of the contaminants mentioned become indoor air quality problems when they are combined with other conditions. Many indoor air problems can be eliminated or reduced by addressing the following conditions.

Carbon Dioxide Levels

Carbon dioxide (CO_2) is a normal byproduct of breathing and, if monitored, can be used to screen the adequacy of the outside air introduced into a building. CO_2 concentrations are related to a building's occupancy patterns. High levels will be experienced during high occupancy times. The outdoor ambient CO_2 is generally 250/350 parts per million (ppm). As of March 2006, the CO_2 levels stood at 381 parts per million (ppm) — 100ppm above the pre-industrial average. The occupational standard for maximum CO_2 concentration is 5,000 ppm. When CO_2 concentrations exceed 1000 ppm, the supply of outside air is probably inadequate, although it would be unlikely for a building to have a level this high. At these levels, complaints of headaches, fatigue and eye and throat irritation are more frequent. The high level of CO2 is not the source of the complaints. Rather, the high level indicates the increased presence of other contaminants, due to insufficient or inadequate outside air being introduced into the building. NIOSH has maintained that levels below 600 ppm are preferable and should indicate that sufficient outside air is being introduced. NIOSH encourages 1000 ppm to be used as the upper limit guideline. The effects of concentrations between 600 and 1000 ppm are not yet clearly understood.

Temperature

Various guidelines have been developed by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the operating temperature necessary to achieve thermal acceptability or a comfort zone. At this level, eighty (80) percent of the building occupants would find the environment comfortable. For example, the recommended comfort zone for a building occupied by sedentary or semi-active occupants during the summer would be 73° to 79° Fahrenheit. Temperatures above or below this range, or the applicable range for other building types, are likely to result in increased complaints of discomfort.

Humidity

Humidity is closely related to temperature and is referred to as relative humidity. ASHRAE has also developed recommended guidelines for a relative humidity comfort zone. When studying the effects of relative humidity, ASHRAE determined that the ideal range to maintain health and comfort was from forty (40) to sixty (60) percent relative humidity. Levels above or below this range tend to produce more discomfort and increased complaints. A possible explanation for this is that at levels less that forty (40) percent or greater than sixty (60) percent, the presence of bacteria, viruses and fungi in the air become more prevalent. Sampling of relative humidity has found frequent percentage levels ranging into the eighties (80s) in the summer and as low as five (5) percent in the winter. Low humidity causes discomfort and drying of mucous membranes which often results in respiratory problems. It also causes discomfort for contact lens wearers.

Inadequate Outside Air

Prior to the 1973 oil embargo, most building HVAC systems were designed and operated to provide as much as fifteen (15) cubic-feet-per-minute (cfm) of outside air for each building occupant. To save energy, conservation measures have been implemented which reduce the amount of air provided for ventilation to only 5 cfm per occupant. Although within the standard, this level is believed to be too low to flush out air contaminants. NIOSH has also recommended that if smoking is permitted, the minimum amount of air should be 20 cfm per occupant. Also, many HVAC systems do not effectively distribute the ventilation air throughout the building. The result is increased levels of existing pollutants.

Effect on Tenants and Occupants

The above-mentioned factors are all closely related. ASHRAE has developed guidelines recommending comfort levels for all of them. While deviations from these levels are not usually in violation of OSHA standards, they may cause health problems in building tenants. The severity of the problems can vary immensely, but usually involve irritation, illness and loss of productivity. Consequently, property owners and managers of a building with indoor air quality problems may encounter leasing and other tenant-related problems while still being well within OSHA standards. There has also been legal action involving liability for indoor air quality problems (see selected cases). Occupant complaints are the most frequent indicator of indoor air quality problems.

It is normal for some occupants to complain of comfort problems or to experience symptoms and acute sensitivities similar to those caused by indoor air contamination. This is especially true for occupants with existing allergy and sinus problems. Other complaints may result from job-related stress, glare from ceiling lights or monitor screens, noise and vibration levels, work space ergonomics, job dissatisfaction or other psychosocial factors. Even though air quality is not the cause of these complaints, these symptoms may be adversely affected by indoor air contaminants.

