

International Sampler Comparison Group (ISCG)

**Report of activities
2025**



**INTERNATIONAL
SAMPLER COMPARISON
GROUP**

About the International Sampler Comparison Group (ISCG)

The ISCG coordinates and communicates research to progress the science of occupational aerosol sampling. This report presents a summary of the ISCG activities during 2025.

<https://www.ecu.edu.au/research/dust>



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1. WHAT ARE THE AIMS OF THE ISCG REPORT?

- Describe the terms of reference of the International Sampler Comparison Group (ISCG) and composition of the group.
- Summarise the engagement activities of the ISCG during the calendar year 2025, these including meetings and conference presentations.
- Summarise ISCG programmes of work either completed or ongoing during the calendar year 2025.
- Summarise ancillary programmes of work not funded by ISCG but aligned with the ISCG activities.
- Summarise the planned ISCG activities for the following calendar year (2026).

[Reports outlining the activities of the ISCG during 2019-2023 and 2024 are also available.](#)

2. WHO ARE THE ISCG?

The terms of reference of the ISCG were agreed as follows:

- Develop a research plan (short / medium / long-term) for future laboratory and workplace-based studies, which will allow the assessment of the performance of aerosol sampling heads.
- Identify external funding support to allow for elements of the research plan to be funded.
- Where funds for research activities are made available through the ISCG, act as a steering committee for that project
- Engage and involve other stakeholders who are interested in the activities of the ISCG.
- Communicate findings from ISCG's work openly (e.g., via publications, workshops, conference presentations etc) so that the wider community can benefit from the learning.

The core ISCG members are detailed in Table 1 (in alphabetical order).

Table 1: Core ISCG member

Name	Organisation
Pieter Bertier	Belgian Center for Occupational Hygiene (BeCOH), Belgium
Marcus Cattani	Edith Cowan University (ECU), Australia
Karen Galea	Institute of Occupational Medicine (IOM), UK
Martin Harper	Independent, USA
Darrah Kaye Sleeth	University of Utah, USA
Steven Verpaele	Nickel Institute, Belgium

3. FUNDING FOR ISCG ACTIVITIES

The core activities of the ISCG to date have been made possible by funding from various associations, these including the Nickel Institute (NI), the Cobalt Institute (CI) and the International Copper Association (ICA). However, for the ISCG activities to continue, additional financial support is essential. The ISCG is happy to discuss opportunities with potential sponsors to enable mutually beneficial work programmes to move forward.

Members of the ISCG are involved in other ancillary work programmes, funded by other organisations, which are summarised in this report for completeness.

4. ENGAGEMENT ACTIVITIES

4.1 ISCG MEETINGS

- Fortnightly on-line video conferencing meetings of the core ISCG group throughout the year.
- In-person meeting of core ISCG group, 14 June 2025, Loen, Norway.

4.2 ENGAGEMENT WITH OTHER STAKEHOLDERS

- Meeting with STAMI, 13 June 2025, Oslo, Norway.
- 11th AIRMON Symposium on Modern Principles of Air Monitoring and Biomonitoring, 15-19 June 2025, Loen, Norway. Session IX: The role and work of the International Sampler Comparison Group.
 - *Consensus recommendation for aerosol sampler selection*, Martin Harper.
 - *Validation results of a multi-fraction sampler for recovering inhalable and respirable dust mass, and metals in workplace air*, Steven Verpaele.
 - *Sampler selection tool*, Pieter Bertier.
 - *The Western Australian sampler comparison project*, Marcus Cattani.
 - *Aerosol sampler performance - laboratory protocol development and related field studies*, Darrah Sleeth.
- 42nd Annual Conference on Safety and Industrial Hygiene, October 9, 2025, Salt Lake City, UT, USA
 - Darrah Sleeth, presentation on *Current Efforts for Standardizing Traditional Aerosol Samplers*.
- Industrial Hygiene Webinar, Center for Occupational and Environmental Health, November 12, 2025, Berkeley, CA, USA
 - Darrah Sleeth, presentation on *Current International Research Efforts for Traditional Occupational Aerosol Samplers*.

