

Air Monitoring **in** the Workplace



Occupational Safety and Health Branch
Labour Department



OCCUPATIONAL SAFETY & HEALTH COUNCIL

This booklet is prepared by the
Occupational Safety and Health Branch,
Labour Department

First edition January 2006

This booklet is issued free of charge and can be obtained from offices of the Occupational Safety and Health Branch of the Labour Department. It can also be downloaded from website of the Labour Department at http://www.labour.gov.hk/eng/public/content2_9.htm. For enquiries about addresses and telephone numbers of the offices, please call 2559 2297.

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Introduction

Chemicals used in the workplace may be dispersed into the air in various forms. They can be breathed in together with the air, thus causing harm or illness. Monitoring these air impurities in the workplace is an important part of the assessment of risks to health. Proprietors should ensure that exposure of workers to air impurities is regularly monitored and that their exposure levels are below the relevant Occupational Exposure Limits (OELs) as published in the “Code of Practice on Control of Air Impurities (Chemical Substances) in the Workplace”. This booklet is intended to introduce to proprietors the basic principles and different methods of monitoring of air impurities in the workplace. ^{Note 1, 2}

Note 1 For details of the occupational exposure limits and air monitoring, please refer to the Labour Department’s “Code of Practice on Control of Air Impurities (Chemical Substances) in the Workplace” and the reference materials listed in its Annex II.

Note 2 The photographs of the equipment shown in this publication are for the purpose of illustration only. It does not imply that such brand or model of equipment is approved, endorsed or recommended by the Labour Department.

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The Purpose of Air Monitoring in the Workplace

Air monitoring serves:

- to identify the source of air impurities for implementation of suitable control measures; and
- to evaluate the effectiveness of existing or the newly implemented control measures.

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Approaches for Air Monitoring

Basically, there are two approaches for air monitoring in the workplace: personal monitoring and fixed-point monitoring.

3.1 Personal Monitoring

This monitoring approach requires the sampler to be placed within the worker's breathing zone, i.e. the space within 30 cm from the worker's nose and mouth. Personal monitoring can establish the concentration of air impurities within the breathing zone and hence evaluate the exposure of the worker to these

substances. For example, by positioning the sampler on the lapel of the worker, the sampler collects samples of air in the breathing zone continuously even if the worker is moving around while working.



Personal Monitoring

3.2 Fixed-Point Monitoring

In fixed-point monitoring, air samples are collected at a particular area of the workplace where the sampler is positioned. It is useful for identifying the source(s) of air impurities, determining their distribution in the workplace, and confirming the effectiveness of control measures.



Fixed-Point Monitoring

4 Air Monitoring Equipment

Different monitoring equipment is available in the market, depending on the nature of the air impurity and the sampling strategy adopted. ^{Note 3}

Note 3 Please refer to the operation manuals provided by the suppliers of the monitoring equipment for the characteristics of the equipment and the operating procedures.

4.1 Direct Measuring Methods

Direct measuring methods display the results rapidly so that users can swiftly evaluate the health risks of the air impurities in the workplace and respond instantly to safeguard the health of the workers.

The following are some examples of direct measuring methods:

Detector Tubes

Detector tubes are one of the most commonly used methods for air monitoring. They are fairly simple to use and are mainly used for determination of the concentrations of gas or vapour in the air. Different types of tubes are available for detecting different air impurities. There are two main classes of detector tubes: hand-pump based tubes and diffusive tubes.

- (a) hand-pump based detector tube is operated by connecting an unsealed tube to a hand pump. By operating the pump manually, air is drawn into the tube. If the relevant air impurity is present, the purpose made chemicals in the tube will react to give a colour change. The concentration of the air impurity is measured by the length or the intensity of the colour change. Examples are ozone generated from photocopying or toluene vaporized from the solvents used in printing process.

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- (b) diffusive detector tube is used for long-term measurement of the concentration of air impurities by diffusion and the use of hand pump is not required.

Detector tubes have a limited shelf life and some of them are subjected to cross-interference, hence it is important that instructions provided by the manufacturer should be referred to before using detector tubes.



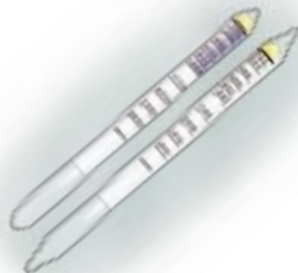
Different detector tubes



Detector tubes in use with hand pumps



Diffusive detector tube



A detector tube showing colour change (left) and a fresh detector tube (right)

A General Guide on Use of Hand-pump based Detector Tube



Step 1

Select the proper detector tube with respect to the air contaminant to be tested. Make sure the tube has not yet expired.



