EHS Response to IAQ Complaints

1. Purpose / Background

MIT is committed to providing a safe and healthy work and living environment that is free of recognized hazards. Good Indoor Air Quality (IAQ) enhances occupant health and comfort and contributes to increased workplace productivity and a general sense of well-being.

The Environment, Health and Safety Office (EHS) assists Departments, Labs, and Centers (DLCs) and the Department of Facilities (Facilities) in resolving concerns related to IAQ. EHS can investigate the likely source of a problem, provide recommendations to remedy the situation, and help DLC’s and Facilities to proactively plan new environments for work, study, research or residential life that meet a high standard for IAQ.

This document describes the EHS approach to evaluating IAQ complaints and provides guidance on conducting IAQ investigations at MIT. It covers the process by which DLC personnel request assistance or report IAQ problems, the services provided by the EHS Office to evaluate and investigate the reported problem, and the steps that should be taken with regard to remediation.

Most IAQ investigations are referred to the Industrial Hygiene Program (IHP), but they often require a cooperative effort and effective communication among several groups including the Biosafety Program (BSP), MIT Medical, and/or Facilities. Although technical considerations are important, communication between concerned occupants, MIT management, and IAQ investigators is often the most important factor in the actual resolution of complaints.

2. Scope

This document applies to any IAQ concern in a MIT building. It outlines the EHS Office’s assessment responsibilities, the role of Facilities in prevention and remediation, and the responsibility of DLC’s for assistance and communication.

This document also applies to non-MIT buildings where MIT personnel are assigned to work or perform research. In non-MIT buildings, EHS will work with the relevant building management in investigation and remediation of the IAQ concern.

While the objective of this Policy is to ensure to the greatest extent feasible the general adequacy of environmental conditions for building occupants, it must be acknowledged that varying tolerances and expectations among that population may diminish the likelihood that any set of conditions will satisfy every occupant.

3. Prerequisites

N/A

4. Procedures

4.1. Initial Reporting

As a matter of policy, every complaint deserves a response, including transitory IAQ problems (e.g.
new carpet odor). Suspected IAQ problems may be reported to EHS by building occupants, the DLC support staff (e.g., EHS Coordinator or Facilities Manager) or by Facilities personnel. The EHS Office can be directly contacted at (617) 452-3477 (or 2-EHSS). Initiating the investigation through the DLC will help ensure awareness and cooperation, which is often critical for an effective investigation and problem resolution. IAQ concerns received by the EHS office are forwarded to the IHP day call person (or on-call person off-hours). For extended investigations, the lead and IHP contacts for the DLC may assume leading roles.

4.1.1 Initial IHP Response
A. The IHP representative should use the call/initial meeting to informally interview the individual who reports the issue and to gather information (e.g., Is it a new concern? Are other building occupants involved? Is there an odor? Do you have symptoms? Do you see mold?). Appendix A contains a sample occupant questionnaire form. If the call is related to an ongoing or recurring problem, it may be more appropriate to refer the call to the lead IHP representative on the project.
B. The IHP representative should inform the caller of his/her intention to investigate the problem, explaining the IAQ investigation process. If the problem cannot be resolved over the phone, the IHP representative should schedule an appointment to meet with the individual reporting the suspected IAQ problem.

4.1.2. Thermal Comfort – Temperature and/or relative humidity are among the most common factors that affect IAQ and they may be evaluated as part of a typical IAQ investigation. However, if in a given problem area, either or both of these parameters can be identified as the only cause(s) of the problem, then the DLC should submit a work request to Facilities who primarily deals with comfort issues. DLC’s can visit http://web.mit.edu/facilities/services/temperature.html for more information. Facilities may contact EHS if they are not able to identify and resolve the problem.

4.1.3. Mold Contamination/Excessive Moisture – Complaints that include reports of visible mold growth, water intrusion or moisture will be forwarded to a BSP representative or investigated jointly by IHP and BSP.

4.1.4. Odor Complaints – Odor complaints may not always require a complete investigation. In responding to odor complaints, ask occupants to characterize odors (describe what they smell like) along with times and locations of detection.

