















# Applicable Standards and Regulations

OSHA does not have a general IAQ standard, but does provide guidelines addressing the most common workplace complaints about IAQ, which are typically related to temperature, humidity, lack of outside air ventilation, or smoking. OSHA standards address potential hazardous conditions leading to serious physical harm or death. Such standards may include those for specific air contaminants, ventilation systems, or the General Duty Clause of the Occupational Safety and Health Act of 1970 (OSH Act). This section highlights OSHA standards, standards interpretations (official OSHA letters of interpretation of its standards), and national consensus standards related to IAQ.

## OSHA Standards

All OSHA regulations, interpretations, and the OSH Act can be found on [www.osha.gov](http://www.osha.gov). Important OSHA statutes and standards include:

- Occupational Safety and Health Act of 1970

**Section 5(a)(1)**, often referred to as the General Duty Clause, requires employers to “furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.”

**Section 5(a)(2)** requires employers to “comply with occupational safety and health standards promulgated under this Act.”

Some of the applicable OSHA Standards are:

- 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses.
- 29 CFR 1910.94, Ventilation.
- 29 CFR 1910.1000, Air Contaminants.
- 29 CFR 1910.1048, Formaldehyde.
- 29 CFR 1910.1450, Occupational exposure to hazardous chemicals in laboratories.



## State Programs

The *Occupational Safety and Health Act of 1970* (OSH Act) encourages states to develop and operate their own job safety and health plans. States with plans approved and monitored by OSHA under section 18(b) of the OSH Act must adopt standards and enforce requirements that are at least as effective as federal requirements. There are currently 27 State Plan states and territories: Twenty-two of these states and territories administer plans covering both private and public (state/territory and local government) workers; the other plans, Connecticut, Illinois, New Jersey, New York, and the Virgin Islands, cover public-sector workers only.

Additional information on State Plans may be found at <http://www.osha.gov/dcsp/osp/index.html>.

For the most part, these OSHA-approved State Plans adopt standards that are identical to the federal OSHA standards. However, some states have adopted state-specific standards that are at least as effective as the Federal OSHA standards, including the New Jersey IAQ standard. The New Jersey IAQ standard, (N.J.A.C. 12:100-13; 2007) sets standards for indoor air quality in existing buildings occupied by public employees during their regular working hours.

State of California IAQ Program. (<http://www.cal-iaq.org/about-us/about-cal-iaq>)

This program is a part of the California Department of Public Health (CDPH), separate from the State OSHA program. The purpose of the California IAQ program is to conduct and promote the coordination of research, investigations, experiments, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, and control of indoor pollution in California.

## National Consensus Standards

Note: These are **NOT** OSHA regulations. However, they do provide guidance from their originating organizations related to worker protection.

American National Standards Institute (ANSI)/American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).

- **62.1-2010**, Ventilation for Acceptable Indoor Air Quality. This standard specifies recommended outdoor air ventilation rates. The recommended outdoor ventilation rates are based on olfactory studies, and acceptable indoor air quality is met when 80% or more of the exposed people do not express dissatisfaction. Whereas ASHRAE Standard 62 has always been considered a design standard for ventilation, building owner/operators should pay particular attention to Section 8 titled Operations and Maintenance. Section 8 offers guidance to the building owner/operator as to what outdoor air ventilation components should be maintained, what tasks should be performed, and the minimum frequency for performing those tasks.
- **55-2010**, Thermal Environmental Conditions for Human Occupancy. Specifies temperatures that approximately 80 percent of building occupants should find acceptable.

American Society for Testing and Materials (ASTM).

- **E1971-05**, Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings.

## OSHA Assistance

OSHA can provide extensive help through a variety of programs, including technical assistance about effective safety and health programs, state plans, workplace consultations, and training and education.

### Safety and Health Management System Guidelines

Effective management of worker safety and health protection is a decisive factor in reducing the extent and severity of work-related injuries and illnesses and their related costs. In fact, an effective safety and health management system forms the basis of good worker protection, can save time and money, increase productivity and reduce employee injuries, illnesses and related workers' compensation costs.

To assist employers and workers in developing effective safety and health management systems, OSHA published recommended Safety and Health Program Management Guidelines (54 *Federal Register* (16): 3904-3916, January 26, 1989). These voluntary guidelines can be applied to all places of employment covered by OSHA.

