IAQ Diagnostic Requirements for Contractors Conducting Work at The University of Texas at Austin

I. Purpose

The University of Texas at Austin (UT) has established a set of procedures third party consulting companies must follow when conducting Indoor Air Quality (IAQ) investigations at its facilities. These procedures assume an investigation of areas for pre-renovation planning purposes and not as a response to IAQ complaints.

II. Potential Source Inspection

In order to diagnose a problem and prescribe mitigation options, the investigator must determine the different sources of potential contaminants in the building. This process involves a walkthrough of the building, inspection of the building ventilation system, and inspection of adjacent outdoor locations, during which a detailed inventory of potential sources of contaminants will be identified. A contaminant source inspection of the building ventilation system should include a description of any sources of contaminants which may be entrained into the outside air inlet (sewer vents or fume hood exhausts) and any standing water or visible microbiological contaminants in the cooling coil condensate drip pan or inside the duct work downstream of the cooling coils. Also the cooling coil drain should be checked to see if it is properly trapped.

A. Contaminates commonly found inside buildings may include, but are not limited to the list below. Contaminants of concern will not be included in investigations without UT's Environmental, Health, and Safety (EHS) Department prior approval:

- Ozone from copiers and fax machines
- Volatile Organic Compounds (VOCs) from adhesives, paints, stains, and varnishes or new furniture off-gassing
- Formaldehyde
- Mold
- Pesticides
- Scents from perfumes, colognes, and air fresheners
- Sewer gas from dry traps
- Dust and fibrous mineral from building materials
- Particulates from human, animal, or other sources
- Fiberglass or glass wool insulation
- Gypsum dust from renovation projects

B. Contaminates commonly found outside buildings may include, but are not limited to the list below. Contaminants of concern will not be included in investigations without EHS prior approval:

- Exhaust from motor vehicles
- Fumes from construction or renovation
- Roofing & street paving projects
- Odors from dumpsters and other refuse containers

III. Ventilation System Inspection

Air contaminant measurements should be taken into consideration for the amount of outside air being delivered into the building during the time which contaminant measurements are taken.

IV. Contaminant Measurements

EHS prior approval of sampling parameters is required. Prior to any data or sample collection, a visual inspection of suspect areas must be performed. The next required step is the collection of contaminant measurements as part of an indoor air quality investigation. Collect data and samples using only the parameters EHS has specified in the scope of work. Additional sampling will not occur unless EHS has approved the change in scope.

A. Common Contaminants of Concern

The contaminants to measure will be decided by EHS or in conjunction with the project manager. Below is a list of the most common indoor air quality parameters to assess.

1. Carbon Dioxide
   Carbon dioxide (CO_2) is used as an indicator to evaluate the performance of ventilation systems. Ordinary outside air in urban areas normally contain about 350 to 400 parts per million (ppm). ASHRAE standard 62.1-2013 (Ventilation for Acceptable Indoor Air Quality) recommends that CO_2 levels be maintained below 1,000 ppm.

2. Temperature
   Temperature ranges of 68^0 F to 73^0 F during the winter months and 73^0 to 79^0 F during summer months are recommended by ASHRAE.

3. Relative Humidity
   Relative humidity levels can affect the release rate of many indoor contaminants, their concentrations in the air, and the potential growth of microbial organisms. Acceptable range of humidity is from 20% to 50%. Indoor relative humidity levels should never exceed 60%.

4. Carbon Monoxide
   Indoor levels of carbon monoxide (CO) are generally similar to but should not exceed levels found in the air outside of the occupied building. The current regulatory permissible exposure limit (PEL) is 50 ppm.

5. Formaldehyde
   Use low-level (0.04-1 ppm) detector tubes to evaluate issues such as off-gassing from insulation, building materials, carpets, drapes, or glues and adhesives.