5. ONGOING ISCG WORK PROGRAMMES

5.1 COMMENTARY WITH RECOMMENDATIONS FOR SAMPLING PRACTICE FOR AEROSOLS

Contracted to – Martin Harper, Independent Consultant

- Due for completion – 2025
- Estimated cost - £10,500 (excluding any open access publication fees)
- Funded by: NI, Ci and ICA

This Commentary publication will provide the basis for recommendations for sampling practice with respect to aerosols. This will be based on the following available information:

- recently published compendia of research
- previously published research, not included in i)
- unpublished research
- previously published guidelines

This Commentary will begin with an introduction to aerosol sampler developments and how they have been linked to our understanding of the behaviour of aerosols in the environment and through the process of inhalation, but, in addition, will include how developments have been influenced by practical considerations, including cost and ease of use. The Commentary will then report on each currently available sampling device, describing first the laboratory and field research involving each and then discussing how the results of those studies may be reconciled, considering environmental conditions. Gaps in our knowledge will be highlighted along with the contribution of those gaps to our level of uncertainty. The Commentary will form a basis for sampler selection, taking into specific environmental conditions, which will be incorporated in a web-based tool under development.

This publication was submitted to a peer-reviewed journal (Journal of Occupational and Environmental Hygiene) in 2nd quarter 2025 and it has been favourably reviewed. A revision was submitted in 1st quarter 2026, and the paper has been accepted for publication in 2nd quarter 2026.

5.2 VALORISATION OF SAMPLER PERFORMANCE DATA BY MEANS OF A SAMPLER SELECTION TOOL

- Contracted to - BeCOH
- Due for completion – 2026
- Estimated cost – € 63,500
- Funded by: NI, Ci and ICA

Previous work of the ISGC has shown that many industrial hygiene (IH) professionals do not read sampler validation studies in scientific literature. Their perception is that all samplers on the market must have been validated, and that workplace specific sampler validation is not required. Sampler selection is therefore all too often based on availability and tradition. Many IH professionals also rely on the laboratories they work with for sampler selection advice. Yet analytical experts in labs are not

always sampling experts.

Hence, there is a need for a 'quick and easy' sampler selection guide. This should preferably be a tool that is always and everywhere accessible. It should provide the user information on sampler performance at different levels: from very basic level "I don't care, just tell me what to use" to specialist level, for example "I need the references for the bias map of sampler X". The tool needs to be a dynamic source of information, meaning that it should always reflect the most recent insights and not be a snapshot of the state-of-the-art, like a review paper. This tool will help in generating the awareness that not all samplers perform equally at all workplaces.

This project will commence following completion of the short commentary (as the outputs of that programme of work feed into this).

5.3 OPTIMISING LABORATORY TESTING PROTOCOLS

- Contracted to – University of Utah
- Due for completion – late 2026
- Estimated cost - £41,790 University of Utah
- Funded by: NI, Ci and ICA

The overall objective of the proposed project is to continue to optimize the laboratory testing protocols while making progress towards resolving identified questions. First, we will identify the priority areas for further study regarding protocols for laboratory sampler comparison studies of both inhalable and respirable samplers based on many additional discussions that have occurred since the original workshop. Next, we will seek to conduct limited studies to address issues of concern that are identified as part of that prioritization, focusing on (a) the top priorities and (b) studies that are able to be conducted efficiently with the resources currently available.

The deliverables will be as follows:

- Task 1: List of priority concerns regarding laboratory protocols for performance testing of inhalable and respirable air samplers.
- Task 2: Dataset that provides sampler performance data for at least two (2) respirable samplers under varying conditions

5.4 VALIDATION OF PHASE-SPECIFIC ANALYSIS AND SAMPLERS FOR NICKEL-CONTAINING WORKPLACE AEROSOLS

- PhD student: Steven Verpaele (Nickel Institute)
- Collaborators: Marcus Cattani, ECU; Pieter Bertier, BeCOH; Matthew Leybourne, Queens University
- Funding through NI, ISCG and other to identify

The aims and objectives of this PhD project are as follows:

- Evaluation of the disposable respirable multi-fraction aerosol sampler (DRS) at higher flowrate than nominal to determine if it can be used at a higher flowrate

- Develop a semi-automated extraction cell for wet chemical metal speciation
- Validate the semi-automated extraction cell with known metal reference materials for comparison with the conventional methods
- Evaluate the usefulness of the semi-automated extraction cell for metal speciation analysis of real workplace samples taken with the DRS.

6. ANCILLARY WORK PROGRAMMES

6.1 DOES THE PERFORMANCE OF COMMONLY USED RESPIRABLE AND INHALABLE AEROSOL SAMPLERS ENABLE ADEQUATE COLLECTION OF WORKPLACE METALS TO MEET OCCUPATIONAL EXPOSURE LIMITS?