Common causes of odor complaints include:
- Sink and floor traps (fill if possibly dry)
- Food in trash barrels and refrigerators
- Diesel odors, (check for construction vehicles near the air intakes or outside windows)
- Outdoor excavation/construction
- Indoor construction activities – check for painting, installing floors, carpets, etc. See Project or Facilities Manager for information
- In laboratories check autoclave exhaust, look for open containers and check vacuum pump exhausts.
4.1.5. Reporting
When a new IAQ complaint received at the EHS Office, either by the Receptionist or thru environment@mit.edu basic information is collected and referred to the IHP person on day call. The IHP investigator is responsible for investigating the day call report, communicating the results to affected parties and documenting on the EHS Office M-drive EHS Response folder and the I-drive Building File folder. Refer to Sections 4.3 and 8 for more details about report and record management.

4.1.6. Referral to Medical Department
If any person(s) has reported symptoms or complaints, you should remind the individual(s) that they may visit MIT Medical at no charge, and may schedule an appointment by calling 3-4904. EHS will provide Medical with background information if it is likely that the affected individual(s) will make an appointment.

Symptoms that require immediate medical attention include sudden onset of headaches, dizziness, drowsiness, nausea (possible carbon monoxide poisoning), diagnosed building related illness (such as Legionnaires’ disease), and widespread breathing difficulties.

4.2. Initial Investigation
The typical IAQ investigation includes: (1) problem characterization, (2) initial walkthrough, and (3) HVAC system review. After completing the investigation, always provide the affected employees with a brief overview of your initial findings.

4.2.1 Problem Characterization
Problem characterization includes gathering historical information, assessing occupant symptoms and obtaining occupant perspective.

- Check the Day Call Reports, building files and other information sources to determine in this is an ongoing or recurring problem. Determine if similar concerns have been documented in other areas in the past.
- Interview the affected employee(s) or student(s) and other occupants in the vicinity. Determine the type of symptoms (general or specific) and other problems that they may be experiencing, and if they attribute these to the building air quality. If the occupants identify a suspected source of air contaminants, it should be noted and checked later. See Appendix A for an interview checklist example and Appendix B for a symptom diagnostic aid.

4.2.2 Walkthrough Survey
Typically, if there is a possibility that problem resolution will require work on building infrastructure, IHP will contact the Facilities Zone Supervisor and/or the EHS Coordinator for assistance during the walkthrough.

Try to complete as much of the problem characterization as possible before visiting the site so that the relevant survey equipment can be brought along. The focus of the walkthrough will be informed by the initial problem characterization. The survey areas should include the problem area and a non-problem (control) area along with a tour of the building perimeter. Look for processes or activities in typical places such as areas or office spaces, areas or spaces that may be occupied by personnel for extended periods, and areas or spaces near ventilation systems or HVAC equipment.
the area or adjacent areas that may serve as emission sources, e.g., copiers and autoclaves, for air contaminants. Typically, the IHP investigator observes/measures some or all of the following on the walkthrough:

- **Direct Reading Measurements (Temperature, Relative Humidity and Airflow)**
  - Measure temperature (T), relative humidity (%RH), carbon dioxide (CO2) and air velocity at occupant level if there is some concern that the problem is associated with thermal comfort or ventilation. Determine if parameters are within acceptable ranges (see Appendix C). If CO2, Temperature or %RH appears to be related to the problem, continuous monitoring over an extended time may be conducted.
  - Note areas of stuffiness or drafts, or hot or cold areas.
  - In general, 15 cfm of fresh air per occupant will keep indoor minus outdoor CO2 levels below 700 PPM, while 20 cfm will keep indoor minus outdoor CO2 levels below 500 PPM. (This corresponds to indoor values of 1000 PPM and 800 PPM when outdoor values are 300 PPM, which is assumed by ASHRAE.) (From EPA I-beam)

- **Dust on surfaces or complaints of dust** – complaints of eye and respiratory irritation may be related to particulate matter (Type and color of particle or fiber may indicate source). The Dust-Trak or P-Trak can also be used to quickly assess if levels of dust or particles are atypically high. The P-Trak can be used to identify a source or sources for fine particulate matter such as combustion by-products.

- **HVAC system (initial survey)** – Look for dust streaking at the diffuser - it may indicate ineffective filtering. Air currents at the occupant work areas should not be excessive (>40 fpm). Mechanical rooms with air handling units (AHUs) may be adjacent to loading docks or other sources of air contaminants. Check whether mechanical rooms in such locations are under a negative pressure with respect to their surroundings. While outdoors, locate the air intake and check for airflow and nearby contaminant sources. Consult maintenance records for HVAC filter replacement (check to see if filters are installed)

- **Housekeeping** – Poor housekeeping can contribute to occupants’ symptoms.