6. Nitrogen Oxides and Ozone
   (Recommend Using Detector tubes) Also collect outdoor samples since ambient levels of ozone may reach levels that are 1-3 times the PEL of 0.1 ppm during air-temperature inversions. If a more accurate or continuous ozone evaluation is required, a chemiluminescent monitor that is specific for ozone and can measure in the range of 0.01 to 10 ppm.

7. Moisture Levels
   In areas with observable water intrusion, the walls, floors, or ceilings should be accessed to determine the extent of damage and to detect any microbial growth. The moisture content of the affected building component should be measured and documented. As in the HVAC evaluation, tracer gas analysis may be used to determine pollutant pathways and the extent of pollutant migration.

8. Particulate Levels
   Both particle count and mass concentration readings are important in determining the overall quality of air in indoor settings. The 0.1, 0.3 and 0.5 micrometer size ranges should be half the outdoors levels.

B. Mold Sampling Methods Options

1. Tape (or tape-lift) - These samples can be collected using clear adhesive tape, packing tape, or bio-film. Easily removed material is collected by touching the tape gently to a test surface and removing the tape with a steady force. Do not rub the tape into the material being sampled.
2. Bulk - These are portions of environmental materials (e.g., settled dust, sections of wall board, pieces of duct lining, carpet segments, or return-air filters) tested to determine if they may contain or be contaminated.
3. Swab – This sampling method is not recommended by EHS on UT Austin's campus. EHS must provide prior approval if this method is being considered.
4. Non-Viable Air Sampling – This method uses spore trap cassettes in conjunction with a portable air pump to rapidly collect airborne aerosols including mold, pollen, dander, and other particulates.

C. How to Measure
Sampling and analytical protocols should be selected to provide the necessary analytical sensitivity, this is subject to EHS's approval. All equipment that is used for the investigation must be calibrated before and after use. Documentation of the calibration protocol, sequence, date it was last calibrated if applicable, and readings must be provided in the report.

D. Where to Measure
Indoor air quality diagnostic investigations will be conducted simultaneously at indoor locations in the occupied zone and at an outdoor location near the outside air inlet of the ventilation system. Check with EHS or the project manager prior to sampling during business hours, some projects will require sampling when buildings are unoccupied. For general building assessments a minimum of one sample location per ventilation system zone and with a subset of sample duplicates and sample field blanks is required. The report should discuss the mixing of air in buildings in order to prepare the sampling matrix.

E. When to Measure.
Eight hour samples provide measures of the average concentration. Peak measurements must be taken into consideration when evaluating HVAC systems.

V. Data Interpretation

If EHS requests the third party consultant to provide interpretation of the collected data then the following must be taken into consideration:

- potential contamination source,
- ventilation system inspection, and
- contaminant measurements.

During this process, the third party consulting company considers results of the investigation by comparing the results to the ASHRAE and DSHS standards. Deviation from these standards must be approved by EHS prior approval to report submittal.

VI. Mitigation

Provided EHS has granted prior approval, the third party consultant should formulate a mitigation plan to address the indoor air quality issues. Once the mitigation plan has been implemented the building must have clearance sampling performed.

VII. Communicating Information

Information regarding sampling collection, data analysis, and the investigation in general will only be communicated to EHS or the project manager.

Building occupants are not to be communicated with directly by the third party consulting company personnel. Building occupants must be referred to the project manager for all project information.

If EHS specifies that raw data is the deliverable, then only raw data with no interpretation must be provided.

All data tables must include unit of measure if appropriate. The margin of error for all methodologies and devices must be included in the report, as a foot note under the table unless otherwise specified by EHS.
Sample identification must be consistent in the report, floor plans, and on the chain-of-custody (COC).

VIII. Chain-of-Custody Documentation

The COC procedure is intended to ensure that the sample is kept secure at all times and will stand up to the documentation requirements that may be associated with legal challenge. The COC document identifies the location, transfer, and security of the sample from collection to disposal and provides documentation that identifies each person having true possession of the sample.

The COC will be completed in sufficient detail so that individual sample identification can be directly correlated to the corresponding floor plans and the laboratory analytical results. Current room uses, designations, or colors can change and should not be the only way of identifying the sample.