This was funded by Worksafe BC.

Grant recipient: Darrah Sleeth, University of Utah

Collaborators:

- Martin Harper, University of Florida (Zefon International)
- Steven Verpaele, NI
- Pieter Bertier, BeCOH

Project overview:

- Laboratory and field comparisons of samplers for both inhalable/total and respirable fractions
- Laboratory study conducted in wind tunnel at University of Utah using inert particles and gravimetry
- Field comparisons used the “Workplace Atmosphere Multisampler” (WAM) device that allowed 12 different samplers to sample the same atmosphere
- Sampling was conducted at 3 locations in Europe and one in North America, one of the European locations involved two different situations
- Pb/Zn/Cd, Mn/Fe, Co, Ni, Cu/Fe using chemical analysis

Key findings:

- Laboratory tests resulted in respirable sampler rankings that were somewhat different from field-based rankings
- No sampler was considered to be a true reference method, and the lab had problems isokinetic samplers
- In the field, respirable data from the multi-fraction sampler (Disposable Inhalable Sampler (DIS) with foam insert) consistently gave the highest respirable results
- In the field, the multi-fraction sampler analysed for the inhalable fraction gave identical results to the same sampler (DIS) used without foam
- DIS gave similar results to the IOM in the lab when tested for inhalable fraction, but much higher results in the field because wall deposits were not accounted for in the IOM

[The final project report is available from WorkSafe BC website.](#)

6.2 DEVELOPING A SEQUENTIAL ANALYTICAL PROCEDURE FOR EVALUATING CHROMIUM (III) AND CHROMIUM (VI) SPECIATION AND THEIR DIFFERENTIAL SOLUBILITIES FROM AIR SAMPLES

This is funded by Worksafe BC.

Grant recipient: Hossein Kazemian, Northern Analytical Lab Services (NALS) at University of Northern British Columbia (UNBC), Canada

PhD student: Mya Schouwenburg

Collaborators:

- Martin Harper, Zefon International/University of Florida
- Steven Verpaele, NI

Project overview:

- Evaluation of a specially cleaned PVC “Disposable Inhalable Sampler” (DIS) from Zefon/Environmental Express for:
 - Soluble hexavalent chromium
 - Soluble trivalent chromium
- Total chromium using microwave digestion procedure (without hydrofluoric or perchloric acids) developed under this project
- IC-ICP-MS method, laboratory studies include background, LOD/LOQ, and recovery with and without the presence of Fe(II)
- Project was intended to validate use of monoisotopic Cr standards per EPA 6800 to correct for interspecies conversion but this could not be accomplished in the time available
- Final report submitted to WorkSafe BC in 2024.
- Paper submitted to peer-reviewed journal (Journal of Hazardous Materials) in 4th quarter 2025.

6.3 VALIDATING THE USE OF A MULTI-FRACTION SAMPLER FOR RECOVERING INHALABLE AND RESPIRABLE DUST MASS, AND METALS IN WORKPLACE AIR”

This is funded by Worksafe BC.

Grant recipient: Hossein Kazemian, Northern Analytical Lab Services (NALS) at University of Northern British Columbia (UNBC), Canada

PhD student: Leila Doudey

Collaborator: Martin Harper, Zefon International/University of Florida

Project overview:

- Evaluation of PVC/polyurethane foam “Disposable Respirable Sampler” (DRS) from Zefon/Environmental Express for inhalable and respirable sampling of welding fumes
- Validation of recovery of metals, including reference welding fume from sampler and foam insert

- Validation of gravimetric analysis of sampler and foam insert
- Field study using the Workplace Atmosphere Multi-sampler (WAM) in three welding shops with comparison to Disposable Inhalable Samplers and Higgins-Dewell cyclones
- Final report submitted to Worksafe BC in 2025
- Paper submitted for presentation at the Respirable Crystalline Silica and Other Minerals and Metals Symposium in June 2026, New Orleans, USA
- Paper in preparation for submission to a peer-reviewed journal in 2026

6.4 COMPARISON OF CONVENTIONAL SAMPLERS AND REAL TIME DETECTION SYSTEMS (MEDIUM AND LOW COST) FOR MEASURING PARTICULATES AND THEIR ELEMENTAL COMPOSITION

Grant recipient: A/Prof Marcus Cattani, Edith Cowan University, Australia

Collaborators:

- Steven Verpaele, NI
- Pieter Bertier, BeCOH

Additional funding has been obtained from Rio Tinto, and Fortescue. In-kind support has been received from GCG.