- **New Furniture or Construction** – Some new products can emit relatively high levels of VOCs for a few days to weeks after installation. Even ‘green’ products may have objectionable odors even if VOC emissions are low.

- **Mold-contamination/moisture** – Look for evidence of water damage/mold contaminated building materials. If there is has been recent flooding, a moisture meter can be used to identify walls that are wet.

- **Ergonomics and Noise** – Lighting (Is it sufficient? Glare?), noise (HVAC or other noise?), ergonomic stressors (poorly designed work stations and tasks), job related psychosocial stressors.

- **Airflow Visualization and Pressure Differentials** – Use airflow visualization (smoke sticks, liquid nitrogen, micromanometer) to track the pathway from a possible contaminant source to the area of concern. Generally office areas should be slightly positive especially with respect to potential contaminant sources, while chemical laboratories are designed to be under negative pressure.

- **Printer Emissions** – A study was conducted which measured particles emitted from laser printers in office settings and in a test chamber for purposes of characterizing printers as high, medium, or low emitters. IHP staff will sample for printer particle emissions if requested using the screening protocol established in the published paper. No health effects were correlated with printer emissions, but the premise is that keeping particles low is preferable for good air

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quality. See the published paper (Congrong et al, 2007); IHP’s summary of the paper, and related memos and MSDS’s on the I-drive file titled “printer toner”. Non-IHP staff should contact EHS if they would like a copy of any of these materials.

4.2.3 HVAC System Review
If carbon dioxide levels are elevated or odors and/or particles appear to be originating from the supply air, an in-depth inspection of the HVAC system may be required.

Note that not all occupied spaces at MIT have HVAC systems that supply fresh air, e.g., some offices in older buildings contain recirculation units that only provide temperature control (these local units may still contain condensate drip pans and filters). While older labs may not have supply air, a high negative pressure in such a lab can contribute to odors and dust problems.

It may be necessary to trace airflow from the air intake to the diffusers. Systems on campus include: Variable Air Volume (VAV), Constant Air Volume (CAV), terminal reheat, heat pumps, fan coils, induction units, floor plenum supply (only in Stata Center), and ceiling plenum return. EHS will normally partner with a Facilities representative where the IAQ problem occurred or Facilities Engineering when evaluating the HVAC system.

Key features of the ventilation system to be examined on most HVAC inspections are:

<table>
<thead>
<tr>
<th>Feature</th>
<th>What to inspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor Air Supply</td>
<td>Air intake location, Damper position, check airflow (smoke tube), bird screen present?</td>
</tr>
<tr>
<td>Mixing plenum</td>
<td></td>
</tr>
<tr>
<td>Air filters</td>
<td>Filter efficiency? Check maintenance interval and condition.</td>
</tr>
<tr>
<td>Terminal Units</td>
<td>May include VAV boxes and fan coil units. Check condensate drain pans. If system is VAV, ensure a minimum airflow is guaranteed.</td>
</tr>
<tr>
<td>Supply ductwork and diffusers</td>
<td>General Condition? Interior lining present? Particles on diffuser? (a sign of inadequate filtration) Sufficient airflow? (use balometer)</td>
</tr>
<tr>
<td>Coils</td>
<td>Look for particulate buildup and microbial growth on upstream face of filter.</td>
</tr>
<tr>
<td>Humidification</td>
<td>Certain HVAC systems may include humidification for process reasons.</td>
</tr>
<tr>
<td>Return Air</td>
<td>If open plenum above suspended ceiling, check for possible contaminant sources.</td>
</tr>
<tr>
<td>Local Exhaust</td>
<td>Check that point sources of pollutants, e.g. copiers, ovens, vacuum pumps, are exhausted to the outdoors.</td>
</tr>
<tr>
<td>AHU Mechanical Rooms</td>
<td>Are any pollutant sources present in room or nearby?</td>
</tr>
</tbody>
</table>


EPA: [http://www.epa.gov/iaq/schools/tfs/refguide_toc.html](http://www.epa.gov/iaq/schools/tfs/refguide_toc.html)
4.2.4 Air Quality Measurement Equipment and Further Investigation
For access to IHP equipment guides see: \Equipment\Equipment Quick Guides Manuals

EPA I-beam offers general information on measurement equipment:
http://www.epa.gov/iaq/schools/tfs/refguide_toc.html

Note: Particulate matter is measured with the TSI Dustrak or P-Trak. The P-Trak is used for tracking the source of fine particles, usually from combustion sources. The Dustrak is more appropriate for measuring larger particles and relatively high concentrations of smaller particles.