1) Sample Identification
   All samples collected shall have a unique identification number assigned to them so that there are multiple ways to research individual samples. The preferred method is to use the three letter building designation followed by a hyphen and then a catalog number for the sample. This would also apply to UT Systems buildings. For outlying facilities such as MSI, MCB, PRC etc. use the facility designation.

2) Sample Location
   This should include:
   Room number(s), this is dependent on whether or not the material is homogeneous throughout the area being inspected.

All floor plans should be marked to indicate rooms and areas within the rooms where sampling was conducted. This information should be reflected on the COC.

IX. Reporting

All reporting must be inclusive of raw data and laboratory analyses. Recitation of current state and federal rules and statutes will not be put in the report. Regulatory reference may be placed in an appendix. Reporting should be provided in tabular format and the information should be cross-referenced with the COC and sample analytical results.

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Prior to report submittal the third party consulting company will confirm report format with EHS. This information may be communicated by the project manager.

Recommendations will be included in the report, only if EHS has provided prior approval.

X. Definitions

For definitions see: http://www.epa.gov/iaq/glossary.html

XI. REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH), ***Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices****,* Cincinnati OH. [R] http://www.acgih.org

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Standard 55-2013**,** *Thermal Environmental Conditions for Human Occupancy***,** Atlanta, GA. [S] http://www.ashrae.org

ASHRAE Standard 62.1-2013, *Ventilation for Acceptable Indoor Air Quality***,** Atlanta, GA. [S]
http://www.ashrae.org

EPA Indoor Air Quality Links
http://www.epa.gov/iaq/index.htmlhttp://www.epa.gov/iaq/largebldgs/ibeam_page.htm
http://www.epa.gov/iaq/schooldesign/hvac.html#Air%20Filtration

Indoor Air Quality Handbook, Spengler, 2001
http://www.knovel.com/knovel2/Toc.jsp?BookID=601&VerticalID=0

Indoor Air Quality Publications from CPSC
http://www.cpsc.gov/cpscpub/pubs/iaq.html

Institute of Inspection Cleaning and Restoration (IICRC), S500, *Standard and Reference Guide for Professional Water Damage Restoration,* Vancouver, Washington, 1999. [G]
http://www.iicrc.org

Institute of Inspection Cleaning and Restoration, S520, *Standard and Reference Guide for Professional Mold Remediation*, Vancouver, Washington, 2004. [G]
www.iicrc.org

- **NIOSH (National Institute for Occupational Safety and Health)** Guidance for Indoor Air Quality Investigations, Cincinnati: NIOSH, 1987
- Building Air Quality, A Guide for Building Owners and Facility Managers. EPA Publication No. 400/1-91/003 - DHHS (NIOSH) Publication No. 91-114, December 1991.

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
http://www.osha.gov/SLTC/indoorairquality/index.html

OSHA Technical Manual—IAQ Investigations
http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html

OSHA Technical Manual, Section III, Chapter 2, Subsection V "Recommendations for the Employer," Engineering and administrative guidance to prevent IAQ problems.
http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html

Texas Administrative Code (TAC), 25 TAC §§295.301-295.338
http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=25&pt=1&ch=295&sch=J&rl=Y

