

INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

1869-TRP, Evaluation of VOCs with Respect to Development of Revised Standard 62.1 Indoor Air Quality Procedure (IAQP) Design Compounds and Design Limits

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 2.3- Gaseous Air Contaminants and gas Contaminant removal Equipment
Co-sponsored by: SSPC 62.1 Ventilation and Acceptable indoor air Quality, TRG4-IAQP – Indoor Air Quality Procedure Development & SSPC 189.1- Standard for the Design of High Performance, Green Buildings Except Low-Rise Residential Buildings

Budget Range: \$190,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **September 1, 2023** or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EDT, Wednesday, May 31st, 2023. NO EXCEPTIONS, NO EXTENSIONS. 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: 1869-TRP, Evaluation of VOCs with Respect to Development of Revised Standard 62.1 Indoor Air Quality Procedure (IAQP) Design Compounds and Design Limits 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
Marwa Zaatari
D Zin Partners
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Austin, TX 78704
Phone: 512-203-2204
Email: marwa.zaatari@gmail.com

or Administrative or Procedural Matters:

Manager of Research & Technical Services (MORTS)
Michael R. Vaughn
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180 Technology Parkway, NW
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Contractors intending to submit a proposal should so notify, by mail or e-mail, the Manager of Research and Technical Services, (MORTS) by Monday, May 15, 2023 in order that any late or additional information on the RFP may be furnished to them prior to the bid due date.

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 mvaughn@ashrae.org.
Hardcopy submissions are not permitted. **In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EDT, Wednesday, May 31st, 2023.**
NO EXCEPTIONS, NO EXTENSIONS.

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)

The current Standard 62.1 includes the IAQP which permits the outdoor air requirement to be lower than that required by the Ventilation Rate Procedure (VRP). The IAQP currently requires that the designer selects the contaminants and concentration limits. This is an impediment to using the IAQP because designers lack access to the necessary contaminant and concentration limit data and lack the knowledge to select which are most appropriate. Unfortunately, this allows ventilation via the IAQP to be quite discretionary. The SSPC62.1 committee is undertaking this project to fill this serious knowledge gap by specifying the compounds and concentration limits. The recently-approved addendum (AA) to 62.1-2019 specifies 15 compounds, 11 of which are VOCs. Yet, the committee found that there was inadequate current data to select the most appropriate VOCs, so the current proposed list is based on best judgement. It is critical to provide the committee with the best current data, including current prevalence of VOCs in indoor air and health guidelines associated with exposure to these VOCs.

A recent literature search for summaries of VOCs concentrations in indoor air only found studies reported from the 1990s (see, for example, USEPA (3) and Brown *et. al.* (4)). While some VOCs may be in declining concentrations in green buildings, others may be increasing because of product substitution and/or energy conservation (reduced outdoor air). An analysis of currently-occurring VOCs is needed to ensure that the air quality is as acceptable as possible. When the list of "Design Compounds" (DCs) for the IAQP is established, designers will require emission rate data from manufacturers, who must test their product(s). It is important that the DC list become established and supported by the practitioners to avoid real or perceived inhibition in using the IAQ Procedure. Reliance on a current analysis of concentrations will be essential as well to build confidence in the IAQP to provide acceptable IAQ when ventilation is reduced. This project will greatly contribute to the dual goals of ASHRAE of providing good IAQ while reducing energy consumption.

Justification and Value to ASHRAE

This project will advance the state of the art in HVAC design because it will help to improve the Standard 62.1 IAQP design process allowing for more widespread use of the IAQP. This RP will also move IAQP closer to designing HVAC systems that provide both good IAQ and low energy use. Until now, only a few and select engineers have used the IAQP because of lack of guidance on identifying contaminants to assess during design (particularly volatile organics), and what level of contaminant control is appropriate.

This project will be of interest to the US Green Building Council (USGBC) because their Leadership in Energy and Environmental Design (LEED) system promotes design of low-energy use buildings. With the information from this RP, it may be feasible to coordinate with USGBC and other groups to harmonize the various DC lists. Other committees in ASHRAE are anticipated to be interested and potentially use the research from this project. These include SSPC 170 (Ventilation for Health Care Facilities), SSPC 189.1 (Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings), and possibly SSPC 160 (Air Quality within Commercial Aircraft).