Further investigation is often necessary after the initial assessment. While very few of the issues in an IAQ evaluation lend themselves to clear-cut interpretations, a few general guidelines are available. Always obtain sample data at the air intake to the relevant building system, or at some other representative outdoor location, to determine the contribution from sources outside of the building. See Appendix C for a list of guidelines for IAQ parameters.

4.3. Report and Remediation Recommendations
After the investigation, it is generally appropriate to submit a written report to the building occupants (and other relevant MIT personnel, e.g., the Medical Department, Facilities representatives and other EHS staff). EHS may also submit a work request online to Facilities in order to initiate appropriate repairs to building systems. The report should describe what was done, present the findings, list any corrective measures which have already been taken, and confirm the resolution of the problem. If possible, the report should recommend future specific actions that should be taken by Facilities, by the area occupants or their department, or by any other appropriate group within MIT.

Remediation of IAQ problems is often complex and may involve several changes to the work area. For examples of possible solutions, see the EPA IAQ Guide for Large Buildings, Chapter 7 Migration of IAQ Problems: http://www.epa.gov/iaq/largebldgs/pdf_files/sec_7.pdf

4.3.1. Air Cleaning Units - For areas affected by construction activities and for other situations evaluated on a case-by-case basis, EHS owns a limited number of air cleaning units for particles and organic vapors. EHS will lend these units for up to 2 weeks. At present EHS uses the Executive 5000 manufactured by AllerAir. See link below for specifications and other product information: http://allerair.com/air-purifiers/air-purifiers-all-purpose-5000-exec.html

5. Roles & Responsibilities
5.1. Faculty, Staff or Students Will:
   5.1.1 Report IAQ concerns to their DLC EHS Coordinator or directly to EHS.
   5.1.2 Follow recommendations made by EHS to assist with the identification, characterization, and remediation of the problem.

5.2. DLCs, Through Their EHS Coordinator, Will:
   5.2.1. Assist, as needed, with the EHS assessment of the problem.
5.2.2. Assist, as needed, with remediation by assuring spaces are accessible, and vacated (if necessary).
5.2.3. Assure concerned or impacted personnel in the DLC are kept informed of actions being taken to address the problems.

5.3. EHS Will:
5.3.1. Investigate the IAQ problem as outlined in this SOP.
5.3.2. Work with Facilities in developing possible solutions to the problem.
5.3.3. Communicate with the EHS Coordinator regarding findings, recommendations, and remediation actions being taken.

5.4. The Facilities Department Will:
5.4.1. Maintain building systems that contribute to good indoor air quality.
5.4.2. Work with EHS in developing possible solutions to indoor air quality problems.

6. Training
Awareness training of EHS staff regarding this SOP is conducted in IHP staff meetings and though each of the programs within EHS.

7. Data Collection Requirements
N/A

8. Record Management
Day call report forms are filled out and turned in for every IAQ call into EHS. Exposure monitoring data requiring a chain of custody sheet (results of laboratory analysis of samples) is retained in the IHP exposure monitoring database.

9. References

9.1. Other SOPs Referenced in this Document
EHS-0022 - Assessment and Remediation of Fungi in Indoor Environments

9.2. Further Information
Indoor Air Quality Handbook, Spengler, 2001 (Available online at MIT only)


NIOSH Indoor Environmental Quality Webpage
http://www.cdc.gov/niosh/topics/indoorenv/

The IAQ Investigator’s Guide, AIHA, Gunderson, 2006

OSHA Indoor Air Quality Webpage

An official hardcopy of this document exists in the EHS Office or on the EHS website. See Legal Disclaimer at: http://ehs.mit.edu/site/content/legal-disclaimer
OSHA Technical Manual—IAQ Investigations
http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html

http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html

EPA Indoor Air Quality Links

Health Canada IAQ – Tools for Schools Action Kit
http://www.hc-sc.gc.ca/ewh-smt/pts-air/tools_school-outils_ecoles/index_e.html

NIOSH (National Institute for Occupational Safety and Health
  o Guidance for Indoor Air Quality Investigations, Cincinnati: NIOSH, 1987

ASHRAE
Standard 62.1-2004 – Ventilation for Acceptable Indoor Air Quality
Standard 55-2004 -- Thermal Environmental Conditions for Human Occupancy

9.2. Other SOP/ SOGs
  • EHS-0008 Reporting Work Related Illnesses and Injuries of OSHA-Covered Personnel
  • EHS-0021 - Records Retention SOP

10. Definitions
Indoor Air – Indoor air is air that occupants breathe in the 'built' environment at MIT, e.g., labs, dorms, offices.