APPENDIX A
GENERAL IAQ GUIDELINES

Indoor Air Quality Guidelines

Parameter	Standard or Guideline	Remarks
Temperature	68 - 75 F (winter), 73 - 79 F (summer)	ASHRAE Standard 55-2013
Relative Humidity	< 60% RH	ASHRAE Standard 55-2013
Airflow (drafts)	20 to 50 fpm at the occupant level	The IAQ Investigator's Guide (AIHA)
Air Change (Ventilation)	For offices - 5 cfm/person, plus 0.06 cfm/ft2 outdoor air, for a 1,000 ft^2 office and 5 people = 17cfm/person	ASHRAE Standard 62.1-2013 See standard for additional information on other spaces
Carbon Dioxide (CO_2)	800 ppm Massachusetts Department of Public Health guideline for public buildings.	If CO_2 >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.
	<700 ppm above outdoor levels. May indicate inadequate fresh air supply	Ventilation Adequacy (ASHRAE) Note: Not for use in low density population areas, not to be used alone as an indicator of acceptable indoor air
	5,000 ppm for 8 hours, ACGIH TLV)	Occupational exposure limit
Carbon Monoxide (CO)	9 ppm for 8-hour (EPA) 35 ppm for 1 hour (EPA)	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 potentially affected indoor locations.
Hydrogen Sulfide (H_2S)	8-hour TWA of 1.0 ppm 15-minute STEL of 5.0 ppm (ACGIH)	Threshold Limit Value
Oxygen (O_2)	19.5 % to 23.5 % (OSHA)	29 CFR 1910.134
Ozone (O_3)	0.08 ppm EPA (outdoor limit), ND to 0.03 commonly found indoors	Note: Take into account ambient levels of O_3, measure at air intake also.
PM-10 Particulates (<10 µm)	150 µg/m^3 24-hr Exposure (EPA)	Generally office areas are well under 100 ug/m^3 of PM-10
Fine Particulates (<2.5 µm)	65 µg/m^3 24-hr Exposure (EPA)	See 40 CFR Part 50.7 for definitions and additional information
Formaldehyde (HCHO)	0.04 ppm Health Canada, Generally < 0.03 indoors	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.
	0.3 ppm Ceiling Level (ACGIH)	Occupational exposure limit
TVOCs	300 ug/m^3 Comfort Level (CEC, Seifert, 1990)	If total VOCs are in excess of 0.5 mg/m^3 consider an assessment to identify of eliminated sources. Contact the IH laboratory to determine the appropriate sampling method.
	500 ug/m^3 Building Standard (State of Washington) USGBC LEED Guidelines	
Sulfur Dioxide (SO_2)	0.03 ppm (EPA)	Annual Average outdoors
Chlorine (CL_2)	0.5 ppm (1.5 mg/m3) TWA (ACGIH)	Threshold Limit Value

ASHRAE = American Society of Heating Refrigerating and Air Conditioning Engineers
EPA = U.S. Environmental Protection Agency
ACGIH = American Council for Governmental Industrial Hygienists

OZONE LEVELS (PPM)	
.003 - .015	Odor Detecting Range for Humans
.005 - .01	Heavy Forest Country Air
.02 - .05	Outdoor Air After a Lightning Storm
.02	90% Reduction of Indoor Airborne Bacteria
.05	FDA Limit for Medical Devices
.04	OSHA Limit for Indoor Air
.12	EPA Limit for City Air
1.0	Human Tolerance Level

Minimum Number of Sample

Area of building (m^2)	Minimum number of sampling points
3,000 - <5,000	8
5,000 - <10,000	12
10,000 - <15,000	15
15,000 - <20,000	18
20,000 - <30,000	21
30,000 or more	25

APPENDIX B
EXAMPLE OF A STANDARD IAQ COC

IAQ Diagnostic Requirements for Contractors Conducting Work at The University of Texas at Austin

Requestor: _____ **Date Samples Collected:** _____

Building Name: _____ **Room Number / Location:** _____

Account Number: _____ **Work Order Number:** _____

Sample Collector: _____ **Date Results Required:** **Verbal:** _____ **Written:** _____ **Page** _____ **of** _____

SAMPLE NUMBER	SAMPLE LOCATION / DESCRIPTION	TEST CODE	TOTAL VOLUME (L)	TAT CODE	COMMENTS

Comments: _____

TEST CODES:

