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ABU DHABI PUBLIC HEALTH CENTRE | مركز أبوظبي للصحة العامة

Abu Dhabi Occupational Safety and Health System Framework (ADOSH-SF)

ADOSH-SF Technical Guideline

Occupational Air Quality Management

Version 4.0

July 2024

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1. Introduction

(a) This technical guideline provides guidance for air quality monitoring and for collecting air samples for the investigation of pollution. It identifies international standards / guidelines applicable to the measurement of air quality (ambient, workplace and indoor air) and outlines the considerations required for air monitoring.

(b) The information contained in this guideline provides a consistent approach for conducting air quality assessments in the Emirate of Abu Dhabi and shall be considered as minimum requirements. The guideline aims to provide general direction on appropriate sampling and quality assurance procedures during the undertaking of monitoring to obtain representative samples, which faithfully represent the environment from which they were taken.

(c) This guideline assumes that an appropriate level of site conceptualization has been completed as part of a Preliminary Site Investigation and that a suitable sampling pattern/regime has been established.

(d) This guideline is not intended to be comprehensive and further information should be sought from international standards and codes where considered relevant for the purpose of completing the site investigation.

2. General

(a) Prior to undertaking air sampling, the objectives of the investigation shall be established. These shall define how and why samples are to be collected. These objectives will guide the development of the investigation strategy and sampling plan.

(b) The sampling objectives will be site specific and depend on the purpose of the investigation and will be guided by the Data Quality Objectives (DQOs). These objectives should be established at the outset of the investigation and can be developed using the seven-step process presented below:

(i) Step 1. State the Problem - define the problem that requires assessment / investigation.
(ii) Step 2. Identify the Goal of the Study - identify the study question(s) and state how the data will be used in meeting the objectives of the study.
(iii) Step 3. Identify the Information Inputs - identify the data and information required to answer the study question(s).
(iv) Step 4. Define the Boundaries of the Study - define the spatial and temporal limits of the study. Specify the target sample population for the study.
(v) Step 5. Develop the Analytical Approach - develop an analytic approach that will guide how you analyze the study results and draw conclusions from the data.
(vi) Step 6. Specify Performance or Acceptance Criteria - determine what data quality assessment criteria will be used to assess data Precision, Accuracy, Representativeness and Comparability and Completeness (PARCC parameters).
(vii) Step 7. Develop a Plan for Obtaining the Data - develop a sampling, analysis and quality plan (SAQP) that meets the performance criteria.

(c) A site recognizance/review shall be undertaken prior to establishing a monitoring plan to gain information on the site characteristics and to provide input into the sampling / monitoring plan.

3. Standards and Guidelines on Air Measurement

(a) A particular substance in air can be sampled / measured by a variety of methods. The sampling / measurement principles of these methods could be different.

(b) It is important that a same method shall be adopted for all monitoring events throughout a project. For a project involving more than one party to carry out monitoring, the monitoring method shall be agreed before monitoring and all parties shall adopt the same method.

(c) Air monitoring shall be performed in accordance with current international standards. For the air management standards and guideline values under the ADOSH-SF, the applicable monitoring standards / guidelines are shown in Table 1 below. These standards / guidelines provide details on the specification of sampling / monitoring instrument, calibration requirements, step by step sampling / monitoring procedures, quality assurance (QA) and quality control (QC) required and the processing of data.

(d) All laboratories that are used for the purpose of air quality sampling / monitoring / measurement should be registered and approved by the Emirates National Accreditation System (ENAS) or the Abu Dhabi Quality and Conformity Council (QCC).

Parameter	Measurement Standard / Guideline
Ambient Air	
Occupational Air	
Substances listed in ACGIH (2009)	NIOSH Manual of Analytical Methods (NMAM); or OSHA Sampling and Analysis Method; or ASTM; or EPA Methods Note: An Air Sampling Guide is shown on: https://www.skcinc.com/pages/sampling-guides
Indoor Air	
Heating, Ventilation, Air Conditioning (HVAC) System	
Carbon Dioxide	Building Air Quality: A Guide for Building Owners and Facility Managers, USEPA
Ventilation	Building Air Quality: A Guide for Building Owners and Facility Managers, USEPA, USEPA (ventilation is measured via the measurement of carbon dioxide concentration)
Thermal Comfort	
Air Temperature	Building Air Quality: A Guide for Building Owners and Facility Managers, USEPA
Relative Humidity	Building Air Quality: A Guide for Building Owners and Facility Managers, USEPA
Pollutants / Characteristics	