Step 2

Read and follow the instructions for use.



Step 3

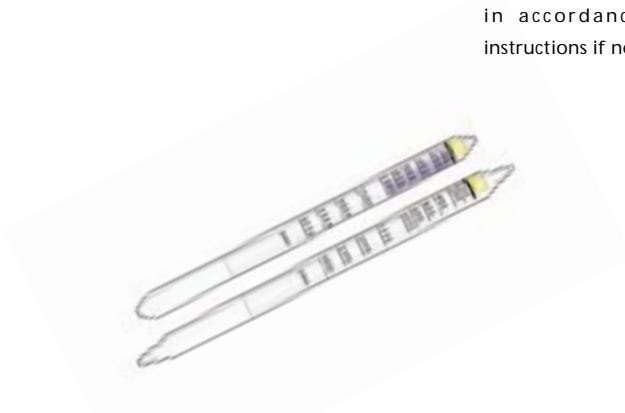
Insert an unopened detector tube to the pump and test for leaks by squeezing the pump completely. The position of the pump should remain unchanged if there is no leak. Leak is indicated if the pump returns to the original position, and therefore the pump should be maintained or replaced.



Step 4 Break the tips of the tube carefully since glass splinters may come off. The opened tube should be handled with care to avoid being injured by the sharp edges of the tips.



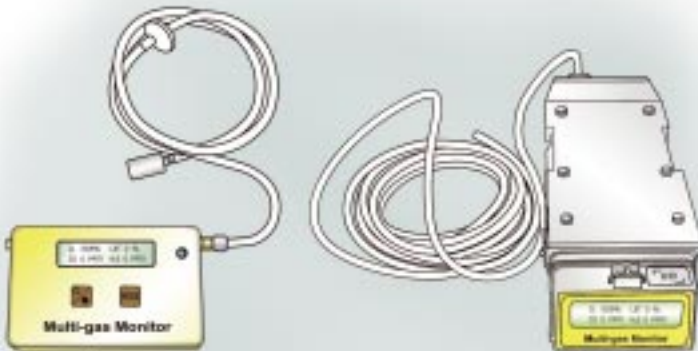
Step 5 Insert the opened detector tube into the pump with the arrow mark pointing towards the pump. At the location for measurement squeeze the pump and allow it to release completely for a stroke. Repeat in accordance with the instructions if necessary.



Step 6 Remove the used tube with caution and read the length of the colour change in accordance with the instructions.

Instrumental Methods

Different models of real-time instrumental devices are available in the market for measuring the concentrations of chemical impurities in the air and the results are displayed on the screen directly. Some instruments are portable and can be carried to different environments for air monitoring, for example, the multi-gas detector for testing atmosphere before entry into confined space and the dust monitor for measuring dust concentration in construction sites. Some instrumental devices are designed for continuous fixed-point monitoring, for instance, the chlorine gas detector(s) installed in rooms where compressed chlorine gas cylinders are stored or used. Such detectors allow users staying safely in an independent control room to monitor remotely any leakage in the storage rooms.



Different models of multi-gas monitor



Dust monitors

Certain instrumental devices are equipped with alarm function to alert users if the concentration of air impurities detected in the atmosphere exceeds a certain level, and some devices even come with data-logging function and downloading to computer for further analysis and record keeping.

Instrumental devices should be maintained and calibrated regularly to ensure the sensors, battery and other parts are functioning properly. Moreover, users should be familiar with the operating procedures and possible interference of the devices.

4.2 Air Sampling Methods

Alternatively, the concentration of air impurities can be determined by collecting air samples or the air impurities by air sampling devices for laboratory analysis. With the use of better laboratory analytical instruments and testing methods, accurate measurements can be obtained.

Various sampling devices are designed for sampling air impurities of different nature. The following are some examples of sampling devices:

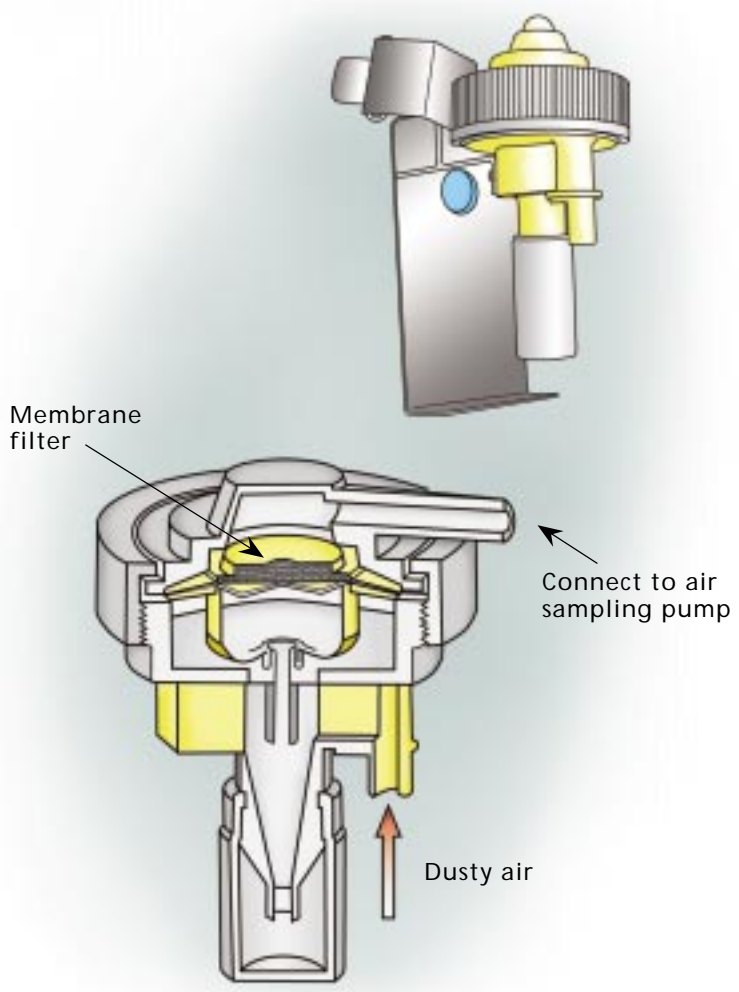
Gas bag



Charcoal adsorbent tube for sampling organic vapour

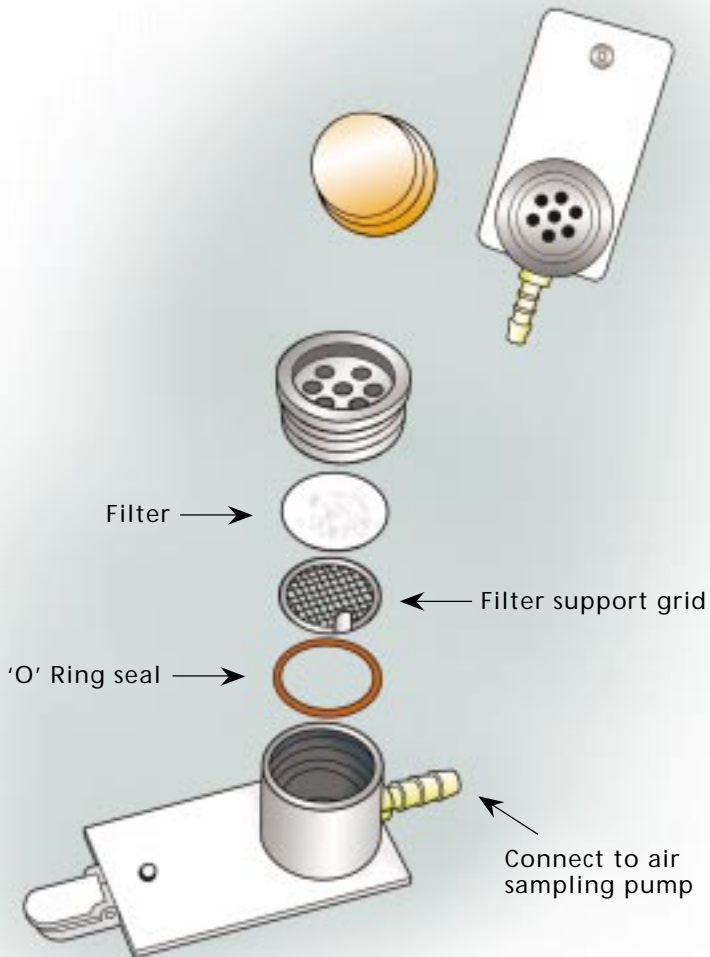


Cyclone sampler for sampling respirable silica dust



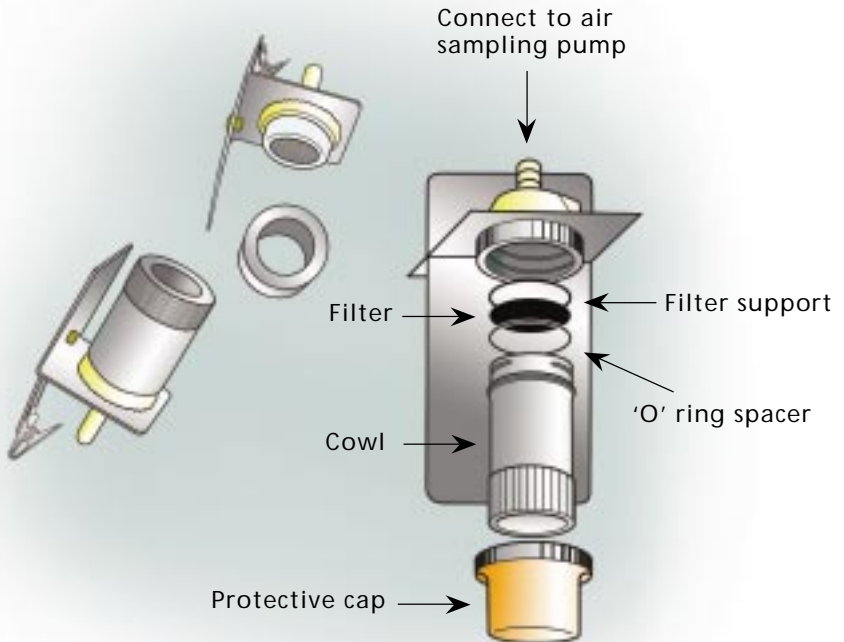
[Reference : Health and Safety Executive, MDHS14/3 General Methods for Sampling and Gravimetric Analysis of Respirable and Inhalable Dust, UK]

Device for sampling metal fumes



[Reference : Health and Safety Executive, MDHS14/3 General Methods for Sampling and Gravimetric Analysis of Respirable and Inhalable Dust, UK]

Cowl sampler for sampling airborne asbestos fibres



[Reference : Health and Safety Executive, MDHS39/4 Asbestos Fibres in Air Sampling and Evaluation by Phase Contrast Microscopy (PCM) under the Control of Asbestos at Work Regulations, UK]

Air sampling pumps are generally used to draw air into air sampling devices. Except air bag, the other devices shown above can be used for both personal sampling and fixed-point sampling. In addition, a small diffusive sampler is also available in the market, which is designed for collecting organic vapour in the air by the latter's diffusion without using air sampling pump.

5 Air Monitoring Records

Since the purpose of air monitoring and the monitoring strategy adopted determine the interpretation of measurement results, such information should be recorded in addition to the monitoring results. For example, the work process, the work nature, the use of chemicals, the control measures in place, the position, the time and the duration of air monitoring, the monitoring method and instrument used, and the conclusion should be clearly recorded and kept for future reference.

6 References

You may refer to the following publications for further information on 'Occupational Exposure Limits' and control measures of air impurities:

- Labour Department, *Code of Practice on Control of Air Impurities (Chemical Substances) in the Workplace*
- Labour Department, *Code of Practice: Safety and Health at Work with Asbestos*

