

INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

2027-SP, Refrigerant Leakage Rate Emissions Tracking

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: Center of Excellence for Building Decarbonization (CEBD)

Budget Range: \$270,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **April 1, 2026** or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EDT, December 15th, 2025. 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: “2027-SP, Refrigerant Leakage Rate Emissions Tracking” 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

Stet Sanborn

E-Mail: Stet.Sanborn@smithgroup.com

For Administrative or Procedural Matters:

Manager of Special Projects

Derrick Nesfield

ASHRAE, Inc.

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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. Monday, December 1st, 2025 is the deadline for submitting technical inquiries.

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 dnesfield@ashrae.org. Hardcopy submissions are not permitted.

In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EDT, December 15th, 2025. 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)

This project will provide a simplified tracking form template to smaller-scale portfolio owners to allow for easier annual data submission. A voluntary anonymized collection tool will allow for the development of a database of portfolio-level annual refrigerant leakage rates for ASHRAE standards to reference normalized to equipment type, age, equipment size ranges (in tons of refrigeration), refrigerant and climate zone. This will allow for the ranking of reported leakage source occurrences from highest to lowest for each type of equipment. Current data sets are piecemeal, dated, and do not currently represent the types of equipment expected to see the largest growth in the next 20 years.

Justification and Value to ASHRAE

ASHRAE should have harmonization across its standards and continue to be a leader in the improvement of the built environment. According to the ASHRAE Position Document on Building Decarbonization, by 2030, the global built environment must halve its 2015 GHG emissions, including at least a 40% reduction in new construction embodied carbon. By 2050, at the latest, all new and existing assets must be net zero GHG emissions across the whole life cycle. According to current research, refrigerant leakage emissions contribute around 2% of total global greenhouse gas (GHG) emissions; this is primarily due to the high Global Warming Potential (GWP) of many refrigerants, particularly hydrofluorocarbons (HFCs), which can be thousands of times more potent than carbon dioxide when released into the atmosphere¹.

For teams attempting to calculate the whole-life carbon impact of refrigerant leakage, it can be challenging to find a consistent data set to reference. Existing leakage rate references differ significantly in addition to having poorly documented sample sizes and collection methodology. Currently, leakage rate assumptions are not aligned between ASHRAE 228P, ASHRAE 240P, BREEAM, CIBSE TM65, EPA, IPCC, and GHG Protocol. Recent studies have also shown leakage rates that differ even from these references, including leakage rates reported from a field study reported in the October 2022 issue of the ASHRAE Journal² (note, study presented was manufacturer funded). Refrigerant rates included in the above references range from less than 1% annual leakage to as much as 25% annual leakage depending on equipment type, with several references suggesting a range of 7-12%.

In addition, nearly all reference sources indicate a flat-rate annual leakage rate. It is unclear if any of the reference data sets were analyzed with a longitudinal time basis to evaluate whether leakage rates are linear, or whether leakage rates change over time with age of equipment. These are variables that will have carbon impacts across the entire life cycle of equipment.

Objectives

The following describe key goals of the refrigerant leakage data collection project, allows the project to be broken into phases:

Perform a “Missing Data” Research literature review phase of the project to verify and identify holes in existing data sets; this may include an international literature review and/or industry outreach in partnership with AHRI.

- Create a voluntary anonymized collection of historical leakage data based on owners’ equipment service records with include recharge volumes with development of a database of portfolio-level annual refrigerant leakage rates for ASHRAE standards to reference normalized to equipment type, age, equipment heating/cooling capacity in terms of TON(R), refrigerant and refrigerant type in accordance with ASHRAE 34, and climate zone per ASHRAE 169. Reporting mechanism must include all pieces of equipment at the particular sites investigated regardless of occurrence of leaks to determine a portfolio-wide level leakage rate.
- Rank reported leakage source occurrences from owner service records from highest to lowest for each category of tracking in the database, i.e. for each type of equipment, age, refrigerant, climate zone, etc.

¹ Woods, J., J. Nelson, E. Kozubal, et.al, “Humidity’s impact on greenhouse gas emissions from air conditioning.”: Joule, Volume 6, Issue 4, 726 - 741

² Pistochini, T., R. Silveira, D. Ross, R. McMurphy, A. Umarani, “Analysis of Refrigerant Use for AC Equipment Maintenance.”: OCT 2022 ASHRAE Journal, 44.

In addition, the following objectives shall be considered:

- The database and/or collection method shall align with and/or allow for export from industry-standard portfolio asset service-tracking software packages
- The project shall provide a simplified tracking form template for smaller-scale portfolio owners to allow for easier annual data submission.
- It is critical that the platform allows ongoing, annual reporting, such that the data sets represent on-going leakage rates, not just a single snapshot in time from a single service event.
- Although on-going maintenance of the platform beyond the study period is not required, the structure shall be able to be transferred to ASHRAE or 3rd party for on-going maintenance.

Scope:

Project Phase 1: Missing Data Literature Review & Statistical Uncertainty Approach development

Review existing data sets and identify gaps, including available international data and industry outreach in partnership with AHRI. Produce a summary report of existing leakage data sets referenced in ASHRAE standards and international standards. Identify gaps in the existing data sets and verify Phase 2 data collection methodology is able to address data deficiencies. Results shall be presented to PMS for approval prior to moving onto phase 2.