Acceptable Indoor Air Quality - Acceptable Indoor Air Quality is air in which there are no known contaminants at harmful concentrations and with which a substantial majority of the people in an area do not express dissatisfaction.

Air handling unit (or air handler) (AHU) - Equipment that prepares outdoor air before it enters the indoor environment. Air handlers are typically comprised of many components including the blower, heating and cooling elements, filter racks or chamber, dampers, humidifier, and other central equipment in direct contact with the airflow. Air handlers do not include the ductwork that carries the air through the building.

Fan Coil Unit (FCU) - a small terminal unit that is often composed of only a blower and either a heating or a cooling coil. Often used in hotels, condos, or apartments.
EPA I-Beam – The Indoor Air Quality Building Education and Assessment Model (I-BEAM) is a guidance tool designed for use by building professionals and others interested in indoor air quality in commercial buildings.

Heat Pump - A device that warms or cools a building by transferring heat from a relatively low-temperature reservoir to one at a higher temperature.

VAV (Variable Air Volume) - an all-air or air-water HVAC system that has a relatively fixed supply air temperature, but the volumetric flow rate of air varies to meet the thermal load. Most new larger buildings have VAV systems due to their reduced fan energy consumption, as compared to Constant Air Volume (CAV).

Note: For other definitions see:
http://www.epa.gov/iaq/glossary.html
http://www.answers.com/topic/hvac
Appendix A Interview Check List for Initial Contact

1. What is your work/research?

2. What does it involve?

3. Chemicals used during work:

4. When did the [symptom or complaint] begin?

5. Does the [symptom or complaint] exist all the time, or does it come and go? That is, is it associated with times of day, days of the week, or seasons of the year?

6. (If so) Are you usually in a particular place at those times?
   Or is it otherwise associated with certain tasks/people?

7. Does the problem abate or cease, either immediately or gradually, when you leave there? Does it recur when you return?

8. Has the place where you work been redecorated or refurnished, or have you recently started working with new or different materials or equipment? (These may include pesticides, cleaning products, craft supplies, et al.)

OPTIONAL

9. Have you recently changed your place of residence?

10. (If not) Have you made any recent changes in or additions to, your home?

11. Have you, or has anyone else in your family, recently started a new hobby or other activity?

12. Have you recently acquired a new pet?

13. Does anyone else in your home have a similar problem? How about anyone with whom you work? (An affirmative reply may suggest either a common source or a communicable condition.)

Adapted from “Indoor Air Pollution: Introduction for Health Professionals”
CPSC Document #455
## Appendix B: Symptom Diagnostic Quick Reference

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Environmental Tobacco Smoke</th>
<th>Other Combustion Products</th>
<th>Biological Pollutants</th>
<th>Volatile Organics</th>
<th>Heavy Metals</th>
<th>Sick Building Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESPIRATORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhinitis, nasal congestion</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Epistaxis (nose bleed)</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES(^i)</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Pharyngitis (sore throat), cough</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Wheezing, worsening asthma</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Dyspnea (Shortness of breath, difficult or labored breathing)</td>
<td>YES(^2)</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES(^i)</td>
</tr>
<tr>
<td>Severe lung disease</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES(^i)</td>
</tr>
<tr>
<td><strong>OTHER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conjunctival irritation</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Headache or dizziness</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Lethargy, fatigue, malaise</td>
<td>NO</td>
<td>YES(^4)</td>
<td>YES(^5)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Nausea, vomiting, anorexia</td>
<td>NO</td>
<td>YES(^4)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Cognitive impairment, personality change</td>
<td>NO</td>
<td>YES(^4)</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Rashes</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Fever, chills</td>
<td>NO</td>
<td>NO</td>
<td>YES(^6)</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>NO</td>
<td>YES(^4)</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Retinal hemorrhage</td>
<td>NO</td>
<td>YES(^4)</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Myalgia (muscle pain)</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES(^5)</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

1. Associated especially with formaldehyde.
2. In asthma.
3. Hypersensitivity pneumonitis, Legionnaires disease.
4. Particularly associated with high CO levels.
5. Hypersensitivity pneumonitis, humidifier fever.
6. With marked hypersensitivity reactions and Legionnaires disease.

