

INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

1963-TRP, Test procedure to measure in-situ chemicals emissions of labs equipment and processes

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you decide not to submit a proposal, please circulate it to any colleague who might have interest in this subject.

Sponsoring Committee: TC 9.10, Laboratory Ventilation

Budget Range: \$400,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **April 1, 2027**, or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EST, Tuesday, December 15th, 2026. NO EXCEPTIONS. Electronic copies must be sent to rpbids@ashrae.org. Electronic signatures must be scanned and added to the file before submitting. The submission title line should read: 1963-TRP, Test procedure to measure in-situ chemicals emissions of labs equipment and processes, and “*Bidding Institutions Name*” (electronic pdf format, ASHRAE’s server will accept up to 10MB)

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

For Technical Matters

Technical Contact

Roland Charneux

rcharneux@pageaumorel.com

For Administrative or Procedural Matters:

Manager of Research & Technical Services (MORTS)

Steve Hammerling

ASHRAE, Inc.

180 Technology Parkway, NW

Peachtree Corners, GA 30092

Phone: 404-636-8400

Fax: 678-539-2111

E-Mail: MORTS@ashrae.net

Contractors who plan to submit a proposal must notify the Manager of Research and Technical Services (MORTS) via email by December 1st. This will ensure that they receive any late or additional information regarding the RFP before the bid due date. The deadline for submitting technical questions is also Tuesday, December 1st, 2026.

All proposals must be submitted electronically.

Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below.

ALL electronic proposals are to be sent to rpbids@ashrae.org.

All other correspondence must be sent to

ddaniel@ashrae.org

and

shammerling@ashrae.org.

In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EST, Tuesday, December 15th, 2026.

NO EXCEPTIONS.

The following forms (Application for Grant of Funds and the Additional Information form have been combined) must accompany the proposal:

- (1) ASHRAE Application for Grant of Funds (electronic signature required) and
- (2) Additional Information for Contractors (electronic signature required) ASHRAE Application for Grant of Funds (signed) and

ASHRAE reserves the right to reject any or all bids.

State of the Art (Background)

In normal operation, the basic function of laboratory HVAC systems is the management of contaminant concentrations in the space by dilution; the air is supplied and exhausted in order to reduce the risk to the researchers of ingesting or being in contact with contaminants. Additionally, the HVAC covers cooling loads. In case of a spill, occupants leave the labs and a special team cleans the labs; HVAC equipment is not normally designed to cope with high concentrations of materials from spills.

Unlike commercial spaces, energy-intensive laboratories utilize high volumes of filtered and conditioned outdoor air to dilute airborne contaminants. This requires large amounts of outside air that has to be cooled, dehumidified, reheated and often humidified, resulting in very high energy use. As per LBNL 2017 report (ref. 1), there are about 150,000 labs totaling 751,000,000 sq.-ft. in the United States. The energy consumption of these buildings totals approximately 55 million MWh. Of this, approximately 60% (or 33 million MWh/yr) was associated with the HVAC systems.

Even today, the ventilation rate in laboratories is empirical, varying between 6 to 20 ACR, but are not based on scientific calculations, like cooling loads for air conditioning. Real data does not exist for contaminant emissions in active labs. There is data available for cooling loads of different types of equipment following ASHRAE research, but emissions in labs are not available.

Justification and Value to ASHRAE

This research project is in line with the ASHRAE Strategic plan to reduce carbon footprint by rightsizing the ventilation systems in laboratories while maintaining a high indoor air quality for the researchers. A scientific approach for laboratory ventilation is required to improve energy efficiency while maintaining indoor air quality and safety.

Objectives

Reducing energy consumption in laboratories will help to meet the ASHRAE mission to attain a sustainable built environment and reduce CO₂ emissions resulting from the energy requirement of laboratories. Compared to commercial buildings, the opportunity for energy savings in laboratories is much greater. ASHRAE should play a leadership role in optimizing the HVAC systems in laboratories while keeping safety a top priority. The objectives of this research are to:

1. Develop a Standardized In-Situ Test Procedure

Define the technical requirements for a repeatable and reliable test approach, including:

- Design and configuration of temporary enclosures for in-situ testing
- Air supply, mixing, and exhaust strategies within the enclosure
- Control of pressure and leakage characteristics
- Sampling and analytical methods for contaminant measurement
- Criteria to ensure minimal interference with the process being tested