When a building's occupants complain of health and comfort problems which can be related to working in the building, the building is said to be "sick". Health problems associated with a sick building's indoor air pollution problems are known as Sick Building Syndrome and Building Related Illness. These terms do not refer to problems that result only from inadequate temperature or humidity control, nor do they refer to long-term symptoms such as those caused by exposure to radon or asbestos. Sick Building Syndrome and Building Related Illness result from short-term exposure to indoor air contaminants.

Sick Building Syndrome (SBS)

The term Sick Building Syndrome (SBS) refers to health problems associated with buildings in which a substantial percentage of the occupants complain of headaches, eye, nose and throat irritation, dry cough, dry or itchy skin, dizziness and nausea or other acute discomfort. Occupants also experience difficulty in concentrating, fatigue, and sensitivity to odors. The cause of these symptoms is unknown. Occupants of a building with SBS usually report relief upon leaving the building.

Building-Related Illness (BRI)

When complaints of symptoms such as coughing, tightness of the chest, fever, chills, and muscle aches are associated with a clinically defined illness, disease or infirmary, that is attributable to exposure to indoor air contaminants, the building is said to cause Building Related Illness (BRI). BRI requires a prolonged recovery time after leaving the building.

Identifying and Dealing with SBS and BRI

Physician and board-certified occupational medicine specialists can determine if individuals who experience the symptoms associated with SBS or BRI do, in fact, suffer the symptoms as a result of the building environment. If the building is determined to be the cause of the symptoms, the property manager will need to identify and resolve the specific problem. A careful assessment and visual inspection of the building or area in question may reveal the cause of the problem.

If symptoms arise suddenly, the manager should first look to any recent changes or occurrences that may have caused the contamination. Many times, symptoms arise soon after remodeling or installing new carpeting which is a major source of VOCs. In other cases, air vents may have been turned off or otherwise blocked. Even the arrangement of work stations, especially modular partitions, can affect SBS and BRI symptoms. Partitioned work areas frequently restrict the proper circulation and supply of fresh air. Flooding, sewer backups and other plumbing problems can also cause air quality problems. Symptoms may also occur during and after maintenance work. Again, it is important to look at any recent changes that may have taken place. If possible, the manager should remove or repair the suspected source of the contaminant and, if possible, should attempt to increase the amount of outside air being introduced into the building and see that it is properly and adequately circulated.

In some cases, the problem will be more difficult to identify or may actually involve multiple sources of contamination. In this case an owner or property manager may need to consult an indoor air quality specialist. Indoor air quality consultants usually employ different methods to identify air quality problems in sick buildings. They also perform preventative inspections and assessments of newly designed or remodeled buildings.

The methods employed by indoor air quality consultants typically involve consultation and diagnostic procedures. In the consultation, investigators will try to identify the nature of the problem through confidential discussions. They will also visually inspect the building and attempt to identify the cause of the problem. If this is unsuccessful, the consultants may perform qualitative diagnostics which may include an evaluation of the building's environmental control and HVAC systems, air sampling, biological and chemical sampling, and perhaps recommendations for treatment of SBS symptoms. Consultants may also perform quantitative diagnostics through on-site and laboratory analysis which would involve objective measurements of contaminants and other factors and the subjective responses of their effect on the occupants. Consultants may also recommend modifications to the building systems or other actions.

Curing Sick Buildings

There are four primary methods to resolving indoor air quality problems: Pollutant Source Removal, Increasing Ventilation Rates, Air Cleaning, and Education and Communication. There are most effective when used concomitantly.

Pollutant Source Removal

Once identified, the source of the contaminant is removed, modified, or substituted. Such action will reduce or eliminate the contaminant emissions. This would include cleaning and changing HVAC filters, removing water-stained carpeting and particle tiles, instituting no-smoking policies or areas and discontinuing use of certain solvents and cleaners.

Increased Ventilation Rates

Ventilation should be provided at no less than 15 cfm per person. However, additional ventilation is helpful in reducing the effect and presence of air contaminants. Poor ventilation exacerbates air quality problems and can allow a problem to arise that could have been prevented with sufficient or increased ventilation. Additional ventilation, preferably localized exhaust, should be employed in

restrooms, copying rooms, printing facilities and smoking areas. These areas are sources of indoor air contaminants.