The guidelines identify four general elements critical to the development of a successful safety and health management system:

- Management leadership and worker involvement,
- Worksite analysis,
- Hazard prevention and control, and
- Safety and health training.

The guidelines recommend specific actions, under each of these general elements, to achieve an effective safety and health management system. The *Federal Register* notice is available online at [www.osha.gov](http://www.osha.gov).

### State Programs

The *Occupational Safety and Health Act of 1970* (OSH Act) encourages states to develop and operate their own job safety and health plans. OSHA approves and monitors these plans. Twenty-five states, Puerto Rico and the Virgin Islands currently operate approved state plans: 22 cover both private and public (state and local government) employment; Connecticut, Illinois, New Jersey, New York and the Virgin Islands cover the public sector only. States and territories with their own OSHA-approved occupational safety and health plans must adopt standards identical to, or at least as effective as, the Federal OSHA standards.

### Consultation Services

Consultation assistance is available on request to employers who want help in establishing and maintaining a safe and healthful workplace. Largely funded by OSHA, the service is provided at no cost to the employer. Primarily developed for smaller employers with more hazardous operations, the consultation service is delivered by state governments employing professional safety and health consultants. Comprehensive assistance includes an appraisal of all mechanical systems, work practices, and occupational safety and health hazards of the workplace and all aspects of the employer's present job safety and health program. In addition, the service offers assistance to employers in developing and implementing an effective safety and health program. No penalties are proposed or citations issued for hazards identified by the consultant. OSHA provides consultation assistance to the employer with the assurance that his or her name and firm and any information about the workplace will not be routinely reported to OSHA enforcement staff. For more information concerning consultation assistance, see OSHA's website at [www.osha.gov](http://www.osha.gov).

### Strategic Partnership Program

OSHA's Strategic Partnership Program helps encourage, assist and recognize the efforts of partners to eliminate serious workplace hazards and achieve a high level of worker safety and health. Most strategic partnerships seek to have a broad impact by building cooperative relationships with groups of employers and workers. These partnerships are voluntary relationships between OSHA, employers, worker representatives, and others (e.g., trade unions, trade and professional associations, universities, and other government agencies).

For more information on this and other agency programs, contact your nearest OSHA office, or visit OSHA's website at [www.osha.gov](http://www.osha.gov).

### OSHA Training and Education

OSHA area offices offer a variety of information services, such as technical advice, publications, audiovisual aids and speakers for special engagements. OSHA's Training Institute in Arlington Heights, IL, provides basic and advanced courses in safety and health for Federal and state compliance officers, state consultants, Federal agency personnel, and private sector employers, workers and their representatives.

The OSHA Training Institute also has established OSHA Training Institute Education Centers to

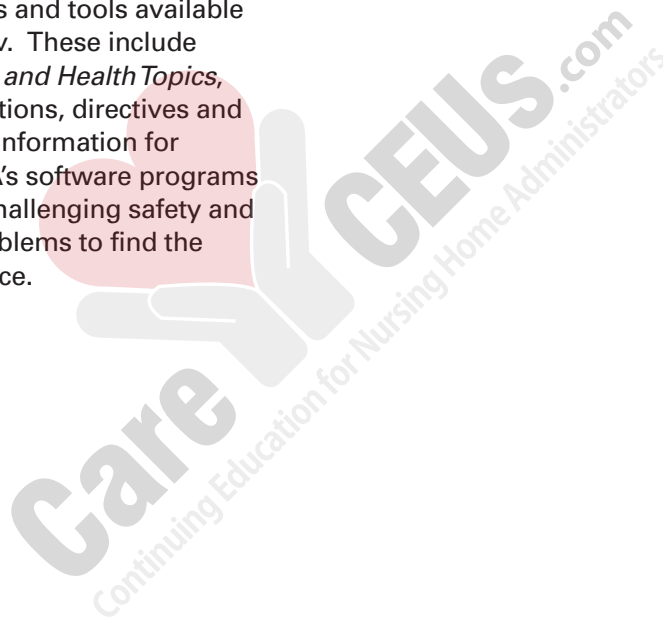
address the increased demand for its courses from the private sector and from other federal agencies. These centers are colleges, universities, and non-profit organizations that have been selected after a competition for participation in the program.

OSHA also provides funds to nonprofit organizations, through grants, to conduct workplace training and education in subjects where OSHA believes there is a lack of workplace training. Grants are awarded annually.

