AUSTRALIAN INSTITUTE OF OCCUPATIONAL HYGIENISTS ®

Flow Measuring Equipment: Calibration Requirements

Technical Paper

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AUSTRALIAN INSTITUTE OF OCCUPATIONAL HYGIENISTS INC (AIOH)

The Australian Institute of Occupational Hygienists Inc. (AIOH) is the association that represents professional occupational hygienists in Australia. Occupational hygiene is the science and art of anticipation, recognition, evaluation and control of hazards in the workplace and the environment. Occupational hygienists specialise in the assessment and control of:

- Chemical hazards (including dusts such as silica, carcinogens such as arsenic, fibrous dusts such as asbestos, gases such as chlorine, irritants such as ammonia and organic vapours such as petroleum hydrocarbons);
- Physical hazards (heat and cold, noise, vibration, ionising radiation, lasers, microwave radiation, radiofrequency radiation, ultra-violet light, visible light); and
- Biological hazards (bacteria, endotoxins, fungi, viruses, zoonoses).

AIOH members are the professionals most likely to be asked to identify hazards associated with airborne contaminants and assess any exposure risks, which often requires the use of air sampling pumps. Therefore, the AIOH has a keen interest in the integrity of flow measuring equipment used to calibrate air sampling pumps.

The Institute was formed in 1979 and incorporated in 1988. An elected governing Council, comprising the President, President Elect, Secretary, Treasurer and three Councillors, manages the affairs of the Institute. The AIOH is a member of the International Occupational Hygiene Association (IOHA).

The overall objective of the Institute is to help ensure that workplace health hazards are eliminated or controlled. It seeks to achieve this by:

- Promoting the profession of occupational hygiene in industry, government and the general community.
- Improving the practice of occupational hygiene and the knowledge, competence and standing of its practitioners.
- Providing a forum for the exchange of occupational hygiene information and ideas.
- Promoting the application of occupational hygiene principles to improve and maintain a safe and healthy working environment for all.
- Representing the profession nationally and internationally.

More information is available at our website – http://www.aioh.org.au.

EXPOSURE STANDARDS COMMITTEE MISSION STATEMENT

The AIOH established the Exposure Standards Committee to provide expert guidance and comment to the exposure standards setting process at a State and National level and internationally where appropriate, through development of AIOH Position Papers, AIOH guidance publications or comment on relevant Standards, Regulations and Codes of Practice. The Committee's remit is to confirm that the revision of exposure standards, and other relevant Standards and Codes of Practice, are valid and based on good occupational hygiene and scientific principles. The Committee is also concerned with the integrity of the exposure assessment process whereby sampling results for airborne contaminants are compared against exposure standards.

STATEMENT OF POSITION REGARDING AIOH TECHNICAL PAPERS

The AIOH is not a standard or method setting body. Through its Technical Papers, the AIOH seeks to provide relevant technical information on equipment and methodologies with regard to ensuring the integrity of the process of evaluating workplace hazards. The information herein is supplementary to published and validated methods for sampling and is provided as a resource where the information is not available elsewhere, such as from Australian Standards (AS) or the National Association of Testing Authorities (NATA), or in methods published by Regulatory organisations (e.g. Safe Work Australia).

NATA is in the process of withdrawing technical documentation regarding procedures and frequency for calibration of field and laboratory equipment used for occupational hygiene assessments and analysis. These documents have been developed by experienced AIOH members as part of their role on the previous NATA Occupational Hygiene Technical Committee and have been subject to public review for more than 20 years. The technical content of the documents along with copyright is being handed over to the AIOH, to be published as Technical Papers.

The information included in this document attempts to provide practical and pertinent information to assist Occupational Hygienists or laboratory personnel to use correct sampling or analytical techniques and equipment for collecting valid samples, which can be used to compare against the relevant workplace exposure standards (WES) where personal sampling has been conducted. Data quality is an important aspect of the exposure assessment process, particularly when it is necessary to demonstrate compliance with a WES.

Consultation with AIOH members

AIOH activities are managed through committees drawn from hygienists nationally. This Technical Paper has been prepared by the Exposure Standards Committee based on NATA documentation, with comments sought from AIOH members with interest and/or expertise in this area. The AIOH acknowledges the following contributors to this Paper: Neil Shepherd from NATA; and AIOH Members Linda Apthorpe, Philip Hibbs, Robert Golec and Ian Firth.