Objectives

The overall objective of this RP is to provide information in a report format to the SSPC 62.1 committee in order that they may approve a solid and defensible list of DCs and DLs for VOCs for use with the IAQP.

The RP will compile all reasonably available published, peer-reviewed data for VOC concentrations over recent years into a database of DCs for statistical analyses as identified in this RP. The database can be placed in the public domain and be of value to other inquiries and will be available to the Committee for further analysis if desired by the Committee.

The RP will also compile a comprehensive list of VOC concentration guidelines that can be used to select DLs.

Scope:

Task #1. Design an appropriate database in commercially available software, e.g., Microsoft Access. The database design must be approved by the PMS prior to inputting data. A conceptual design shall be submitted and approved. Subsequently, a functional database with minimal data inputted shall be submitted and approved prior to entry of significant literature data. The minimum data to include in the database include: contaminant VOC, CAS# cross

reference, location(s) of buildings (country, state/province), type of building (i.e., retail, residence, office. etc.), date(s) of sample collection, method(s) of analysis, number of buildings in study, ventilation rate data, age(s) of buildings relative to sampling dates, other relevant characteristics (e.g., if the buildings were complaint buildings, they may be flagged and excluded from the statistics of central tendency; likewise, if there were “green” building, separate statistics should be computed). If data are not reported, N/R would be entered into that field.

Task #2. VOC Literature Review. Conduct a literature review using the following minimum databases: Web of Science, Science-Direct, PubMed/MEDLINE, Engineering Village 2, and Google Scholar. Include only published, peer-reviewed data and technical reports by government agencies and Non-Governmental Organizations. The search shall include the prior 15 years. Export all references into EndNote or equivalent. Perform title and abstract review to screen for papers with potential data. Review papers and flag all papers with usable data. It is anticipated that there will be around 500 useful papers to be found. If significantly more than this number are located, prioritize them to maximize the diversity of VOCs covered and reviewed. If fewer than the anticipated number of papers are located, extend the search backwards past 15 years to allow usable data extraction from a total of around 500 papers.

Task #3. Consult with major IAQ laboratories throughout the US and other countries to request that they share data from TO-14, TO-15, or TO-17 analyses. Contact at least 50 laboratories. In order to ensure that representative datasets are not contaminated with data from complaint buildings, the lab would have to request information from the entity who performed sampling. A survey form shall be given to the lab requesting the information in the database design (e.g., year of construction etc.) and at a minimum if the sample was considered representative as opposed to due to concerns or complaints. Not all parameters must be known e.g., age of building. The lab should be requested to provide the data electronically so that it can be uploaded into the database. If only paper copies are available, they will be compiled and submitted with the report, as budgeting time to do data entry is outside the scope of the RP.

Task #4. Enter all usable data into the database. Incorporate older meta-analyses including Brown et al (1994) and the USEPA Base study as well as other major datasets. Comparisons between the older data and current data will be made. Provide for interim review by the PMS of the database at 33% and 66% completion.

Task #5. Development of List of all potential Design Limits for VOCs. Obtain lists that are published by all known cognizant authorities (all Federal Governments, provincial governments (as appropriate, such as California), and Non-Governmental Organizations (e.g., World Health Organization) determined cognizant by the PMS. Add to database the guideline concentration, the agency, year of promulgation, and critical effect (if known) for the guideline (e.g., cancer, neurodevelopmental effects, etc.) Occupational exposure values are excluded.

Task #6. Odor thresholds. Add to the database odor thresholds for all VOCs with published concentration data. Measured values, primarily from the works of Abraham, Cometto-Muniz, and Cain should be included for VOCs where concentration data were found. If no measured value is published by this group, include calculated values from Abraham et al. (5).

Task #7. Data analysis.

