Carnegie Mellon University Environmental Health & Safety FIRE | LAB | WORK	**Environmental Health and Safety** **Indoor Air Quality Program**
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1. Purpose

1.1. The quality of the indoor working environment and indoor air can affect the performance, health, morale, and productivity of faculty, staff, and students. The most common complaints regarding indoor air quality (IAQ) are indicated by inconsistent levels of temperature, ventilation, humidity, and odors.

1.2. This guideline establishes a source for general IAQ information, the items necessary to maintain satisfactory University-occupied spaces, including work and living environments, and ways to reduce the incidents of IAQ problems. This document also provides information on who to contact with IAQ concerns and identifies an organized approach to addressing IAQ issues.

2. Scope

2.1. Members of the University community are expected to follow the recommendations contained within this document and to recognize that IAQ issues may have multiple contributing factors with, at times, complex solutions.

2.2. Appendix A—Types of IAQ Contaminants contains additional information on types, causes and some health effects of IAQ contaminates.

2.3. Appendix B—IAQ Tips contains tips and recommendations should be followed in order to minimize the risk of creating a potential IAQ problem.

3. Guidelines

3.1. The accumulation of irritating contaminants is another potential source of IAQ problems. Contaminants can originate from inside the building due to smoking, molds, cleaning agents, new building materials and furnishings, or from external sources such as construction operations and pesticides.

3.2. Proper ventilation and adherence to applicable ventilation guidelines and standards designed to maintain comfort factors acceptable to most occupants is one of the most effective means to promote good IAQ.

3.2.1. Adequate ventilation occurs when a sufficient amount of fresh outside air is supplied to the interior environment based on the number of occupants within a particular space in addition to the space's air handler's capacity to move fresh air into the space. In doing so this will prevent the accumulation of significant quantities of vapor-air or gas-air mixtures within the indoor environment.

3.2.2. At a minimum, an area should have either a mechanical means of ventilation, such as an air handler, or a physical means of ventilation, such as a window that is capable of providing a sufficient amount of fresh,

outdoor air into the room. A fan or air horn may be used to push air into the space.

3.3. All mechanical and physical equipment, including air handling units, exhaust fans, and windows, must be maintained in working order.

3.4. Any significant sources of contaminant emissions must be kept isolated from occupied spaces and any major sources of contamination must be promptly controlled. See Sections 4 and 5 of Appendix A for examples of sources of indoor and outdoor contaminants.

4. Responsibilities

4.1. Environmental Safety and Health (EH&S)

4.1.1. Receive IAQ complaints and determine the appropriate response action.

4.1.2. Conduct site investigations (when necessary) and initiate remedial measures, which may include bringing in additional professionals (in-house or independent consultants) to evaluate the IAQ situation.

4.1.3. Document all IAQ activities in ServiceNow.

4.1.4. Communicate relevant information related to findings to administrators, staff and other interested and affected parties. This may include informal meetings between all affected individuals.

4.1.5. Serve as an information source for material related to improving and maintaining good environmental air quality.

4.2. Facilities Management Campus Services (FMCS)

4.2.1. Maintain each site in a condition that provides good IAQ, which may include maintenance and repair of interior and exterior building components.

4.2.2. Serve as an information source for building components and schematics (especially those involved with ventilation of a building) that are involved with an IAQ situation.

4.2.3. Request support from EH&S Department when IAQ issues and/or concerns exceed their level of expertise.

4.3. Building Occupants

4.3.1. Exercise safe and healthy work practices. If unsafe or unhealthy work is observed, please report it to EH&S (see section 8).

4.3.2. Eliminate practices that restrict air movement, such as blocking air vents with furniture or covering supply vents to control temperature.

4.3.3. Clean-up any spills or leaks immediately.

4.3.4. Avoid using air cleaners and fresheners, which can be potentially dangerous, irritating or noxious.

4.3.5. Do not use 3D printers, laser cutters, or other contaminant-generating equipment in office areas without proper ventilation.