For more information on grants, training and education, contact the OSHA Training Institute, Directorate of Training and Education, 2020 South Arlington Heights Road, Arlington Heights, IL 60005, (847) 297-4810, or see Training on OSHA's website at [www.osha.gov](http://www.osha.gov). For further information on any OSHA program, contact your nearest OSHA regional office listed at the end of this publication.

### **Information Available Electronically**

OSHA has a variety of materials and tools available on its website at [www.osha.gov](http://www.osha.gov). These include electronic tools, such as *Safety and Health Topics*, *eTools*, *Expert Advisors*; regulations, directives and publications; videos and other information for employers and workers. OSHA's software programs and eTools walk you through challenging safety and health issues and common problems to find the best solutions for your workplace.



# Appendix A: Common Indoor Air Contaminants

The purpose of this section is to provide additional information about several common indoor air contaminants.

## Carbon monoxide (CO)

CO is a colorless, odorless gas produced by the incomplete burning of material containing carbon. CO poisoning<sup>2</sup> can cause brain damage and death. Common sources of CO are leaking vented combustion appliances, automobile exhaust, parking garages, etc. When not properly ventilated, emitted CO can build up. Employees exposed to low levels of CO may feel sick with headache and nausea, and will feel better when exposed to fresh air outside. However, their symptoms will recur shortly after returning to their workplace if CO is not eliminated.

### CO Poisoning Symptoms

Poisoning due to low levels of CO can be confused with influenza symptoms, food poisoning, or other illnesses, and can be a long-term health risk if left unattended. Some of the symptoms of low-level CO poisoning are shortness of breath, mild nausea, and mild headaches (30-35).

Prolonged exposure to high levels of CO can lead to brain damage and even death. Adequate ventilation is an important control measure. The OSHA Permissible Exposure Limit (PEL) for CO is 50 parts per million (ppm) as an 8-hour time-weighted average (TWA); the National Institute for Occupational Safety and Health has a Recommended Exposure Limit (REL) of 35 ppm as a 10-hour TWA. According to the American Conference of Governmental Industrial Hygienists (ACGIH), the threshold limit value for CO is 25 ppm as an 8-hour TWA.

### Carbon Monoxide Detectors

In addition to having a professional inspect appliances and furnaces, commercially available carbon monoxide detectors can be used to monitor the levels of carbon monoxide in buildings throughout the year. The manufacturer's instructions on placement and maintenance should be followed.

<sup>2</sup>CO is a chemical asphyxiant; it displaces O<sub>2</sub> in the blood, thereby suffocating the person exposed.

## Carbon dioxide (CO<sub>2</sub>)

CO<sub>2</sub> is a colorless, odorless, and tasteless gas (36). It is a product of completed carbon combustion and the by-product of biological respiration. ASHRAE states that CO<sub>2</sub> concentrations in acceptable outdoor air typically range from 300-500 ppm. Adverse health effects from CO<sub>2</sub> may occur since it is an asphyxiant gas. At concentrations above 15,000 ppm, some loss of mental acuity has been noted (36). The OSHA PEL is 5,000 ppm as an 8-hour TWA. The CO<sub>2</sub> levels can be used as a rough indicator of the effectiveness of ventilation (26), and excessive population density in a structure. CO<sub>2</sub> increases in buildings with higher occupant densities, and is diluted and removed from buildings based on outdoor air ventilation rates. Therefore, examining levels of CO<sub>2</sub> in indoor air can reveal information regarding occupant densities and outdoor air ventilation rates. High CO<sub>2</sub> levels may indicate a problem with overcrowding or inadequate outdoor air ventilation rates.

### Carbon Dioxide Poisoning – Symptoms

CO<sub>2</sub>, a by-product of normal cell function, is removed from the body via the lungs in the exhaled air. Exposure to high levels of CO<sub>2</sub> can increase the amount of this gas in the blood, which is referred to as *hypercapnia* or *hypercarbia*. As the severity of hypercapnia increases, more symptoms ranging from headache to unconsciousness appear, and it can also lead to death (36, 37).

## Pesticides

Pesticides are any substances or mixture of substances used for preventing, destroying, repelling, or mitigating any pest. These substances include insecticides, herbicides, fungicides, and various other substances used to control pests. Pesticides can cause harm to humans, animals, and the environment because they are designed to kill or otherwise adversely affect living organisms. Pesticides can also kill potential disease-causing organisms (8, 38).