Air Cleaning

Ordinary filters used in HVAC systems are not effective at trapping many contaminants, such as pollen or small particles. Higher performance filters can remove such contaminants but are costly. Other equipment may be used to remove vapors and gases, but are also costly and require a great deal of maintenance. Improper maintenance and operation of these systems can actually contribute to indoor air quality problems. To be effective, air filtration and purification should be combined with other methods to improve air quality.

Education and Communication

Understanding the sources and effects of indoor air contamination is an important method of controlling air contaminants. If occupants understand what practices and activities contribute to indoor air quality problems, changes in behavior can significantly reduce contaminant problems.

Things Everyone Can Do to Influence Air Quality

The EPA's Office of Air and Radiation has published a simple list of things building occupants can do in order to promote quality air space. Making tenants and their employees aware of these guidelines may help to avoid future indoor air quality complaints.

Do not block air vents or grilles

Keep supply vents or return air grilles unblocked, so you won't unbalance the HVAC system or affect the ventilation of a neighboring office. Furniture, boxes or other materials near supply vents or return air grilles may also affect air flow. Follow procedures to notify building management if the work space is too hot, too cold, stuffy or drafty.

Comply with the office and building smoking policy

Smoke in designated areas only.

Clean up water spills promptly, water and maintain office plants properly and report water leaks right away.

Water creates a hospitable environment for the growth of micro-organisms such as molds or fungi. Some of these microbes, if they become airborne, can cause health problems.

Dispose of garbage promptly and properly.

Dispose of garbage in appropriate containers that are emptied daily to prevent odors and biological contamination.

Store food properly

Food attracts pests and pests carry disease. Never store perishable food products in your desk or on shelves. Keep kitchen and dining areas clean and sanitize as necessary to prevent pests and maintain hygiene.

Case Study

In El Segundo, California, contractors were preparing the interior of a suite on one half of a floor in a twenty-four story, high-tech office building. Two corporate clients, employing sixty individuals, occupied the other half of the floor. Both shared a common HVAC system with the half being remodeled. As new carpet, furniture and paint were added to the interior work being done, the employees of the two existing clients began to complain of dizziness, nausea, nosebleeds, headaches, disorientation, and respiratory problems. The

corporations and many individual employees sued, alleging that the HVAC system was defective. The corporations claimed that lost productivity caused severe losses and interruptions to business operations. It was believed that the situation was worsened because ducts in the HVAC system leaked and did not fully and sufficiently supply fresh air. It was also determined that the problem may have been alleviated by circulating one-hundred (100) percent fresh air into the building to flush out the contaminants, although there would have been a significant energy cost to doing so. Building managers were informed about the problem and asked to increase the fresh air to the floor. Actions taken by the building managers were not sufficient in reducing the problem. It was also determined that circulating one-hundred (100) percent fresh air was impossible for the building's HVAC system, because, even at full efficiency, the dampers were too small to bring in that amount of fresh air. The amount of fresh air being introduced was believed to be near only ten (10) percent. Building managers were unable to address the problem because of the initial design of the building. The general contractor who had constructed the shell and the core of the building had agreed at the time of construction to indemnify the owner. The general contractor settled with the plaintiffs out of court for an undisclosed amount. Interviews of the jury later indicated that they understood the issues and were receptive to the allegations that poor indoor air was to blame for the medical problems and the loss of business.

The lawyer for the plaintiffs would not disclose the amount of the settlement, but stated that the plaintiffs alleged "multimillion-dollar damages" and they were "satisfied". The general contractor is expected to sue the subcontractors, and possibly the architects and engineers. The judge in the case had ruled that if the HVAC system were determined to be defective, a strict liability theory of law could be applied which would make everyone who participated in the design, manufacture, and installation of the system, or its components, liable for damages.

This was the first sick building case to reach a jury. The plaintiff's attorney identified what she believed to be the factors involved in typical sick building circumstances: a tight building shell, inadequate HVAC system, building managers who were perhaps untrained at operating a complicated HVAC system, a building constructed without identifiable tenants in mind which led to interior remodeling being necessary after existing tenants were already in place, and the use of synthetic materials and furnishings containing volatile organic compounds.