4.3.6. Do not alter or block airflows to and from air conditioning diffusers without first contacting FMCS.

4.3.7. Do not bring in pesticides from home. Pest and weed control concerns should be directed to FMCS.

4.3.8. Eliminate standing water in the bottoms of plant pots. Note that potted plants can be a significant source of mold in an indoor environment.
4.3.9. Avoid using electrostatic cleaners which can generate ozone.
4.3.10. Ensure any personal air-cleaning device used to supplement office air-filtration should be equipped with a High Efficiency Particulate Air (HEPA) filter. These devices should also be maintained per the manufacturer's specifications.

4.4. Construction Project Managers

4.4.1. Project managers are responsible for assuring that renovation projects in occupied buildings do not create new IAQ problems in relation to the renovation.
4.4.2. Ensure contractors' actions do not result in the deterioration of the IAQ on the construction site to the greatest extent feasibly possible. Work should be completed with controls in place to prevent contamination or a risk of exposure to occupants either inside or outside of the work area.
4.4.3. Verify contractors are performing housekeeping activities throughout the duration of the project. This includes clean-up prior to leaving the work site each day as well as maintaining a clean work site throughout the day.

5. Complaint Reporting and Investigation Process

5.1. Indoor environmental quality concerns should be reported directly to EH&S by emailing safety@andrew.cmu.edu or by calling 412-268-8182.
5.2. A ServiceNow ticket will be created by EH&S to track the findings of the investigation, which will include documenting testing data and any relevant recommendations.
5.3. When needed, EH&S will involve other departments or organizations to assist with the investigation and implementation of corrective actions.
5.4. The cost of laboratory analysis, although infrequently required, for any collected samples will be charged to the department responsible for the area being evaluated. No sampling involving laboratory analysis will be conducted until authorized by the affected department.
5.5. All indoor environmental quality concerns will be investigated with a goal of reaching a mutually satisfactory resolution between EH&S and the affected party.
5.6. Questions regarding the use of portable air cleaners should be directed to EH&S.

6. Sampling as part of an IAQ investigation

6.1. Various direct reading survey instruments should be used by EH&S to provide a characterization of an indoor environment. In most cases, the information provided during this initial survey is sufficient to identify any problems that may be responsible for the IAQ concerns.
6.2. When air sampling is proposed, a sampling strategy must be developed that is based on a comprehensive understanding of how the building operates and the nature of the complaints.

6.3. Measurement of specific chemical or biological contaminants can be very expensive. Before expending any time or money to obtain measurements of indoor air pollutants, the following items must be planned:
  6.3.1. How the results will be used,
  6.3.2. What substances should be measured,
  6.3.3. When and where to collect the samples, and
  6.3.4. What sampling and analysis method should be used to generate useful information.
6.4. When laboratory sampling services are necessary, the associated costs will be passed on to the affected department.
6.5. If a student alleges health effects associated with the academic or University housing environment, they will be requested to visit Student Health Services, for a medical evaluation.
6.6. If a faculty or staff member alleges health effects associated with a University work location, they should contact their supervisor and a Supervisor's Injury/Illness Report should be initiated.
6.7. The results of the on-site EH&S assessment of the involved space, the detailed description of IAQ allegations, and the outcome of associated medical evaluations will be utilized to formulate an action plan for remediation.
6.8. EH&S will provide remedial recommendations to designated representatives of FMCS, construction project manager or Housing as appropriate. EH&S may collect preliminary IAQ data to monitor the levels of carbon monoxide, carbon dioxide, temperature, volatile organic compounds (VOCs) and relative humidity in certain instances to assist in formulation of the remediation plan.
  6.8.1. Additional consideration will be made to determine if poor IAQ is a result of outdoor air in the City of Pittsburgh failing to meet the U.S. Environmental Protection Agency's standards for air quality.
6.9. If all suggested remedial actions have been implemented and symptoms or complaints persist, EH&S will consider performing more extensive air sampling. Air monitoring is most feasible when specific pollutants or contaminants are suspected. In other cases, air monitoring results rarely exceed documented guidelines and are often inconclusive.
6.10. In the event that data is collected regarding the air in the involved space, EH&S will utilize the following established standards regarding acceptable IAQ:
  6.10.1. American Society of Heating, Refrigerating and Air Conditioning Engineers Incorporated (ASHRAE), standard 62-1989;
  6.10.2. American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Values (TLV);
  6.10.3. Environmental Protection Agency (EPA)-published Environmental Standards.