Project overview:

- In 2022 the NI donated a Workplace Aerosol Multi-sampler to ECU, and a research group at ECU was established
- A sampling strategy to compare a statistically significant series of real time and conventional samples taken in the field was established, using the IOM and Higgins-Dewell Cyclone as standards
- The ISCG funding was used to hire a full-time research technician for one year to conduct the field work
- Fortescue hosted the WAM and the Technician in 2024, and this will continue in 2025
- Samples have been submitted to a laboratory in Perth, Western Australia for analysis.

The first series of samples has been collected on an iron ore mine site in Western Australia

- Preliminary findings indicate:
 - Inhalable dust concentrations ranged from 0.22 mg/m³ to 95.05 mg/m³ (IOM sample head), and respirable dust concentrations ranged 0.1 mg/m³ to 1.33 mg/m³ Casella Cyclone.
 - In comparison to the standard the AMS520 with the Dorr-Oliver cyclone had the highest respirable dust confidence (intra-class correlation).
 - In comparison to the standard the DIS (Zefon Filter/plug) had the lowest confidence (intra-class correlation).

- Problems were identified with the analytical laboratory and the above conclusions may be modified pending further data analysis.

6.5 SAMPLING AND ANALYSIS OF AIRBORNE NICKEL AND ITS COMPOUNDS TO MEET ACGIH® TLV® REQUIREMENTS

This is funded by Worksafe BC

Grant recipient: Matthew Leybourne, Queen's University, Toronto, Canada

PhD student: TBD

Collaborators:

- Martin Harper, University of Florida
- Steven Verpaele, NI
- Pieter bertier, NI

Project overview:

- Evaluation of DIS from Zefon/Environmental Express and French CIP-10I for collecting samples for speciation of nickel and its compounds through a novel speciation analysis procedure
- 18-month project funded at end 2025
- Anticipated completion 3rd quarter 2027

6.6 CALIBRATION OF THE ALUMINUM (ALUMINIUM) CYCLONE FOR MOST ACCURATE RESPIRABLE AEROSOL SAMPLING

This is funded internally by NIOSH

Principle Investigator: Dr. Taekhee Lee, Pittsburgh Mining Research Division, NIOSH, Pittsburgh, PA

Research Associate: Sena Yang

Collaborator: Martin Harper, University of Florida

Project overview:

- Evaluation of aluminium cyclones from Zefon/Environmental Express and SKC Inc. to determine the most appropriate flow rate for sampling in accordance with the ISO 7708 respirable convention.
- Project completed and final recommendation for sampling at 2.2 L/min published: Yang S, Harper M, Cauda E, Lee T. Recommended flow rate of the aluminum cyclone for improved exposure assessment. *Annals of Work Exposures and Health* 70(2): DOI: 10.1093/annweh/wxaf075 (2026).

7. ISCG WEBSITE

ISCG has a website to further facilitate dissemination of the ISCG activities, <https://www.ecu.edu.au/research/dust>. This is hosted by ECU.

This is hosted by ECU. Presently details of the ISCG aims, core group composition, publications and an overview of some of the ongoing activities are included. The content of the website will continue to evolve and be updated periodically to reflect ISCG continued work.

Three projects have been shared by the research community in the “Register of research”.

8. FURTHER DISSEMINATION AND ENGAGEMENT ACTIVITIES IN 2025

- Fortnightly on-line video conferencing meetings of the core ISCG group will take place throughout 2026.
- Members of the ISCG will present on the group's activities at the 2026 Respirable Crystalline Silica and Other Minerals and Metals Symposium and AIHA Connect conference, in June 2026, New Orleans, USA. An in-person meeting of ISCG will take place aligning with these events.
- A general overview of the ISCG activities will be presented at the joint Inhaled Particles and International particles Toxicology Conference, 11-14 May 2026 Glasgow, UK.
- Two graduate Student Research Assistants at the University of Utah will present public final oral defence presentations (estimated April 2026) based on the data obtained as part of optimization of laboratory testing protocols (see Section 5.3).
- ISCG will seek to present outputs of the projects at other, appropriate forums during 2026.



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