### Pesticide Poisoning Symptoms

Symptoms of pesticide poisoning depend heavily on the pesticide to which the worker was exposed. Symptoms often appear within minutes of pesticide exposure, but may take much longer to develop. The most common symptoms include headache, tears in the eyes, vomiting, sweating, and general weakness. Exposure to high doses may cause seizures and death.

## Steps to Reduce Exposure

Integrated Pest Management Principles should always be implemented. Pesticide products should be used according to application and ventilation instructions provided by the manufacturer. In addition:

- Mix or dilute pesticides outdoors;
- Increase ventilation when using pesticides;
- Use non-chemical methods of pest control when possible;
- Do not store unneeded pesticides;
- Dispose of unwanted containers safely; and
- Keep indoor spaces clean, dry, and well ventilated to avoid pest problems.

## Radon

Radon is a colorless, odorless, and tasteless radioactive gas (6, 13, 17, 39, 40). It comes from the natural decay of uranium and some other radionuclides that are present in soil. Radon is responsible for most of the public's exposure to ionizing radiation (39, 40). It is often the single largest contributor to an individual's background radiation dose, and levels can vary widely from location to location. Radon gas can accumulate in buildings, especially in confined areas such as attics and basements. Radon penetrates cracks and drain openings in foundations, basements, and crawl spaces. Some building materials will also release radon into the air. It can also be found in some spring waters and hot springs, where it can be released into the air when the water is drawn for use indoors. Exposure to radon may cause lung cancer in humans.

The EPA recommends taking actions to reduce radon exposure if levels exceed four picocuries per liter of air (4 pCi/L) (25). Active soil depressurization and building ventilation are the two most commonly used strategies for controlling radon in buildings. Radon reduction methods include sealing concrete slab floors, basement foundations, and water drainage systems, and increasing ventilation. These techniques are usually cost-effective, and can greatly reduce or eliminate contamination and the associated health risks.

## Biological Contaminants

Animals, plants, and microbes are sources of air pollutants. Dander from animals, pollens from plants, and microbes, may act as allergens when they are inhaled. These biological contaminants are usually attached to dust particles of various sizes.

Small dust particles may remain airborne for long periods, while large particles settle more quickly. However, particles that have settled may be easily resuspended in the ambient air by currents of air or other disturbances. Drapery, carpet and other places where dust collects can harbor these contaminants; dirty cooling coils, humidifiers, condensate drains, and ductwork can incubate bacteria and molds. Areas with high humidity can accelerate their growth.

The most common sources of biological air contaminants are moisture-laden areas that support the growth of mold and bacteria present in the air (8, 16, 19, 44). Also, wet surfaces can provide a breeding ground for insects such as dust mites.

Moisture-induced microbial growth can result from water leaks and/or by condensation due to high humidity. Persistent dampness and microbial growth on interior surfaces and in building structures should be avoided or minimized as they may lead to adverse health effects (15). Common sources of moisture in buildings include: plumbing; roof and window leaks; flooding; condensation on cold surfaces, e.g., pipe sweating; poorly maintained drain pans; and wet foundations caused by landscaping or gutters that direct water into or under the building. Water vapor from unvented or poorly vented kitchens, showers, combustion appliances, or steam pipes can also create conditions that promote microbial growth. The most effective means to prevent or minimize adverse health effects is to determine the sources of persistent dampness in the workplace and eliminate them. Also, strict adherence to a housekeeping schedule and use of HEPA-filtered vacuum cleaners will help reduce ambient levels of allergens.

## Damp Indoor Environments

Damp indoor environments have been associated with many serious health effects, including asthma, hypersensitivity, and sinusitis. Moisture incursion leading to dampness can result from water leaks and/or by condensation due to high humidity. Common sources of moisture in buildings include: plumbing; roof and window leaks; flooding; condensation on cold surfaces, e.g., pipe sweating; poorly-maintained drain pans; and wet foundations due to landscaping or gutters that direct water into or under the building. Water vapor from unvented or poorly-vented kitchens, showers, combustion appliances, or steam pipes can also create conditions that promote microbial growth.



Well-designed, -constructed and -maintained building envelopes are critical to the prevention and control of excess moisture and microbial growth by avoiding thermal bridges and preventing intrusion by liquid or vapor-phase water. Management of moisture requires proper control of temperatures and ventilation to avoid high humidity, condensation on surfaces, and excess moisture in materials. Ventilation should be distributed effectively in spaces, and stagnant air zones should be avoided (5, 8).