Appendix A Types Of IAQ Contaminants

1. **Building Materials (Newly Installed Components or Finishes)**
   Building components may be treated with, or formulated with a variety of chemicals and preservatives. These products may become a source of IAQ problems, particularly if inadequate building ventilation is established. Glues/adhesives, new carpeting, upholstery, particleboard, furniture, and finishes may off-gas VOC's such as formaldehyde or other air contaminants, and contribute to odors, sensory irritation, headaches or other health and comfort-related symptoms to occupants in the indoor environment.

2. **Carbon Dioxide (CO_2)**
   Carbon dioxide is a primary component of human respiration, and can be monitored as a surrogate contaminant, reflecting the adequacy of air exchange or ventilation in the building. CO_2 in outside air may commonly range between 300 – 500 parts per million (ppm), as influenced by outdoor CO_2 sources such as local vehicular exhaust, fuel combustion, or other industrial sources. ASHRAE has determined that indoor CO_2 levels should not exceed 700 ppm greater than outdoor levels (300 – 500 ppm), to maintain biological (human) odors at agreeable levels for most occupants.

3. **Carbon Monoxide (CO)**
   Carbon monoxide in the indoor environment may be associated with sources such as: Improperly vented appliances with natural gas or other hydrocarbon fuel sources, Outdoor vehicular hydrocarbon emissions, or Boilers, heating systems, or other industrial sources.

   CO may therefore build-up or accumulate within buildings where there is inadequate ventilation or fresh-air exchange. With respect to outdoor concentrations, the U.S. EPA has determined that CO levels should typically not exceed 9 ppm in an 8-hour period, more than once per year, or 35ppm in any 1-hour period more than once per year (National Ambient Air Quality Standards).

4. **Other Indoor Contaminant Sources**
   - Indoor contaminant sources may also include:
   - Cleaning agents
   - Sewer gas from dry floor or sink drain traps
   - Appliances not properly maintained or exhausted
   - Personal hygiene and personal hygiene products
   - Humidification devices not properly maintained
   - Smoke or soot from inadequately vented appliances
   - Painting supplies, or other source materials or agents

5. **Other Outdoor Contaminant Sources**
   - Outdoor contaminant sources may also include:
   - Exhaust from motor vehicles
   - Vapors or fumes from construction or renovation activities
   - Odors from landscaping materials, pesticides, etc.
   - Smoke from tobacco products

6. **Inadequate Ventilation**
   Inadequate ventilation occurs when an insufficient amount of fresh outside air is supplied to the interior environment.

7. **Microbial Contaminants**
   Microbial Contamination may occur in buildings that are impacted by water leaks, build-up of humidity, and other sources of moisture. Contaminants can also be introduced into buildings from stagnant water in HVAC distribution systems and cooling towers. Prevention of microbiological contamination is accomplished by eliminating standing water and other sources of moisture and by the proper use of biocides.

8. **Temperature (°F) and Relative Humidity (%RH)**
   Temperature and relative humidity levels may have a direct impact on occupant comfort, the release of other contaminants and/or microbial growth, and subsequent occupant symptoms, complaints or visibly deteriorating building materials. The Occupational Safety and Health Administration (OSHA) has reported that ideal indoor temperature for office occupancies may range between 68 – 76F, and that ideal relative humidity levels should range between 20 – 60%. Relative humidity levels routinely less than 20% may contribute to skin, eye and mucous membrane drying, and levels routinely exceeding 60% may contribute to mold growth. ASHRAE has recently recommended that RH should not exceed 65% when buildings are properly operating at design conditions with respect to dehumidification.

   Indoor temperature and humidity share an integral relationship. In general, more moisture may be retained in air at lower temperatures and constant barometric pressure. Below these "dew point" temperatures, water may condense on cold or cool surfaces within the room or building. This condition may contribute to the collection and build-up of airborne dusts and debris that contain fungal spores onto the wetted surfaces, with subsequent mold growth.