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List of Abbreviations and Acronyms

AIOH	Australian Institute of Occupational Hygienists
AS	Australian Standard
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health (America)
NOHSC	National Occupational Health and Safety Commission (Australia)
OSHA	Occupational Health and Safety Administration
SWA	Safe Work Australia
WES	Workplace Exposure Standard
UKHSE	UK Health and Safety Executive

Competent Person

AIOH recommends the following definition of a *Competent Person* for the purposes of this document:

- A person with the relevant experience (at least 5 years) and proven competence in workplace exposure assessment, particularly as related to workplace testing of airborne contaminants; and
- A Full member of the AIOH; and
- Has current professional indemnity insurance for occupational hygiene work (including asbestos if required).

AIOH Technical Paper: Flow Measuring Equipment: Calibration Requirements

1. Introduction

This Technical Paper was prepared to give guidance on the equipment and calibration requirements for air flow measuring equipment. The flow measuring equipment is required when carrying out air monitoring to collect various contaminants and determining airborne concentrations of those contaminants. The sampling may be required for personal or static (i.e. fixed location) sampling whereby the air flow (i.e. air velocity) is required to be set at a desired rate according to the sampling method in use. The results of the air sampling may be used for risk assessments and determining compliance against the workplace exposure standards (WES).

2. Background

Previously, requirements for flow measuring equipment checks and calibration was provided by NATA for facilities accredited against ISO/IEC 17025 *General requirements for the competence of testing and calibration laboratories*. However, in accordance with recent changes NATA can no longer provide guidance for how sampling equipment such as flow measuring equipment is calibrated and maintained. Instead, the focus will be on the facility to provide information on how to calibrate and check their equipment to ensure it is fit for purpose to collect airborne contaminants.

Therefore, AIOH will provide the relevant information for calibration of flow measuring equipment in the form of this Technical Paper. The information contained herein may be used to assist Occupational Hygienists and Laboratory personnel to ensure their flow measuring equipment is suitable for workplace airborne monitoring purposes, i.e. to be fit for purpose for volume measurement.

3. Airborne contaminant sampling

The purpose of airborne contaminant sampling is to determine the airborne concentration of a substance in a worker's breathing zone (i.e. personal sample) or in an area (i.e. fixed location or static sample). The results of personal sampling for airborne contaminants can be used to determine compliance to the relevant WES. As the results of personal sampling directly relate to exposure and potential health effects, it is important that the sampling is carried out by persons suitably qualified and experienced. In addition, air sampling for determination of compliance against the WES is a requirement of Work, Health and Safety/Occupational Health and Safety Legislation across all jurisdictions in Australia (Safe Work Australia, 2013; Grantham & Firth, 2014)).

Therefore, the AIOH recommends all airborne contaminant sampling be carried out by a competent person using approved and validated methods such as those published by Australian Standards, and National Guidelines as published by NIOSH, OSHA and UKHSE. It is also recommended that analysis of the samples be conducted by laboratory facilities accredited by NATA for the specific test using appropriate validated methods. Based on results obtained from the air sampling, correct interpretation by a competent person of the sampling results is essential to determine compliance with a WES and whether control strategies are required to eliminate or reduce exposures to acceptable levels.

Please refer to the AIOH Technical Paper: *Air Sampling Pumps: Equipment Calibration Requirements* for recommended equipment checks and calibration requirements for carrying out air sampling.

4. Flow measuring equipment

There is a large variety of air-flow measuring equipment (i.e. flowmeters) which can be used to determine the air-flow velocity required for airborne contaminant sampling. The equipment may be laboratory based (e.g. soap film flow meter) or may be used in the field (i.e. workplaces) and have various means of operation (e.g. operated mechanically or electronically). The flowmeters may also measure various ranges of air-flows depending on velocity required for the type of airborne contaminant sampling undertaken.

There are features of flowmeters which make them suitable for workplace air sampling. Technical considerations for suitability include:

- Primary or secondary flow meter standard
- Portability and durability for use in the field
- Ability to be calibrated and adjusted
- Ease of use and readability

- Reliability of results
- Adequate flow range required
- Battery life and intrinsic safety (for electronic versions).

All flowmeters used for workplace air sampling purposes must be suitably calibrated and maintained to ensure optimum performance during use.

Occupational Hygienists use two main types of flowmeters for calibrating air sampling pumps, namely Primary and Secondary Standards (it should be noted that primary standard flowmeters are those where the volume and timekeeping components can be traced back to reference standards[1]). A Primary flowmeter can be used to calibrate Secondary flowmeters (i.e. check that the secondary flow meter is satisfactory for use).