ASHRAE recommends relative humidity levels between 30 and 60 percent for optimum comfort (25). Higher humidity may result in microbial growth. A consistently implemented good-house-keeping plan is essential to eliminate or reduce the microbial growth in the building.

### Legionella

Legionellosis or Legionnaires' Disease is caused by a waterborne bacterium, *Legionella*, which grows best in slow-moving, or still warm water (42-44). The primary route of exposure is aerosolization, most commonly from domestic hot-water systems (e.g., showers, sprays, etc.). Mist from evaporative cooling towers without biocide treatment is another reported source. Outbreaks in medical facilities can occur because the patients often have weak or suppressed immune systems.

For cooling towers and evaporative condensers, prevention efforts center on improving the location and maintenance of the cooling towers to limit the growth and spread of *Legionella* bacteria. These devices should be inspected and thoroughly cleaned at least once a year. Corroded parts, such as drift eliminators, should be replaced, and algae and accumulated scale should be removed. Cooling water should be treated constantly with antimicrobial agents. Ideally, an automatic water-treatment system should be used that continuously controls the quality of the circulating water.

For domestic hot-water systems, prevention efforts focus on controlling water temperature, avoiding dead-legs, avoiding stagnation, and cleaning storage tanks to limit the growth and spread of *Legionella* bacteria.

### Volatile Organic Compounds (VOCs)

VOCs refer to organic chemical compounds that have significant vapor pressures, and that can adversely affect the environment and human health. VOCs are emitted as vapors from certain solids or liquids, and include a variety of chemicals, some of which may have short- and long-term adverse health effects (17, 45, 46). Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands. Examples include paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, and graphics and craft materials, including glues and adhesives, permanent markers, and photographic solutions (8). More commonly known VOCs include benzene, formaldehyde, methylene chloride, trichloroethylene, and tetrachloroethylene (13). Exposure to VOCs can result in both acute and chronic health effects, depending on many factors such as the level of exposure and the length of exposure. A few VOCs, such as benzene, have been directly linked to cancer in humans, and others are suspected of causing cancer.

Since people today spend most of their time at home or in an office, long-term exposure to VOCs in the indoor environment can contribute to IAQ related problems (31). In offices, VOCs result from new furnishings, wall coverings, and office equipment such as photocopy machines, which can off-gas VOCs into the air (47, 48). Good ventilation and air-conditioning systems are essential to reduce VOC emissions in the indoor environment (47).

### Steps to Reduce Exposure

(<http://www.epa.gov/iaq/voc.html>)

- Use products according to manufacturer's directions.
- Make sure that plenty of fresh air is provided when using these products.
- Discard used containers safely.
- Buy quantities that can be used in short periods of time.

## Appendix B: Steps to Improve Indoor Air Quality

### What employers can do

- Maintain a good working relationship with building management on indoor environmental issues.
- Place office furniture and equipment in locations based on the adequate air circulation, temperature control, and pollutant removal functions of the HVAC system.
- Coordinate with building management when responsibility for design, operation, and maintenance of the ventilation system is shared.
- Avoid procedures and products that can cause IAQ problems.
- Integrate IAQ concerns into purchasing decisions.
- Work with the building manager to ensure use of only necessary and appropriate pest-control practices; use nonchemical methods when possible.
- Work with building management and the contractor before starting to remodel or renovate to identify ways of minimizing building-occupant exposure, and to ensure that the air-distribution system is not disrupted.
- Encourage building management to develop a preventive IAQ management program following guidance issued by the EPA and the National Institute for Occupational Safety and Health.

### What workers can do

- Do not block air vents or grilles.
- Water and maintain office plants properly.
- Dispose of garbage promptly and properly.
- Store food properly.
- Avoid bringing products into the building that could release harmful or bothersome odors or contaminants.
- Notify the building or facility manager immediately if you suspect an IAQ problem.

## Appendix C: HVAC System Maintenance Checklist

The following checklist can be used to investigate the HVAC system to make sure it is operating properly (e.g., the right mix of fresh air, proper distribution, and filtration systems are working, etc.)