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- Labour Department, *Code of Practice for Safety and Health at Work in Confined Spaces*
 - Labour Department, *Air Impurities in the Workplace*
 - Labour Department, *Chemical Safety in the Workplace - Guidance Notes on Risk Assessment and Fundamentals of Establishing Safety Measures*
 - Labour Department, *Chemical Safety in the Workplace - Guidance Notes on Personal Protective Equipment (PPE) for Use and Handling of Chemicals*
 - Health and Safety Executive, *MDHS14/3 General Methods for Sampling and Gravimetric Analysis of Respirable and Inhalable Dust*, UK
 - Health and Safety Executive, *MDHS39/4 Asbestos Fibres in Air Sampling and Evaluation by Phase Contrast Microscopy (PCM) under the Control of Asbestos at Work Regulations*, UK
 - Health and Safety Executive, *Methods for Determination of Hazardous Substances*, UK
 - Occupational Safety and Health Administration, *OSHA Technical Manual*, USA
 - National Institute for Occupational Safety and Health, *NIOSH Manual of Analytical Methods*, USA

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Further Information

This booklet is issued free of charge and can be obtained from offices of the Occupational Safety and Health Branch or downloaded from website of the Labour Department at <http://www.labour.gov.hk/labour/eng/public/index.htm>. If you wish to enquire about this booklet or require advice on occupational health and hygiene, please contact the Occupational Safety and Health Branch of the Labour Department through:

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Information on the services offered by the Labour Department and on major legislation can also be found by visiting our Home Page in the Internet. Address of our Home Page is <http://www.labour.gov.hk>.

Information on the services offered by the Occupational Safety & Health Council can be obtained through their hotline **2739 9000**.



Complaints

If you have any complaints about unsafe workplaces and practices, please call the Labour Department's occupational safety and health complaint hotline at **2542 2172**.