Conclusion

The scope of indoor air quality problems has grown dramatically and continues to a major environmental issue in Congress and in state legislatures. There are serious implications for property owners and managers regarding tenant health problems which can result from short term exposure to indoor air contaminants. They range from leasing and tenant problems to financial liability. Although case law is still being developed regarding SBS, experience seems to indicate that indoor air quality is an issue easily understood by juries. Many indoor air problems can be easily addressed once the source is identified. Property owners and managers should keep informed on indoor air quality and take those measures feasible in order to avoid contaminant problems in their properties.

APPENDIX A: MOLD

What You Need To Know About Mold

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What Is Mold?

Mold, one type of fungus, is different from plants, animals and bacteria. Molds are decomposers of dead organic material such as leaves, wood and plants. Molds sometimes can infect living plants and animals. The spores and hair-like bodies of individual mold colonies are too small for us to see without a microscope. When a lot of mold is growing on a surface, it often appears black or green. The color of mold is influenced by the nutrient source and the age of the colony. If mold is growing behind vinyl wallpaper, colorful pink or purple splotches may appear. Mold growing on fabric is called mildew.

What Does Mold Need to Grow?

Mold needs water to grow; without water mold cannot grow. Mold also needs food, oxygen and a temperature between 40 degrees and 100 degrees F. Since mold decomposes dead organic (once living) material it can grow on wood, the paper facing on gypsum board (drywall) and other materials made from wood. Molds secrete digestive fluids that decompose the substrate, making nutrients available.
Mold can also digest some synthetic materials such as adhesives, pastes and paints. While mold cannot get nutrients from inorganic material such as concrete, glass and metal, it can grow on the dirt present on these surfaces. Molds prefer damp or wet material. Some molds can get moisture from the air when the air is very damp, that is when the relative humidity is above 80%. The high humidity makes surfaces damp enough for mold to grow.

How Does Mold Spread?

Mold can grow by extension of hyphae that are like tiny root hairs. In this way, a small colony of mold can expand to cover many square feet of material. Mold can also make spores that are like very small seeds. Spores can survive conditions that are too sunny, hot, cold, dry or wet for mold to grow. When spores are released they can be carried by air or water to new locations. Some spores are so small that they are more affected by air currents than by gravity. When spores land on a damp surface that has food and oxygen available, and if the temperature suits them, they will start to grow. It is important to realize that mold spores are present everywhere, in outside air as well as indoor air – unless very special precautions are taken to remove or kill them. Wherever there is decaying organic material (leaves, mulch, and wood) mold and mold spores are also present. Everyday we are exposed to airborne mold spores from outdoor sources, sometimes at high concentrations. It is almost impossible to create a mold free space or to keep a space mold free. What we can do – and should do – is control the amount of mold in our indoor environments.

Why Do I Need To Know Anything About Mold?

Too much mold can affect the health of you and your family. In addition, mold can damage or destroy building materials such as the wood or gypsum board in our homes.

What Are The Health Effects of Exposure To Mold?

Most people are not affected by exposure to mold, unless they are exposed to a lot of mold. Unfortunately, we are not quite sure what "a lot of mold" means. Furthermore we don't know if "a lot" of exposure to mold for "a brief time" is worse than "not so much" exposure for a longer time. We're also not sure what "not so much" means. Each person is different; what amounts to a "lot of exposure" for some people is "not so much" for others. Remember, mold is everywhere; we are all exposed to mold every day. Exposure to mold can cause allergy in susceptible people, but we don't know how much exposure is necessary to start

the development of allergy. If you have asthma, exposure to mold can cause an asthma attack or make your chronic asthma get worse. At this point we do not know if exposure to mold, especially early in life, can lead to the development of asthma. Although exposure to "enough" mold can cause allergy to mold in susceptible people, accurately diagnosing the allergy can be difficult. Unfortunately, doctors can test for allergy to only a very few of the thousands of species (kinds) of molds that exist.
Only a few molds seem to be able to sometimes cause an infection in healthy people; fortunately these molds do not usually grow in buildings. However, people with a suppressed immune system are much more susceptible to fungal (mold) infections and many of these fungi do grow in wet buildings. Individuals with AIDS, certain types of cancer and those with organ (heart, kidney) transplants on certain drugs are much more susceptible to fungal infections.