### Cooling Towers

- Written maintenance and inspection program.
- Operated in accordance with manufacturer specifications.
- Inspected regularly (monthly, or as required).
- Treatment of waste to control microorganisms, as required.
- Recordkeeping of biocide use – brand, volume, and results.
- Training of workers for hazards involved.

### Humidifiers

- Written maintenance and inspection program.
- Inspected weekly during operation.
- Cleaned and disinfected as required.
- No visual buildup of mold or slime.
- Disinfectants removed before reactivating humidifiers.

### Cooling Coils

- Written maintenance and inspection program.
- Monthly (or, as required) inspections during operation.
- Removal of dirt, slime, and mold, as required.
- Upstream filters operating properly.

### Drain Pans, drainage systems

- Written maintenance and inspection program.
- Monthly inspection (or, as required).
- Drains maintained in free-flowing condition.
- No accumulation of stagnant water.
- No buildup of slime, mold, or dirt.
- Removal of dirt, slime, and mold, as required.
- Sample water for microbes, as required.

### Duct and Plenum equipment

- Written inspection and maintenance program.
- Supply, exhaust, return grilles, and ducts clear and clean.
- Routine inspection of ducts, debris, and microbial growth (e.g., semi-annually).
- Provisions of cleanout (e.g., within four feet downstream of duct expansions, supply air openings, or where particulate deposition may occur).
- Ductwork attached, not dented.
- Insulation intact, not wet, and no microbial growth.
- Ductwork properly balanced.

### Filtration systems

- Written maintenance, operating, and inspection programs.
- Routine inspection.
- Provision for measuring pressure drops across the filtration system.



## Appendix D: Investigating IAQ Problems and Complaints

Identifying the cause(s) of IAQ problems and complaints may be difficult if an obvious source is not evident. Investigating unclear IAQ problems should take into account patterns and factors, such as occupant complaints and symptoms, location(s) in the building, time of day, seasonal differences, and relationship to activities inside or outside the building. Below are suggestions of information that may be helpful to collect.

Once information is gathered, it should then be analyzed for patterns and possible causes of the IAQ problem. The analysis may point to specific methods, such as those discussed on page 7 (Identification and Assessment). The next step is to fix problems identified and evaluate the results. Has the fix resolved the problems or complaints? If not, then further investigation will need to be pursued. Consultation with safety and health professionals or other experts should be considered at any point during an IAQ investigation.

Information that may be helpful in IAQ investigations:

### General office conditions:

- Housekeeping
  - How often is the office vacuumed?
  - How often are carpet and drapes shampooed?
  - How often are floors waxed?
  - Are there any visible signs of dust?
- Have pesticides been applied recently?
- Is there any evidence of moisture intrusion into the building?

### Air quality in the office:

- Odor
- Dry
- Humid
- Dusty
- Warm
- Cool
- Drafts
- Temperature fluctuation
  - Within office
  - Between offices

- Between floors
- Any recent changes in:
  - Work space
  - General office
  - Building
  - New equipment added to the office

When occupant complaints are related to symptoms or health problems, medical evaluation may be required. Persons with respiratory diagnoses that may be caused or exacerbated by workplace exposures should discuss these with their treating physician, and treating physicians may access additional expertise through the network of National Institute for Occupational Safety and Health (NIOSH)-funded Education and Research Centers, or through the member clinics of the not-for-profit Association of Occupational and Environmental Clinics. Workers' compensation systems differ by states, but may also be available to support medical care for work-related diseases.

EPA and NIOSH have published two excellent resources to screen and investigate IAQ problems. The first, published in 1991, is *Building Air Quality: A Guide for Building Owners and Facility Managers* (<http://www.cdc.gov/niosh/baqtoc.html>). Chapter 6- "Diagnosing IAQ Problems" provides a systematic approach and includes tools, such as logs, questionnaires, diaries, and checklists. The second, published by EPA and NIOSH in 2002, is a companion document that updates and expands on the 1991 publication. The 2002 publication, *Indoor Air Quality Education and Assessment Model (I-BEAM)* (<http://www.epa.gov/iaq/largebldgs/i-beam/index.html>), is separated into modules, and includes online interactive examples of problems and solutions.

# Appendix E: Selected Resources

## Hazard Recognition

IAQ problems can be caused by improperly operated and maintained HVAC systems, overcrowding, microbiological contamination, outside air pollutants, and off-gassing from materials in the office and mechanical equipment. Related problems also may include discomfort problems due to improper temperature and relative humidity conditions.