Following Brown et al., 1994 (3), the following calculations and comparisons will be made:

- a. Mean (or Geometric Mean based upon tests for normality), range, and Standard Deviation (or Geometric Standard Deviation) of all data for each VOC reported.
- b. Correlation between each VOC with all others. Appropriate correlation statistics are to be provided.
- c. Comparison between older data statistics and current statistics shall be made to determine overall trend in VOCs and trends for all individual VOCs.
- d. Calculate the ratio of mean concentrations to guidelines for DLs and odor thresholds for all VOCs.

Deliverables:

The project deliverables will be sent to the PMS and will include:

Task #1. Database design. PMS shall approve database design prior to data entry.

Task #2. Endnote library of all references found, with references flagged for review.

Task #3. List of laboratories contacted and data provided. Electronic data is reported in database in Task 7.

Any hard-copy-only reports will be compiled and provided as a pdf.

Task #4. Interim electronic copies of the database at 33% complete (~150-175 publications reviewed), 67% complete (300-350 publications reviewed), 100% complete (up to 500 publications reviewed) for review and comment. A final electronic copy of the database shall be provided after all DTs and odor thresholds have been added.

Task #5. Compendium of guidelines for VOCs by Cognizant Authorities. The electronic report shall provide source information (i.e., copies of regulations, web site documents, etc.) and a table of guidelines by compound. The guidelines shall be added to the database for further calculations.

Task #6. Compendium of Odor Thresholds for candidate VOCs.

Task #7. Data analysis report. This will include a summary of literature reviewed, results of statistical analysis, correlation data, and all analysis as required under Task #7. All files shall be provided as Excel tables as well as appropriate charts and tables in the technical report.

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.

c. *Science & Technology for the Built Environment* or ASHRAE Transactions Technical Papers

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 as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in “Manuscript Central” for an ASHRAE Transactions Technical or HVAC&R Research papers. The paper title shall contain the research project number (1869-RP) at the end of the title in parentheses, e.g., (1869-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

Duration in Months: 18 Principal Investigator: 4 months Research Assistant: 12 months

Estimated \$ Value: US\$ 190,000

Expected Breakdown of Level of Effort:

Task 1: \$10K

Task 2: \$50K

Task 3: \$20K

Task 4: \$30K

Task 5: \$30K

Task 6: \$10K

Task 7: \$20K

Report writing and meetings: \$20K

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	Contractor's understanding of Work Statement as revealed in proposal.	20%
2	Quality of methodology proposed for conducting research.	20%
3	Contractor's capability in terms of facilities.	15%
4	Qualifications of personnel for this project.	20%
5	Probability of contractor's research plan meeting the objectives of the Work Statement.	20%
6	Student Involvement	5%

Project Milestones:

Task No.	Major Project Completion Milestone	Deadline Month
1	Database design	1
2	Literature Search/Review	5, 10, 15
3	Laboratory Data Acquisition	13
4	Database with interim completion at 33% (month 5) and 66% (month 10), and the Final version (month 15).	5, 10, 15
5	Concentration Guideline Data	10
6	Odor Threshold Data	10
7	Data Analysis	17

References:

- [1] ASHRAE. 2019. ANSI/ASHRAE Standard 62.1-2016, *Ventilation for Acceptable Indoor Air Quality*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta. Addendum AA.
- [2] Raynor de Best. 2021. New non-residential commercial buildings put in place in the U.S. from 2006 to 2023. <https://www.statista.com/statistics/290823/value-of-new-nonresidential-commercial-construction-in-united-states/>
- [3] EPA. 2006. Building Assessment Survey and Evaluation (BASE) Study. <https://www.epa.gov/indoor-air-quality-iaq/building-assessment-survey-and-evaluation-study>.
- [4] S. K. Brown, M. R. Sim, M. J. Abramson, and C.N. Gray. 1994. Concentrations of Volatile Organic Compounds in Indoor Air - A Review. *Indoor Air*, 4: 123-134.
- [5] Michael H. Abraham, Ricardo Sanchez-Moreno, J. Enrique Cometto-Muniz and William S. Cain. 2011. An Algorithm for 353 Odor Detection Thresholds in Humans.