Molds sometimes make powerful chemicals called mycotoxins. We think that molds make these mycotoxins to decrease the growth of other molds and bacteria. Penicillin is a mycotoxin that we use because it can kill certain bacteria. Unfortunately some of these mycotoxins make people sick. Mycotoxins can cause illness when they are inhaled, absorbed through skin or ingested (swallowed). Presently we do not know all that much about the health effects of most mycotoxins
on humans. Most of what we know about mycotoxins comes from exposure of farm animals to moldy grain or hay. We do not have any tests that can determine whether mycotoxins are the cause of someone's illness. We cannot easily or reliably measure the level of mycotoxins in air samples to determine exposure levels.

How Can I Prevent Mold From Growing In My Home?

The answer is simple: **keep your home dry.** If mold does not have moisture it cannot grow. Remember mold spores are everywhere so you cannot completely keep them out of your house. Since our houses are built with wood products and paper faced drywall, food for mold is always present. Mold can also thrive on dust, cockroach and dust mite feces, skin flakes and food particles. Oxygen is available in the air so we cannot prevent mold growth by eliminating oxygen. Therefore, controlling moisture is the only effective strategy for preventing mold growth in our homes.

How Do I Keep My House Dry?

First, prevent excessive moisture levels in the air in the house by using the exhaust fans in bathrooms and kitchens where moisture is often generated. Make sure the air from your clothes dryer exhausts from the house. Avoid using a humidifier. If you think that you need a humidifier, first measure the relative humidity inside your home. A device called a **hygrometer** can measure the relative humidity. Try to keep the relative humidity (RH) below 60%. There is rarely a reason to use a humidifier if the RH is above 25%. If you feel you must use a humidifier, measure the relative humidity in the area receiving the humidified air. Never let the
humidifier raise the relative humidity above 35%. Second, look for areas of dampness or wet spots.
Roofs, windows, basement walls and plumbing pipes sometimes leak. If a leak happens suddenly, dry the wet materials as quickly as possible. Mold spores begin to grow 24-48 hours after a water leak. Dry the house quickly and mold will not be a problem.

Small recurring or continuous leaks that are hidden in walls, ceilings or floors present a different challenge since mold growth could be extensive before it is detected. Be alert for dampness in areas such as under sinks, in bathrooms and in ceilings below bathrooms or other plumbing. If you notice dampness in one of these areas or if you notice a strong musty smell in one of these areas, contact your builder.

What Should I Do If I Suspect I Have Mold In My House?

First and foremost, do not panic. Remember mold is everywhere. Even if you do have more than "normal" amounts of mold in your house, you have not necessarily been exposed to it. Exposure means that the mold or mold spores or toxins have gotten inside your body by inhalation (breathing), ingestion (eating) or absorption through your skin. If mold is inside a wall in your home but it does not get into the air, you have

not been exposed. The mold has to get from the wall cavity into the air in the house before you can be exposed to it. However, that does not mean that it's good to ignore the mold if you know you have it somewhere in your house. The mold will continue to grow (as long as it has water), eventually damage the building and increase the chances that you will be exposed.

How Do I Get Rid of Mold In My House?

That depends on how much mold is present and where it is located. If there is only a small amount of mold, such as in a bathroom or kitchen, scrub the moldy area with soapy water, rinse thoroughly and allow to dry. If you have asthma or severe allergies or a weakened immune system, get someone else to do the clean-up. If you have mold on a wall, floor or ceiling, the first question is "where did the water come from?" Remember, mold has to have water to grow. There is no point trying to remove the mold if you do not also correct the moisture problem that led to the mold. If the moisture problem remains, mold will quickly grow back after the initial cleanup. If mold is present in just one corner of a closet scrub it with soapy water, rinse and thoroughly dry. Don't store boxes right up against that corner. Do something to keep that corner warmer such as leaving a light on in the closet. If you have mold growing under a window that leaked or somewhere else that probably is due to a leak, you should have someone with experience dealing with mold in buildings evaluate the building. Why? Again, you need to fix the underlying moisture problem. And more importantly you can release a lot of mold from inside a wall cavity if you don't do the work properly. You can turn a "little bit" of exposure into a "lot of" exposure very quickly.