2. Validate the Measurement Methodology

Demonstrate that the proposed test method produces:

- Accurate and representative emission measurements
- Repeatable results across multiple test conditions and time intervals
- Consistent performance across different enclosure sizes and configurations

3. Quantify Emissions from Representative Laboratory Processes and Equipment

Conduct in-situ testing on a range of laboratory activities and equipment types to:

- Characterize emission rates and variability
- Establish standardized methods for reporting results
- Identify key factors influencing emission behavior

4. Establish a Framework for Application of Results

Define how measured emissions can be used to:

- Inform ventilation system design for new laboratories
- Evaluate and adjust airflow requirements in existing facilities
- Support future development of emission databases and design guidance

5. Enable Risk-Informed Ventilation Strategies (Informational Basis)

Provide foundational data that can support alignment between:

- Laboratory activities and associated emission characteristics
- Ventilation system performance and requirements

This research enables more informed decision-making but does not include development of real-time control or monitoring systems.

Scope:

1. Activity 1 - Literature review

1. Complete an in-depth literature review on different approaches for measuring chemical emissions in laboratories or other types of equipment.
2. Submit to PMS the literature review and useful findings for comments.

2. Activity 2 – Planning and design of the enclosure

1. Develop a realistic methodology to measure emissions of laboratories equipment and processes.
 - Develop tight transparent enclosures of different sizes (minimum 3 sizes) to be easily installed around equipment or process in an operating laboratory.
 - Prepare plans for ease to transport and mount structures.
 - Determine the pressure to be maintained inside the enclosure.
 - Develop a measured clean air supply to the enclosure with a uniform distribution without affecting the chemical release of the process or equipment.
 - Measure the air supply and exhaust to confirm the airflow balance
 - Develop a methodology to sample the air released from the enclosure.
 - Ensure that the process is in a steady state, if not, define the operating conditions.
 - Develop the methodology in using sampling bags or spectrometer analysis of the collected samples.
 - Make sure that there will be no gas emissions by the enclosure or the structure or any material used in the assembly of the enclosure.
 - Determine an acceptable leak rate of the enclosure and a procedure to test it.
 - Determine the filtration requirement of the air supply for particulates and chemicals
 - Determine an efficient air change rate relative to the test and size of enclosure.

3. Activity 3 – Planning and design of tests

1. Prepare the proposed test procedure and submit it to the PMS for discussion and approval.
2. Develop a uniform and useful way to present the results:
 - Description of the process or equipment,
 - Actual control of emissions if any
 - Power input to the equipment
 - Chemicals used by the process or equipment
 - For example, ppm per l/s of emissions
 - Develop a procedure to report the results on one page in a tabulated form with the equipment or process description, photo, diagram, test duration, chemicals emissions, airflow etc.

4. Activity 4 – Tests to be performed

1. Prepare and submit for approval by the PMS a list of 50 equipment's and processes with their dimensions and photos for which in-situ tests are proposed. PMS with PI will choose 30 of these equipment's or processes on which in-situ tests will be conducted. Addition to the proposed list could be made to make sure that all Potential equipment types could be tested by the enclosures and test procedures.
5. Activity 5 – Preliminary in-situ tests
 1. Do a first series of test in-situ on 3 types of different sizes of equipment or processes as approved by PMS and submit results to the PMS. Repeat the 3 test 3 times at different days intervals. This 3-time repeat is only for the preliminary in-situ tests
6. Activity 6 – In-situ series of tests
 1. At each series of 5 in-situ tests, submit the results for discussion and approval by the PMS and readjust the test procedure as needed.
7. Activity 7 – Preliminary report
 1. Submit a preliminary report to PMS for comments. The report shall describe:
 - The requirements for the construction of a suitable enclosure to proceed with the tests.
 - The test procedure description to ensure accurate and repeatable results.
 - A standard presentation of the results
8. Activity 8 – Final report
 1. Submit the final report to PMS for comments
 2. Respond to the PMS comments and prepare the final report.

Deliverables:

A complete Research Report detailing the testing standard methodology and results of tests.

One or more papers shall be published in the peer reviewed STBE. Conference paper is acceptable if approved by TC/PMS.

The results could also be part of a future database that could be developed in the future.

At this point, this research project is to develop a reliable methodology that can be used by owners and designers to find what are the emissions of the different processes and equipment that they are using in labs.

Knowing that, they will be able to design the right amount of ventilation and make sure that contaminants are not compromising the researchers in labs and that high-quality IAQ is maintained at all times.