The following references aid in recognizing IAQ hazards in the workplace:

- OSHA Technical Manual. OSHA Directive TED 01-00-015 [TED 1-0.15A] (1999, January 20). [https://www.osha.gov/dts/osta/otm/otm\\_toc.html](https://www.osha.gov/dts/osta/otm/otm_toc.html)
- Indoor Air Quality Investigation. Contains guidelines for IAQ investigations, recommendations on sampling instrumentation and methods, as well as guidelines for employers to prevent or alleviate IAQ problems. [https://www.osha.gov/dts/osta/otm/otm\\_iii/otm\\_iii\\_2.html](https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html)
- Carbon Monoxide Poisoning. OSHA Fact Sheet (2002) . [http://www.osha.gov/OshDoc/data\\_General\\_Facts/carbonmonoxide-factsheet.pdf](http://www.osha.gov/OshDoc/data_General_Facts/carbonmonoxide-factsheet.pdf)
- Mold. OSHA Safety and Health Topics Page. <https://www.osha.gov/SLTC/molds/index.html>
- Stachybotrys Chartarum. OSHA Safety and Health Topics Page. [https://www.osha.gov/dts/chemicalsampling/data/CH\\_267785.html#General](https://www.osha.gov/dts/chemicalsampling/data/CH_267785.html#General)
- Indoor Environmental Quality. National Institute for Occupational Safety and Health (NIOSH) Safety and Health Topic Page. Links to several other NIOSH publications, including the NIOSH fact sheet on IEQ. <http://www.cdc.gov/niosh/topics/indoorenv>
- Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines and Tools. U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health Publication No. 96-118, (1996). Gives examples of the many situations in which people have been poisoned because they did not recognize the danger of using small gasoline-powered engines indoors. These poisonings can occur quickly, even in the presence of what many would consider “adequate ventilation,” and in areas that many would define as relatively open spaces, such as parking garages. <http://www.cdc.gov/niosh/carbon2.html>
- Fact Sheet: Ventilation and Air Quality in Offices. Environmental Protection Agency. Gives an overview of sources of indoor air pollution, health problems and ventilation, control, ventilation standards and building codes, ventilation system problems and solutions, air cleaners, economic considerations, and resolving air-quality problems. <http://www.epa.gov/iedweb00/pubs/ventilat.htm>
- Air - Indoor Air Quality (IAQ). Environmental Protection Agency. Contains an introduction to IAQ, a listing of common pollutants, and references to IAQ publications, hotlines, and links. <http://www.epa.gov/iaq/pubs>
- Mold Remediation in Schools and Commercial Buildings. March 2001. Presents guidelines for the investigation, evaluation, and remediation/cleanup of mold and moisture problems in schools and commercial buildings. [http://www.epa.gov/iaq/molds/mold\\_remediation.html](http://www.epa.gov/iaq/molds/mold_remediation.html)
- An Office Building Occupant’s Guide to Indoor Air Quality. Describes factors that contribute to indoor air quality and comfort problems, and the roles of building managers and occupants in maintaining a good indoor environment. <http://www.epa.gov/iaq/pubs/occupgd.html>
- The Inside Story: A Guide to Indoor Air Quality. Office of Radiation and Indoor Air, U.S. Consumer Product Safety Commission. April 1995. Provides a comprehensive online booklet on IAQ concerns in homes. <http://www.epa.gov/iaq/pubs/insidest.html>
- IAQ Resources. Provides a listing of various hotlines and resources related to IAQ. <http://www.epa.gov/iaq/iaqinfo.html>

- Guidelines on Assessment and Remediation of Fungi in Indoor Environments. New York City Department of Health. Addresses mold contamination of building components (walls, ventilation systems, support beams, etc.) that are chronically moist or water damaged.  
<http://www.nyc.gov/html/doh/html/epi/moldrpt1.shtml>
- Indoor Air Quality Publications. Consumer Product Safety Commission (CPSC). Contains an index of CPSC publications related to IAQ. <http://www.cpsc.gov/cpsc/pub/pubs/iaq.html>

## Evaluation and Control

Methods used in an IAQ investigation may include: identification of pollutant sources; evaluation of HVAC system performance; observation of production processes and work practices; measurement of contamination levels and employee exposure; medical testing or physical examinations; employee interviews; and review of records of medical tests, job histories, and injuries and illnesses.