APPENDIX B: MOLD TESTING

Mold Testing

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Introduction - The Questions

Homeowners want to know if they have a mold problem. Investigators want to find out where the mold is. Insurance companies want to know if the mold has been cleaned up. Doctors want to know if there has been exposure to mold. So why not do mold testing? This sounds very scientific. If only it were that simple. The problems with testing are:

- Airborne fungal spore concentrations vary greatly over the course of hours, days, weeks and seasons. A sample taken at one instant in time, at one location, may not be representative of typical conditions.
- There are no numerical standards to which tests can be compared making interpretation difficult.
- Even extensive, well made tests cannot determine how much exposure people had in the past.
- Fungal air tests are expensive to make. Any money spent on mold testing will not be available for cleaning up the mold and fixing the water problem that led to the mold.
- It may be days, often weeks before the results of testing are known.

Testing for mold should be done to answer specific questions that can't be answered by easier, more accurate or more direct approaches with fewer uncertainties. Neither the New York City (NYC) Department of Health nor the Environmental Protection Agency (EPA) recommend measuring airborne fungal levels. The likelihood that airborne samples will provide information that careful inspection does not is very small. Airborne sampling should be limited to instances where people are experiencing symptoms that seem to be mold related, but no mold is found by inspection.

How Do You Answer the Questions?

If you see mold or you smell mold you have mold. You do not need to test for mold if you see it or smell it. Knowing the type of mold does not change the way you respond. All mold should be treated the same way. It should be removed without exposing people to lots of mold spores or fragments and the underlying moisture problem causing the mold should be fixed. Knowing the species (type) of mold does not affect what must be done to correct the moisture problem or to safely clean up the mold. What you do need to know is the size of the areas that are contaminated and where the areas are located so you can plan the clean-up and protect people from exposure during the clean-up. The greater the area that has mold, the more careful you have to be in how it is cleaned up. Both the NYC Department of Health and the EPA mold remediation guidance are based on the extent of the visible mold growth. Determining the amount of surface area of moldy surfaces is done by looking. Since mold problems are caused by water problems, looking carefully where water is likely to be or where water likely had been is the best approach to looking for mold. It is easier to "find" the water problem by looking for water than it is to find the water problem by testing for mold.

How to inspect for mold? Look in the places where you might find water. Remember that mold may grow in hidden spaces such as within walls or beneath furniture and cabinets. Air testing will not tell you where the mold is coming from – it will only tell you that it is in the air at the instant in time the air sample was taken. The air testing may provide an inference as to a source, but not the specific location. The source for the

mold still has to be found. Sampling is no substitute for inspection. However, inspection can often be a substitute for testing.

What Testing Cannot Answer

Mold testing procedures were not developed to determine whether a home is "safe" or "healthy" or "clean". Presently no standards exist to determine "safe", "healthy" or "clean". Indoor mold testing procedures were developed to identify the locations where mold is growing or where it has grown – the mold "reservoir" locations or mold "amplification" sites.

Part of the problem is that no one knows what typical conditions are for homes, offices and schools – there is no "baseline" for comparison. Research is going on to answer this question. One day we will know, but we don't know now and it will be many years before we know the answer to this question. The other part of the problem is that there is no "doseresponse" curve for mold and humans. We just don't know how much exposure to which molds and for how long leads to problems. It's even more difficult when you realize that no two people are alike. Research is also going on to answer this question and one day we will also have the answer to this question. This question is far more difficult than the previous question and it will likely take much longer to answer. Common sense tells us that "too much" mold for "too long" is a problem for most people. Prudent avoidance is the best course of action at present. Mold testing is not necessary to quantify "too much". Too much mold in a home is obvious. If you see mold and you smell mold – you have mold – and if you see it and you smell it you probably have too much of it. Remember, mold needs water. No water, no mold. In fact it is more basic than that. No water problem, no mold problem. Find the water problem and you will find the mold.

If a home has mold and the water problem that led to mold is obvious it is pointless to test for mold. The mold testing will not tell you anything that you don't already know you have to do which is to clean up the mold and fix the water problem that led to the mold.