From EPA “Indoor Air Pollution: An Introduction for Health Professionals”
## Appendix C: Indoor Air Quality Guidelines

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard or Guideline</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>68 - 75 F (winter), 73 - 79 F (summer)</td>
<td>ASHRAE Standard 55-2004</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>&lt; 60% RH</td>
<td>ASHRAE Standard 55-2004</td>
</tr>
<tr>
<td>Airflow (drafts)</td>
<td>20 to 50 fpm at the occupant level</td>
<td>The IAQ Investigator’s Guide (AIHA)</td>
</tr>
<tr>
<td>Air Change (Ventilation)</td>
<td>For offices - 5 cfm/person, plus 0.06 cfm/ft² outdoor air, for a 1000 ft² office and 5 people = 17 cfm/person</td>
<td>ASHRAE Standard 62.1-2004; See standard (pg 9-15) for additional information on other spaces</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>800 ppm Massachussetts Department of Public Health guideline for public buildings.</td>
<td>If CO₂ &gt; 800 ppm on walkthrough consider data logging. This level should be used as a guideline that helps maximize comfort for all occupants. If average levels are significantly higher than 800 ppm, work with facilities in reviewing the amount of fresh air that is supplied to the location.</td>
</tr>
<tr>
<td></td>
<td>&lt;700 ppm above outdoor levels. May indicate inadequate fresh air supply</td>
<td>Ventilation Adequacy (ASHRAE) Note: Not for use in low density population areas, not to be used alone as an indicator of acceptable indoor air</td>
</tr>
<tr>
<td></td>
<td>5,000 ppm for 8 hours, ACGIH TLV, OSHA PEL</td>
<td>Occupational exposure limit</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>9 ppm for 8-hour (EPA) 35 ppm for 1 hour (EPA)</td>
<td>Note: If indoors is 1 to 2 ppm above ambient, evaluate indoor and nearby outdoor locations for process sources, combustion sources and/or vehicle emissions. If a suspected source is identified outdoors, investigate possible contaminant pathways to the affected indoor locations.</td>
</tr>
<tr>
<td>Ozone</td>
<td>0.08 ppm EPA (outdoor limit), ND to 0.03 commonly found indoors</td>
<td>Note: Take into account ambient levels of O₃, measure at air intake also.</td>
</tr>
<tr>
<td>PM-10 Particulates (&lt;10 μm)</td>
<td>150 μg/m³ 24-hr Exposure (EPA)</td>
<td>Generally office areas are well under 100 μg/m³ of PM-10</td>
</tr>
<tr>
<td>Fine Particulates (&lt;2.5 μm)</td>
<td>65 μg/m³ 24-hr Exposure (EPA)</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.04 ppm Health Canada, Generally &lt; 0.03 indoors</td>
<td>If guidelines exceeded, a source assessment should be conducted, and elimination or reduction measures should be implemented. Passive badges are available for long-term monitoring.</td>
</tr>
<tr>
<td></td>
<td>0.3 ppm Ceiling Level (ACGIH)</td>
<td>Occupational exposure limit</td>
</tr>
<tr>
<td>TVOCs</td>
<td>300 ug/m³ Comfort Level (CEC, Seifort, 1990)</td>
<td>If total VOCs are in excess of 0.5 mg/m³ consider an assessment to identify of eliminated sources. Contact the IHPI laboratory director to determine the appropriate sampling method.</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>0.03 ppm (EPA)</td>
<td>Annual Average outdoors</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>0.03 ppm (CA)</td>
<td>1-hour average outdoors</td>
</tr>
</tbody>
</table>

ASHRAE = American Society of Heating Refrigerating and Air Conditioning Engineers  
EPA = U.S. Environmental Protection Agency  
OSHA = Occupational Safety and Health Association  
ACGIH = American Council for Governmental Industrial Hygienists  
CEC = the supranational organization of (currently) 15 Member States, including the UK, formed by the amalgamation of Euratom, the European Coal and Steel Community, and the European Economic Community. It now forms