Progress, Financial and Final Reports, Technical Paper(s), and Data shall constitute the deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically, on or before each January 1, April 1, June 10, and October 1 of the contract period.

The following deliverables shall be provided to the Project Monitoring Subcommittee (PMS) as described in the Scope/Technical Approach section above, as they are available:

Furthermore, the Institution's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Report

A written report, design guide, or manual, (collectively, "Final Report"), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement,

including a summary of the control strategy and savings guidelines. Unless otherwise specified, the final draft report shall be furnished, electronically for review by the Society's Project Monitoring Subcommittee (PMS).

Tabulated values for all measurements shall be provided as an appendix to the final report (for measurements which are adjusted by correction factors, also tabulate the corrected results and clearly show the method used for correction).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form suitable for wide distribution to the industry and to the public.
- Two copies; one in PDF format and one in Microsoft Word.

a. Research Paper(s)

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted for publication in the Science and Technology for the Built Environment (STBE). The paper(s) shall conform to the instructions posted in "Manuscript Central" for Science and Technology for the Built Environment papers. The paper title shall contain the research project number at the end of the title in parentheses, e.g., (1963-RP). ASHRAE Conference papers are **not** acceptable as deliverables from ASHRAE research projects unless explicitly approved by a vote of the PMS and TC and communicated to MORTS. Conference paper(s) shall conform to the instructions posted in "Manuscript Central" for ASHRAE Conference papers and the title shall contain the research project number at the end of the title in parentheses, e.g., 1963-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

d. Data

Data is defined in General Condition VI, "DATA"

e. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE Insights

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

Level of Effort

30 months \$400,000

Other Information to Bidders (Optional):

Annex 1 - attached

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	Contractor's understanding of the Work Statement	15%
2	Qualification of personnel Expertise of the PI in this type of research Experience of teams members	30%
3	Test facility (Chemical, Biological and University labs) available, name and commitment from the institution or lab owner.	30%
4	Probability of meeting the objectives of the research Detailed work plan Risk analysis Proposed project schedule Management plan quality Team management planned	15%
5	Performance of contractor on prior ASHRAE Projects (No penalty for new contractor)	5%
6	Students involvement	5%

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Literature review report	1-3
2	Planning and design of the enclosure	4-7
3	Planning and design of the tests	8-10
4	Tests to be performed	12-14
5	Preliminary in-situ tests	15-16
6	In-situ series of tests	17-21
7	Preliminary report	21-22
8	Final report	23-24

References

1. LBNL Report, Characterizing the Laboratory Market, 2017. LBNL-1007254
2. Lee, H., Kwak, DB., Choi, C.Y. et al. Accurate measurements of particle emissions from a three-dimensional printer using a chamber test with a mixer-installed sampling system. Sci Rep 13, 6495 (2023). <https://doi.org/10.1038/s41598-023-33538-9>
3. California Department of Public Health DR. KAREN SMITH, Director California Health and Human Services Agency DIANA DOOLEY, Secretary State of California EDMUND G. BROWN JR., Governor.
4. STANDARD METHOD FOR THE TESTING AND EVALUATION OF VOLATILE ORGANIC CHEMICAL EMISSIONS FROM INDOOR SOURCES USING ENVIRONMENTAL CHAMBERS VERSION 1.2, January 2017.
5. Classification of Laboratory Ventilation Design Levels Developed by ASHRAE Technical Committee 9.10, Laboratory Systems Laboratory Classification Subcommittee In partnership with American Chemical Society Division of Chemical Health and Safety and American Industrial Hygiene Association Laboratory Health and Safety Committee. 2018
6. ASHRAE Research Strategic Plan 2019-2024
7. ASHRAE Strategic Plan 2019-2025

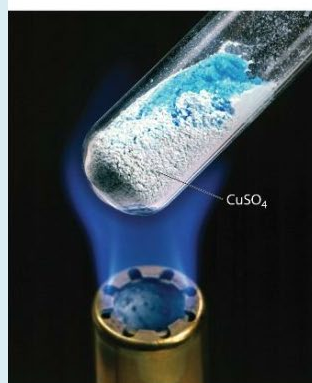
8. ASTM D5116 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products
9. ASTM D6670 Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products
- 10.** ASTM 16 000 Part 11: Determination of the emission of volatile organic compounds from samples of building products and furnishing — Sampling, storage of samples and preparation of test specimens