Mold testing is expensive. Any money spent on mold testing will not be available for cleaning up the mold and fixing the water problem that led to the mold. Also, the samples can take days or weeks to be analyzed – time that is lost that could better be spent cleaning up the mold and fixing the water problem. No recognized authoritative public agency recommends mold testing to guide the clean-up or to direct correction of the water problem.

Mold testing – especially air testing - is often inaccurate. Air samples at best give a "snapshot" of the air in one location at one time – air samples are not representative of air conditions over time unless many air samples are taken over a long period of time. Air sampling typically overestimates or underestimates the amount of mold in the air on average throughout the day.

How Do I Look for Moisture and Mold?

Look in the places where you might find water that has leaked in from the outside, leaked from interior water sources or has condensed on cold surfaces

- The high spots - roofs and attics, especially near dormers and valleys, roof penetrations for plumbing vents or skylights and walls that intersect roof planes
- The low spots - basements and crawlspaces
- The holes - doors, windows (especially under windows since water usually migrates down from the area of the leak)
- Plumbing pipes and fixtures - water tanks, toilets, sinks, dishwashers, showers, clothes washers and the ceilings underneath these if they are located on an upper floor
- The cold spots - areas in contact with the outside (especially corners of closets), surfaces that are cooled by air conditioning (especially ducts that are near exterior walls or in soffits that connect to exterior walls)

Look carefully in wet places that also have materials that are good mold food:

- processed wood products - paper, paper covered gypsum board, cardboard, particle board, OSB, fiberboard
- wood products - lumber, plywood

Going Deeper - finding hidden mold:

Mold may grow in hidden spaces. The most likely hidden spaces for mold growth are in exterior walls or ceilings or spaces that contain water pipes or air conditioning ducts that are open to crawl spaces or foundations materials. Hidden spaces that frequently hide mold are:

- behind or beneath cabinets, furniture, shelving, appliances fixtures, storage containers; under sinks, cabinets, cardboard boxes, toilets; on walls behind headboards, bookcases, sofas, dressers, file cabinets or toilets.
- behind wall, ceiling or floor surfaces - under vinyl wallpaper, mopboards (the space under kitchen and bathroom cabinets), under carpet or vinyl flooring

There are a number of ways to try to figure our whether mold is growing in any of these locations. Inspection is the most direct method and has the most useful return on effort. Move the furniture; look under boxes, behind toilets and inside closets. Examine vinyl wallpaper for lumps and bumps and pink or purple bleed-through spots. Moisture meters can help determine whether a material is wet, even when it appears dry and can therefore help locate a moisture source or reservoir; the moisture meter provides immediate results.

Several fiber optic instruments (boroscopes and endoscopes) permit looking inside cavities through a small hole. However, this method is not as reliable as opening up the cavity and looking directly. If you are going to cut open a wall, be careful. In the process you could release a large amount of mold into the air. At a minimum have a good vacuum to collect the dust and protect yourself from exposure with a dust mask (N95 mask available at most home improvement stores).

How Do I Know How to Clean Up If I Don't Test?

How to clean up the mold should be based on how much mold is present. The more mold present, the more careful you have to be in how it is cleaned up. The amount of mold present is best determined by how much surface area is covered with mold. Mold remediation guidelines developed by the EPA and others are based on this principle. The number of square feet of mold present on moldy surfaces determines the approach to the clean up. Determining the amount of surface area of moldy surfaces is not done by mold testing. It is done by looking. It is done by looking everywhere. In order to do this it is often necessary to cut holes in walls, ceilings and floors to see. Since mold problems are caused by water problems looking carefully where water is likely to be or where water likely has been is the best approach to look for mold.

Where Testing Is Useful

Biological measurements sometimes provide useful information in finding hidden mold when thorough inspection has not found moisture or mold.