The following resources provide information about evaluating and controlling IAQ in the workplace.

### Evaluation

- Volatile Organic Compounds in Air. OSHA Method PV2120. May 2003.  
<https://www.osha.gov/dts/sltc/methods/partial/pv2120/pv2120.html>
- Ozone in Workplace Atmospheres (Impregnated Glass Fiber Filter). OSHA Method ID-214. March 1995.  
<https://www.osha.gov/dts/sltc/methods/inorganic/id214/id214.html>
- Carbon Monoxide in Workplace Atmospheres (Direct-Reading Monitor). OSHA Method ID-209. March 1993. <https://www.osha.gov/dts/sltc/methods/inorganic/id209/id209.html>
- Sulfur Dioxide in Workplace Atmospheres (Impregnated Activated Beaded Carbon). OSHA Method ID-200. April 1992. <https://www.osha.gov/dts/sltc/methods/inorganic/id200/id200.html>
- Carbon Monoxide in Workplace Atmospheres. OSHA Method ID-210. March 1991.  
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  - Hazardous and Toxic Substances <https://www.osha.gov/SLTC/hazardoustoxicsubstances/index.html>
  - Legionnaires' Disease <https://www.osha.gov/SLTC/legionnairesdisease/index.html>
  - Sampling and Analysis <https://www.osha.gov/SLTC/samplinganalysis/index.html>
  - Styrene <https://www.osha.gov/SLTC/styrene/index.html>
- EPA: IAQ Tools for Schools Action Kit. <http://www.epa.gov/iaq/schools/actionkit.html>
- The National Institute for Occupational Safety and Health (NIOSH), through its Health Hazard Evaluation (HHE) Program, responds to requests from employers, employees and their representatives, and government agencies. NIOSH conducts workplace assessments to determine if workers are exposed to hazardous materials or harmful conditions, and whether these exposures are affecting workers' health. NIOSH has conducted more than 200 IAQ-related HHEs. Recent reports can be found on NIOSH's Indoor Environmental Quality website at <http://www.cdc.gov/niosh/topics/indoorenv>
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### **Control**

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# Appendix F: OSHA-Sponsored Environmental Tobacco Smoke Workshops

## Workshop I

**Workshop Summary:** Assessing Exposure to Environmental Tobacco Smoke in the Workplace. Jonathan M. Samet. *Environmental Health Perspectives Supplements*, vol. 107, no. S2, May 1999.

Environmental tobacco smoke (ETS) is a term now widely used to refer to the mixture of sidestream smoke and exhaled mainstream smoke that pollutes air in locations where tobacco smoking is taking place. A multidisciplinary workshop was convened to address key issues related to ETS exposure in the workplace in order to prepare the groundwork for a risk assessment of the hazard ETS poses to workers. Workshop participants concluded that substantial evidence was now available on worker exposure to ETS using both direct and indirect approaches to exposure assessment, and that these data could be used to project distribution of exposures to ETS in the nation's workplaces. This summary of the discussions at the workshop is an overview of the suggested approach to exposure assessment.

## Workshop II

OSHA/ACGIH® Environmental Tobacco Smoke Workshop Proceedings, Publication #99-078

Proceedings of the OSHA/ACGIH® Environmental Tobacco Smoke Workshop held June 6, 1998, in Cincinnati, OH. The workshop brought together a panel of ventilation experts, along with hospitality industry managers and design engineers, to discuss effective and non-effective ventilation strategies for smoking sections in restaurants and bars.

## Workshop III

**Workshop Summary:** Workshop on Health Risks Attributable to ETS Exposure in the Workplace. Maritta S. Jaakkola and Jonathan M. Samet (Johns Hopkins University, Baltimore, Maryland, USA). *Environmental Health Perspectives*, vol. 107, supp. 6, December 1999.

This 1998 workshop was convened to address the health risks of exposure to environmental tobacco smoke (ETS) in the workplace. It was paired with a 1997 workshop on issues related to ETS exposure in work environments. The 1998 workshop involved a multidisciplinary group of participants who reviewed evidence on the quantitative risks to health posed by ETS and discussed the development of risk assessment methodology for the future.

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“This course was developed from the public domain document: Indoor Air Quality in Commercial and Institutional Buildings – U.S Department of Labor, Occupational Safety and Health Administration (OSHA 3430-04, 2011).”