Parameter	Measurement Standard / Guideline
Asbestos	ASTM D6281-06: Standard Test Method for Airborne Asbestos Concentration in Ambient and Indoor Atmospheres as Determined by Transmission Electron Microscopy Direct Transfer (TEM)
Carbon Monoxide	Compendium of Methods for the Determination of Air Pollutants in Indoor Air, USEPA Nondispersive Infrared (NDIR); Gas Filter Correlation (GFC); or Electrochemical Oxidation
Formaldehyde	Compendium of Methods for the Determination of Air Pollutants in Indoor Air, USEPA Solid Adsorbent Cartridge; Continuous Colorimetric Analyzer; or Passive Sampling Device
Lead	NIOSH 7105, NIOSH 7182
Ozone	ASTM D5156-95 Standard Test Methods for Continuous Measurement of Ozone in Ambient, Workplace, and Indoor Atmospheres (Ultraviolet Absorption)
Particulate Matter (PM2.5)	EPA IP-10A
Radon	Citizen's Guide To Radon, USEPA (by a Radon Testing Kit)
Total Volatile Organic Compounds (TVOCs)	Compendium of Methods for the Determination of Air Pollutants in Indoor Air, USEPA Stainless Steel Canister; or Solid Adsorbent Tubes

Table1:Air Monitoring Standards

4. Occupational Air Monitoring

(a) Objective of monitoring: Chemicals used in the workplace may be emitted into the working area or ambient environment in various forms and in turn cause risks to health if they are breathed by people in this environment. The objectives of air monitoring at working area could be:

(i) to evaluate the compliance with occupational exposure values specified by the *ADOSH-SF* and/or recognized organizations (e.g. ACGIH, OSHA, NIOSH);
(ii) to identify the sources of air pollutants for implementing appropriate mitigation measures; and
(iii) to evaluate the effectiveness of existing or the newly implemented mitigation measures.

(b) Approach to air monitoring:

(i) personal monitoring: Personal monitoring is to establish the concentration of air substances within the breathing zone and hence evaluate the exposure of the employee to these substances. A sampler is placed within the employee's breathing zone, it collects air samples in the breathing zone continuously when the employee is moving around while working.
(ii) fixed point monitoring: An air sampler is positioned at a particular area of the workplace to collect air samples. It is applicable to the identification of sources and distribution of chemicals / substances, and evaluation of the effectiveness of control measures.

(c) Air sampling methods:

(i) Direct measuring methods: Direct measuring methods provide the results rapidly. Examples of direct measuring methods include:

1. detector tubes (the hand-pump based tubes require no laboratory testing): The hand-pump based detector tube is operated by connecting an unsealed detector tube (with chemicals that could react with the targeted substance in the air) to a hand pump. Air is drawn into the detector tube by a hand pump manually. The chemicals in the tube will react with the targeted substance and give a colour change. The concentration of the targeted substance in air is measured by the length or the intensity of the colour change; and
2. instrumentation providing real time reading.

(ii) Detector tubes: Detector tubes are mainly for the determination of gas or vapour concentrations in air. There are two main types of detection tubes, they are:

1. hand-pump based tubes (refer to the above);
2. diffusive tubes: Diffusive detector tube is used for long-term measurement of the concentrate of air substances by diffusion (a hand pump is not required); and
3. in view of the monitoring method, detector tubes (hand pump based) could only provide "qualitative" results instead of highly "quantitative" results.

In addition, detector tubes have a limited shelf life. The manufacturer's instructions shall be referred to before using the detector tubes.

(iii) Instruments providing real time reading:

1. various models of real-time instruments are available in the market for measuring substances in the workplace areas. In general, these instruments can provide real-time reading on particulate (e.g. PM1, PM2.5 and PM10), oxygen, carbon monoxide, hydrogen sulphide, Lower Explosive Limit (LEL) of a combustion gas and TVOCs;
2. some instrumental devices are able to provide results on time-weighted average (TWA) and short-term exposure limit (STEL) specified by recognised standards (e.g. NIOSH, OSHA and ACGIH), equipped with data-logging function and allow downloading of data to computer for further analysis; and
3. these instruments shall be maintained and calibrated regularly in accordance with the manufacturer's manual to ensure the sensors, batteries and other parts are functioning properly.