Examples of flowmeter types are provided below:

- Primary Flowmeter
    - Soap film flowmeter (also known as soap bubble flowmeter)
- Secondary Flowmeter
    - Electronic positive displacement and dry piston meters
    - Electronic soap film flow meters
    - Electronic mass flow devices
    - Variable area flowmeters (or rotameters)

Depending on the type of air monitoring to be conducted, the flowmeter may incorporate a small dedicated range (e.g. 150 mL/min – 250 mL/min, 1.8 – 2.5 L/min) or may cover a wider range (e.g. up to 5 L/min). All flowmeters (i.e. Primary and Secondary) must be calibrated to ensure they are fit for purpose and can accurately measure the air flow required.

After calibration, some flowmeters can be adjusted to ensure the correct flow is read off the actual meter, while other flowmeters cannot be adjusted. For the latter, a calibration chart is used to enable mathematical adjustment via a 'calibration factor'.

5. Flowmeter calibration information

The recommended calibrations and checks are detailed in the following Table for flow measuring equipment.

Additional information regarding calibration of flowmeters can be found in the following methods:

- NOHSC:3003 Guidance note on the membrane filter method for estimating airborne asbestos fibres (2nd Edition, 2005)
- AS2985-2009 Workplace atmospheres – Method for sampling and gravimetric determination of respirable dust
- AS3640-2009 Workplace atmospheres – Method for sampling and gravimetric determination of inhalable dust

Item of equipment	Maximum period between successive calibrations (years)	Maximum period between checks (months)	Procedures and comments
Manual soap film flowmeter		On commissioning	Check volume using an appropriate measuring device (i.e. which has links back to traceable reference standards, e.g. NATA Calibrated balance, burette etc.)
Rotameter flowmeters: Small bore, long flowmeter, spherical float		Initial, then every 12 months	Over the range of use (including high flow rates where used). If the difference between the indicated and 'true' flow rate exceeds ± 3%, then

[1] In Australia, the only Primary Standard flowmeter is a soap film flowmeter and all electronic versions are considered to be a Secondary Standard.

Item of equipment	Maximum period between successive calibrations (years)	Maximum period between checks (months)	Procedures and comments
			the indicated flowrate must be corrected (Refer note below)
Rotameter flowmeters: Large bore, short / medium flowmeter, cylindrical float		Initial, then every 12 months	Over the range of use (including high flow rates where used). If the difference between indicated and 'true' flowrate exceeds ± 3%, then the indicated flowrate must be corrected (Refer note below)
Electronic flowmeters (all other types)	12 months	Initial, then every 12 months	Over the range of use (including high flow rates where used). The flow meter must be calibrated at a frequency as recommended by the equipment manufacturer, and at an interval of no longer than 12 months.

Note:

- Flowmeters with spherical or cylindrical floats may be subject to error when used in dusty or humid environments. It is recommended flowmeters which are used in these types of environments are checked on a 6-monthly basis to ensure accurate readings are obtained.

6. References and sources of additional information

- Australian Standard 2985-2009. *Method for sampling and gravimetric determination of respirable dust*. Available from http://infostore.saiglobal.com/store/default.aspx
- Australian Standard 2986.1-2003 (R2016) Workplace air quality - *Sampling and analysis of volatile organic compounds by solvent desorption/gas chromatography - Pumped sampling method*. Available from http://infostore.saiglobal.com/store/default.aspx
- Australian Standard 3640-2009. *Method for sampling and gravimetric determination of inhalable dust*. Available from http://infostore.saiglobal.com/store/default.aspx
- Australian Standard 3853.1 – 2006 *Health and safety in welding and allied processes - Sampling of airborne particles and gases in the operator's breathing zone Part 1: Sampling of airborne particles*. Available from http://infostore.saiglobal.com/store/default.aspx
- Grantham, D & I Firth (2014). *Occupational Hygiene Monitoring and Compliance Strategies*. Australian Institute of Occupational Hygienists (AIOH) guidebook. Available from www.aioh.org.au
- ISO/IEC 17025-2017. *General requirements for the competence of testing and calibration laboratories.* Available from http://infostore.saiglobal.com/store/default.aspx
- NOHSC (2005). *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres*, 2nd Edition [NOHSC: 3003(2005)]. Available from www.safeworkaustralia.gov.au
- NOHSC (1989). *Guidance Note on the Membrane Filter Method for the Estimation of Synthetic Mineral Fibres* [NOHSC: 3006(1989)]. Available from www.safeworkaustralia.gov.au

SEARCH

- The NATA website (www.nata.com.au) for accredited laboratory facilities who can undertake testing and analysis of workplace airborne contaminants.
- The AIOH website for Occupational Hygiene consultants (www.aioh.org.au).