Process	Photo of Process
Redox	Diagram illustrating a redox reaction setup. The setup consists of two beakers connected by a salt bridge. The left beaker contains a Zn anode in a solution of Zn^{2+} and NO_3^- ions. The right beaker contains a Cu cathode in a solution of Cu^{2+} and NO_3^- ions. A switch and a voltmeter are connected between the two electrodes. The overall reaction is: $\text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + 2e^-$ $\text{Cu}^{2+}(aq) + 2e^- \rightarrow \text{Cu}(s)$ Arrows indicate the movement of cations (blue) and anions (pink) through the salt bridge.
Hydrogenation	Photograph showing a laboratory setup for hydrogenation. A blue balloon is connected to a glass apparatus, likely containing a catalyst and a reaction vessel, used for the hydrogenation of organic compounds.
Dehydrogenation	Diagram illustrating a dehydrogenation setup. Ethanol is heated in a hard-glass boiling tube containing porcelain chips. The resulting ethene gas is collected in a test tube. The setup includes a Bunsen burner and a Bunsen valve.
Hydrolysis	Photograph showing four bottles containing different chemical solutions, labeled NH_4Cl, NH_4NO_3, NaCl, and NaNO_3. Below each bottle is a test tube showing the result of a hydrolysis reaction, with colors ranging from yellow to green.

Hydration

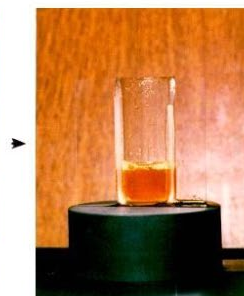


Dehydration



Halogenation

Halogenation
(malonic acid/halogenating agent)