(iv) Sampling followed by Laboratory Analysis: The concentration of substances in the workplace area can be determined by collecting an air sample by a sampler followed by laboratory analysis. This method can provide accurate measurement results. Various sampling devices are available in the market, some examples are shown below.

1. gas bag;
2. charcoal adsorbent tube (for the sampling of organic vapour);
3. canister (for the sampling of VOCs);
4. passive diffusive sampler (for the sampling of hydrochloric acid, hydrofluoric acid, aldehydes, ammonia, VOCs, phenols, anaesthetic gases, hydrogen sulphide, nitrogen dioxide, sulphur dioxide and ozone);
5. cyclone sampler (for sampling of respirable dust);
6. impinger (for collecting air substances into a liquid medium);
7. metal fumes sampler; and
8. cowl sampler (for sampling of airborne asbestos fibres).

(d) Except canister and passive diffusive sampler, the samplers mentioned above are connected to an air sampling pump for drawing an air sample onto the sampler.

(e) The details on the above sampling equipment are available on the websites of equipment manufacturers (see references in Section 8). For the laboratory analysis of the samples, NIOSH, OSHA, ASTM and US EPA provide detailed analytical methods (including discussion, limitation, procedures of field sampling and laboratory analysis, instrument calibration).

5. Indoor Air Monitoring

(a) Acceptable IAQ is defined as air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80%) of the people exposed do not express dissatisfaction (ASHRAE Standard 62.1-2007).

(b) In view of the above definition, the scope of IAQ monitoring is shown in Table 5.01, summarized as follows.

(i) monitoring the substance in indoor air (e.g. VOCs, carbon monoxide);
(ii) checking on the heating, ventilation and air conditioning (HVAC) system (including visual inspection and checking by equipment); and
(iii) occupants' perception of IAQ and health symptoms (via interviewing / questionnaire).

(c) The monitoring guidelines for the above items are detailed in: Standardized EPA Protocol for Characterizing Indoor Air Quality in Large Office Buildings, USEPA.

Environmental Monitoring	Building and HVAC Characteristics		Occupant Survey
	Building Checklist	HVAC Checklist	
– Bioaerosols (air, visible growth) – Carbon Dioxide – Carbon Monoxide – Formaldehyde – Light – Particles (PM10, PM2.5) – Radon – Relative Humidity – Sound – Temperature – VOCs	– Use – Occupancy – Geographical Location – Ventilation (equipment, operation schedule) – Construction – Outdoor Sources – Smoking Policy – Water Damage – Fire Damage – Renovation – Pest Control – Cleaning Practices	– Type Specifications (air handler, exhaust fans) – Filtration – Air Cleaning Systems – Air Washers – Humidification Systems – Maintenance Schedule – Inspection Schedule – Supply Air Flow Rate – Percent Outdoor Air – Outdoor Air Intake Rate – Supply Air (temperature, relative humidity) – Exhaust Fan Rates – Local Ventilation Performance – Natural Ventilation	– Workplace Physical Information – Health and Well-being – Workplace Environmental Conditions – Job Characteristics – Occupant Demographics

Table 2: Scope of Indoor Air Monitoring – Source (referenced at time of document development):

http://www.epa.gov/iaq/base/study_overview.html

6. References

- *ACGIH (2009), TLVs and BEIs based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices, ACGIH*
- *Ventilation for Acceptable Indoor Air Quality (ASHRAE 62-2004)*

References Accessed 2012.

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- *http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?TITLE=16&PART=1303&SECTION=4&YEAR=1999&TYPE=PDF*
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- *http://www.epa.gov/pmdesignations/faq.htm#1*
- *http://www.epa.gov/radon/pdfs/citizensguide.pdf*
- *http://www.ephc.gov.au/sites/default/files/AAQ_NEPM__Ambient_Air_Quality_NEPM_Varied_scaleplus_Final_200305_1.pdf*

7. Document Amendment Record

Version	Revision Date	Description of Amendment	Page/s Affected
4.0	*15th July 2024*	*System acronym updated from OSHAD-SF to ADOSH-SF to accurately reflect document title*	*Throughout*
		Change from OSHAD to ADPHC	
		Change of Logo	
		Indicated (in Table 2 & Section 6) references sourced from the internet at time of document development	
		Minor editorial changes throughout the document without changing requirements.	

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