1. Air-O-Cell (direct exam-count and genus)
2. Air-O-Cell (full profile)
3. Culture Plate (PDA, MDA, etc.)
4. Swab, Bulk, Tape (direct exam)
5. Swab, Bulk, Tape (culture)
6. Bacterial Culture Plate (count and genus)
7. Bacterial Culture Plate (full Profile)
8. CarpetChek (direct exam)
9. CarpetChek (Fungal Culture)
10. CarpetChek (Bacterial Culture)
11. Water (Fungal Culture)
12. Water (Bacterial Culture)
13. Fungal speciation
14. Bacterial speciation

PROJECT TURN AROUND TIME:

1. Immediate (same day)
2. Next day
3. 3 working days
4. 5 working days
5. 7 working days
6. 10 working days

Relinquished By:		Date:		Time:	
Received By:		Date:		Time:	
Relinquished By:		Date:		Time:	
Received By:		Date:		Time:	

University of Texas
Environmental Health & Safety
304 East 24th Street, Suite 202
Austin, Texas 78712-1024
Ph: 512-471-3511
Fax: 512-471-6918

APPENDIX C
EXAMPLE OF A FIELD ROTOMETER CALIBRATION FORM

Environmental Health & Safety

University of Texas
Environmental Health & Safety
304 East 24th Street, Suite 202
Austin, Texas 78712-1024
Ph: 512-471-3511
Fax: 512-471-6918

Primary Calibration Standard Make: _____

Primary Calibration Standard Model: _____

Primary Calibration Standard XXXial Number: _____

CALIBRATION OF SECONDARY STANDARDS (Field Rotameters)

Date	Time	Rotameter ID	Project Name	Project Number	Technician

Field rotameters are to be calibrated at the beginning of each project prior to collection of samples. Equipment calibration should be conducted at the site. This will eliminate corrective calculations necessary for temperature and pressure variations.

Environmental Health & Safety

APPENDIX D
EXAMPLE OF TABLE FORMATS

Environmental Health & Safety

Example Indoor Air Quality Investigation Results Table

Data Point	Standard or Guideline	Exterior North	XXX 232 Hallway	XXX 318	XXX 319	XXX 319G	XXX 319H
TVOC ($\mu g/m^3$)	**300 $\mu g/m^3$**	**0**	0	0	0	0	0
CO_2 (ppm)	**< 700 ppm above outdoor levels**	**396**	429	432	397	474	437
H_2S (ppm)	**1.0 ppm**	**0.00**	0.00	0.00	0.00	0.00	0.00
CO (ppm)	**9 ppm**	**0.0**	0.0	0.0	0.0	0.0	0.0
Temp (^oF)	**68-75^oF (winter) 73-79^oF (summer)**	**83.8**	83.0	80.3	75.6	76.4	77.1
RH (%)	**< 60%**	**70.1**	33.5	73.2	44.8	47.9	48.5

ppbRAE

Data Point	Standard or Guideline	Exterior North	XXX 232 Hallway	XXX 318	XXX 319	XXX 319G	XXX 319H
TVOC (µg/m3)	**300 $\mu g/m^3$**	**0**	0	4,559	0	0	82

MultiRAE

Data Point	Standard or Guideline	Exterior North	XXX 232 Hallway	XXX 318	XXX 319	XXX 319G	XXX 319H
O_2 (ppm)	**20.9 ppm**	**20.9**	20.4	20.9	20.9	20.9	20.9
CO (ppm)	**9 ppm**	**0**	0	0	0	0	0
VOC (µg/m3)	**300 $\mu g/m^3$**	**0.1**	0.1	0.2	0.2	0.2	0.2
LEL (%)	**0 %**	**0**	0	0	0	0	0
H_2S (ppm)	**1.0 ppm**	**0.0**	0.0	0.0	0.0	0.0	0.0
CL_2	**0.5 ppm**	**0.0**	0.0	0.0	0.0	0.0	0.0

TVOC - Total Volatile Organic Compounds
CO_2 – Carbon Dioxide
H_2S – Hydrogen Sulfide
CO – Carbon Monoxide
Bold any results that are above indoor air quality guidelines.

IAQ Diagnostic Requirements for Contractors