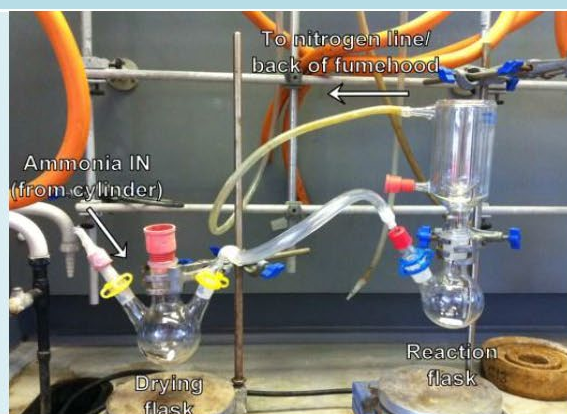
Nitrification



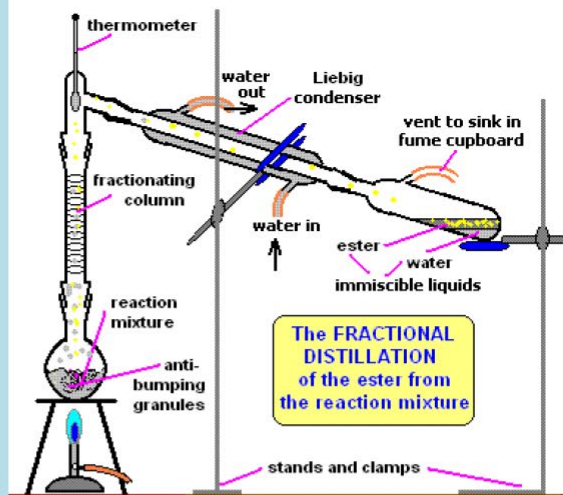
Sulfonation



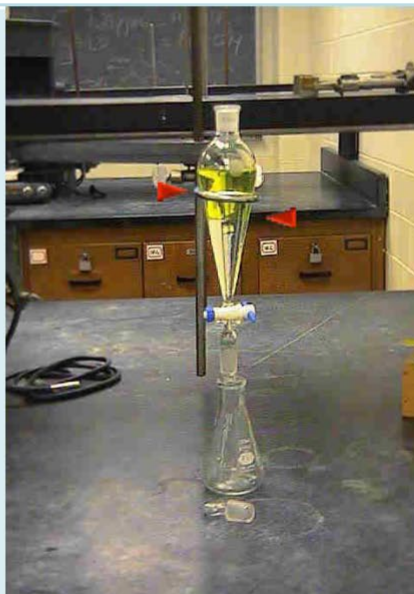
Alkylation and Dealkylation



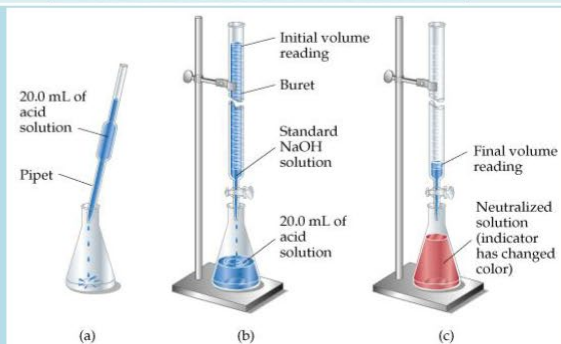
Esterification



Acid-base extraction



Titration



Centrifugation



Precipitation



(a) Precipitation of group 1 cations by adding HCl(aq):
 $\text{AgCl(s)} + \text{Hg}_2\text{Cl}_2\text{(s)} + \text{PbCl}_2\text{(s)}$



(b) Confirmation test for silver by addition of $\text{Na}_2\text{CrO}_4\text{(aq)}$: $\text{PbCrO}_4\text{(s)}$

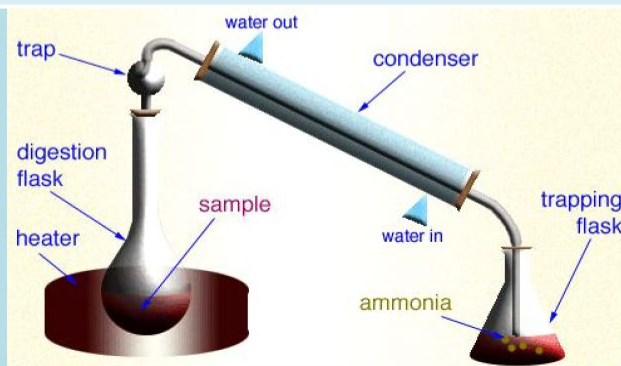


(c) Confirmation test for mercury by adding $\text{NH}_3\text{(aq)}$:
 $\text{Hg}_2^{2+} + \text{Hg(NH}_2\text{)Cl(s)}$

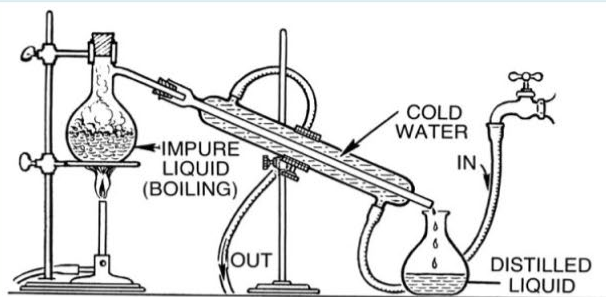


(d) Confirmation test for lead by adding HCl(aq): AgCl(s)

Digestion



Distillation



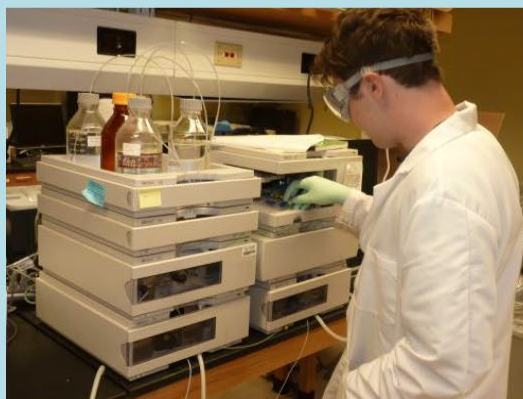
Rotary Evaporation



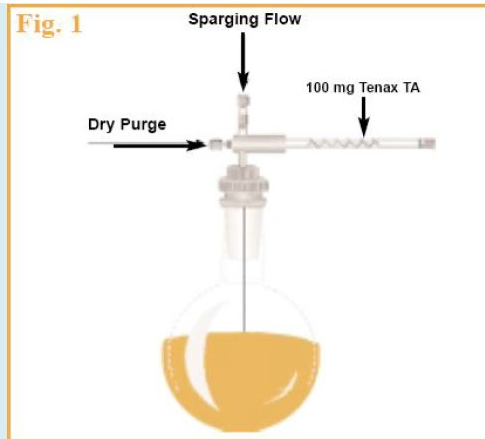
Recrystallization



Chromatography



Sparging



Sublimation