Comparing air samples in many rooms and outdoors sometimes provides evidence that there is fungal growth or at least a reservoir of spores inside a building. However, there are problems with using this method as an assessment tool:

- Large variations over hours, days, seasons require numerous samples, systematically made to be certain that the sample are representative.(Variations are the result of intermittent spore release and the dynamics of air transport).
- There is a difference between total spore counts and viable spore counts. Total spore counts are more representative of allergen load than viable spore counts. Viable spore counts represent a fractional subset of the total spore count and may grossly underestimate the total amount of mold in the air.
- Viable spore counts can provide some information that total spore counts cannot. Only viable spore counts permit speciation, the identification of fungi to the species level. This may be useful in trying to distinguish whether airborne spore counts reflect an outdoor or indoor source.
- Samples that show no evidence of indoor growth can be false negatives. "No growth" cannot be used to conclude that there is not an indoor source of mold. Because of these uncertainties many samples should be taken to increase the probability of obtaining useful information. The likelihood that airborne samples will provide evidence that inspection does not is very small. Reserve air sampling for mystery cases, where things smell moldy or people complain of symptoms that are consistent with mold exposure, but no mold is found upon inspection.

What If the Insurance Company or a Lawyer really wants Mold Testing?

If an insurance company or a third party requires "testing to verify the presence of mold," simply send a piece of moldy material to a qualified lab for verification of the presence of mold (follow the lab's procedures for handling and shipping the sample.)

If it is important for someone to make an estimate (educated guess) of the fungal exposures people have received, then you need to contact someone who has extensive experience in mold investigations. The "educated guess" may or may not involve airborne testing since airborne testing was not developed to assess exposure. And remember, it is only an educated guess.

How Do I Know If The Mold is Cleaned Up If I Don't Test?

The mantra for clean-up is **"clean and dry."** If you don't see it or smell it on a surface you probably don't have it. And if you do have some, even though you don't see it or smell it – you certainly don't have much of it. A little bit of residual mold is not a problem unless moisture is available. Remember, mold is everywhere. Even if the clean-up removes 100 per cent of the mold, spores that are in the air will reintroduce mold back into the cleaned area. The "white glove test" and common sense are currently the best approach. No dust and dirt – no mold. Clean everything for dust and dirt and everything will be clean of mold. All surfaces must be free of debris, dust and dirt. There may be residual mold left in the building that is unseen, but this is acceptable. The object is not to sanitize or sterilize the building. The object is to avoid exposing people to large amounts of mold. Bear in mind that many of the molds that colonize buildings are common in the outdoor air where spore levels may be very high (often having counts of hundreds of cfu/cubic meter, periodically thousands and occasionally tens of thousands). Even if the clean-up does remove 100 per cent of the mold, outdoor air will quickly reintroduce mold spores into the cleaned area. This is why the underlying moisture problem must be corrected to prevent the recurrence of mold. This brings us to the second part of the clean-up mantra- **dry, dry, dry**. A little bit of mold is not a problem. A little bit of residual moisture may be a problem. Materials that have been salvaged must be dry before reconstruction begins. Wooden materials should be less than 15 per cent moisture content by weight and concrete should be less than 4 per cent moisture by weight.

IREM Statement of Policy

For statements of policy on ASHRAE, Asbestos, the Clean Air Act, Toxic Mold and more go to:
http://www.irem.org/pdfs/publicpolicy/Policy-April2006.pdf

Sources for Indoor Air Quality Information

Environmental Protection Agency (EPA)
http://www.epa.gov
http://www.epa.gov/ebtpages/air.html

Indoor Air Quality Information Clearinghouse: (800) 438-4318
http://epa.gov/iaq/iaqinfo.html
iaqinfo@aol.com

Air Risk Information Center Hotline: (919) 541-0888
http://www.epa.gov/ttn/atw/hapindex.html

Asbestos Abatement/Management Ombudsman: (800) 368-5888

Clean Air Technology Center Info line: (919) 541-0800
http://www.epa.gov/ttn/catc/

National Lead Information Center Hotline: (800) 424-LEAD
http://www.epa.gov/opptintr/lead/nlic.htm

National Institute for Occupational Safety and Health
http://www.cdc.gov/niosh/homepage.html

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
http://www.ashrae.org/

American Lung Association
http://www.lungusa.org/

National Association of REALTORS® Field Guide References
http://www.realtor.org/library/index.html

Stigmatized Properties http://www.realtor.org/libweb.nsf/pages/fg703
Mold & Health Issues http://www.realtor.org/libweb.nsf/pages/fg711