9. **Respirable and Ultra-Fine Particulates**
   Airborne respirable and ultra-fine particulates, associated with copier toners, inks, and paper products are anticipated with high production copying. Depending on the copier manufacturer's internal controls or products associated with the copier equipment, low level respirable particulate exposures may occur. However, these exposures are substantially less than the corresponding occupational exposure criteria such as the OSHA Permissible Exposure Limit (PEL), eight-hour time-weighted average (TWA) of 5 mg/m^3, or, the ACGIH TLV-TWA of 3 mg/m^3 inhalable mass for carbon particulate (inhalable mass).

   Inks and toners may also have very small quantities of metals and/or resinous components; however, these components are anticipated to be at airborne exposure levels significantly less than applicable occupational exposure criteria, and may be associated with individual response (irritant or allergic), at levels less than occupational exposure criteria.

10. **Ozone (O3) or Related Oxygen Free Radical Compounds**

Ozone is produced via operation of office machines, copiers and electrostatic appliances. Both occupational and public health exposure criteria have been established for ozone. Ozone is attributable to exacerbations of asthma, and to irritant effects on eyes, nose, throat, lung and mucous membrane tissues. Ozone may also accelerate aging of lung tissue and contribute to the degradation of property due to it's oxidizing effects.

OSHA has established a PEL-TWA for ozone of 0.1 ppm. The ACGIH has established TLV-TWA criteria based on the level of work activity encountered during exposure, ranging from 0.05 ppm during heavy work to 0.2 ppm during light work. The USEPA NAAQS for ozone is 0.12 ppm as a 1-hour exposure not to be exceeded during a year, and otherwise 0.08 ppm as the fourth highest 8-hour daily maximum exposure when averaged over a 3-year period. ASHRAE has listed a 100 ug/m^3 (0.1 mg/m^3) *Concentration of Interest* for ozone (a level at which physical and health-related symptoms or effects may occur in the indoor environment).

Appendix B - IAQ Tips

The following list notes items or procedures that should be followed in order to minimize the risk of creating a potential IAQ problem. Scheduling for some of the noted items is subject to internal department program directives.

- Flooded areas of carpet must be wet vacuumed and extracted as soon as the problem is discovered. Wet areas of carpet must be dried within 24 hours in order to minimize the risk of mold growth, utilizing carpet fans or other means of drying, if necessary, to hasten the drying process.
- If carpet is flooded due to a sewage back-up or due to flooding from outdoors, the affected carpet must be replaced by a certified contractor. The area should not be reoccupied until the carpet is replaced and the underlining floor impacted has been properly decontaminated and/or dried.
- Water damaged flooring and/or ceiling tiles exhibiting visible mold growth must be removed by a certified contractor, not painted over.
- Porous building materials with visible mold growth due to water damage must be removed by a certified contractor and replaced.

Air Conditioning

- Regularly change filters on air conditioning units per the manufacturer's recommendation. Air handling units should be shut off while filters are being changed.
- Whenever possible, low efficiency filters should be upgraded to at least a 30-35% efficient pleated variety. Filter efficiency should never be downgraded.
- Verify that the filters fit properly with no gaps between or around the sections.
- The condition of fan belts and other mechanical components should be checked at least as often as the filters are changed.
- Periodically inspect the interiors of air handling units to look for visible biological growth on any interior components.
- Drain pan anti-fouling tablets should only be used during the cooling months. These tablets should be removed during the traditional heating months since they need to be under water to be effective. If these tablets dry-out, there is a risk of chemical off-gassing from the tablets.
- Chilled water temperature (on applicable systems) should be maintained at a temperature determined to maximize dehumidification efficiency.
- Supply and return diffusers should be periodically cleaned to remove any accumulated dust.
- Outside air intakes should be periodically inspected for the presence of insect or bird nests or build-up of debris.
- Grills and screens that cover intakes must remain clean to allow unrestricted flow of outside air. Make sure no pollutant sources (i.e. dumpsters or idling vehicles) have been positioned near an intake.
- Exhaust fans should be checked for proper operation on a regular basis.
- Chemicals (cleaning or other types) should not be stored in a mechanical room.