During this phase of work, the contractor shall also provide PMS with the total sample size of confirmed data available from proposed partners, confirmed data collection methodology, confirmation of the proposed data collection format, data control and confidentiality plan, including signed releases from data partners acknowledging participation in the research project and transferability of anonymized data to ASHRAE.

The contractor shall be able to show that they have access to the full range of equipment as specified below, as well as having a sample size not dominated by legacy refrigerants (R22, etc). The teams must show access to equipment with currently used refrigerants, including R410, R134, as well as newer refrigerants including A2L's and so-called natural refrigerants such as Ammonia (R717), CO2 (R-744), and hydrocarbons such as Propane (R290) and/or Isobutane (R600a)

The proposed methodology and sample size shall achieve an uncertainty of better than ± 0.5 percent. Responding teams shall propose their plan for achieving or exceed the uncertainty requirements.

Project Phase 2: Data Collection

The project shall include guidance to portfolio owners and/or service companies on the most critical leakage tracking information that is needed to support an aggregate data set. As an example, the following would be considered critical values to track in an internal tracking system and augmented based on results of Phase 1 above:

- Equipment Asset Tag:
- Location (zip code)
- Equipment Type (see note below for minimum required equipment categories)
- Equipment Size (tons of refrigeration)
- Date of Service
- Refrigerant
- Initial Charge (lbs)
- Recharge (lbs) and Reason of recharge (EX: major rebuild or maintenance recharge)
- Leakage Source (if noted)
 - Leak as a result of transportation to site or initial installation
 - Initial Operational Leakage (typically leaks at connection)
 - Longer term Operational leakage (typically small pinhole leaks, or leaks through pressure relief valves)
- Original Install Date of Equipment (Age of Equipment)

Such internal tracking could then be aggregated into a standard annual submission form for inclusion in the collection database. As an example, the rolled-up annual reporting submission could be broken down as follows:

Year	Equipment Type	Refrigerant	Total Installed Tons	Total Initial Charge (lbs)	Total Recharge (lbs)	Avg Equipment Age	Most Frequent Leakage Source

It is recommended that the team align the Equipment type to ASHRAE Standard 240p:

Type of Equipment
Room AC-window/wall/portable
Residential AC/HP (ducted)
Small self-contained AC/HP (PTAC/HP)
Residential mini-split and multi-split ductless AC/HP
Commercial ductless VRF Systems and Multisplits
Light Commercial Rooftop AC/HP units (5-25 tons)
Large Commercial Rooftop AC/HP units (>25 tons)
Water-cooled Centrifugal & Screw Chillers (all sizes)
Air-cooled Chillers (all sizes)

This scope of work purposefully excludes residential, commercial, and industrial refrigeration equipment, which may be included in future work.

It is recommended that large commercial real estate partners be engaged in an advisory capacity such as CBRE, JLL, and GSA.

In addition, existing partners already used by AHRI, DOE, and ASHRAE who perform data collection and anonymization services should be specified. Historically, potential partners have been DOE ORNL, DUKE University and others.

For data collection, it is recommended that potential small grants be awarded to HVAC&R service companies to pay interns to sort through existing service tags and collect multi-year data. Data and cleaning/anonymizing data required. Potential participants include CBRE, JLL, GSA, DOE BCC, DOE Oak Ridge National Laboratory. Workshop with key partners, i.e. CBRE, JLL, AHRI, etc.

Data collected shall cover multiple service years to capture transient changes to leakage (recharge) rates rather than a single point in time. The captured data must include all pieces of HVAC refrigerant-containing equipment on each site regardless of leak occurrences, so as to provide a total portfolio level leakage rate.

Project Phase 3: Best Practices Report and Recommendations

Based on available data from owner service records, where a failure mode or leakage source is identified, develop a report for identifying lessons learned and/or useful conclusions gained from the data collection efforts. This may be completed in parallel with Phase 2 data collection building on industry knowledge and recommendations from TC 3.8, 3.1, 10.2, and others as applicable.

Phase 3 outcome to include:

- Recommended improvements to the data collection methodology for future or ongoing studies
- Recommended additional future data field validation studies or lab studies that should be explored to augment the findings of the research.
- Final Data Collection template to be shared with portfolio owners to allow for ongoing data collection if additional funding is secured to continue data collection

Draft phase 3 report shall be submitted to PMS to confirm findings provide actionable outcomes prior to issuing final report.

Deliverables:

a. Interim Report

After Phase 1, present the results of the literature search, summary of existing data sets to the PMS; agree to list of data sources and validation for Phase 2, develop web-based database for data collection

- After Phase 2 data to present to the PMS; if successful agree to start Phase 3, if unsuccessful repeat Phase 2.
- After Phase 3, develop Best Practices report for Avoiding Refrigerant Leakage

b. 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.

c. Final Report

In support of all Objectives, the researcher shall produce a final written report for the project detailing all work undertaken in the project, including data collection, methodologies used, raw data collected, data analysis, and results. Create a simplified summary table (1-2 standard paper size pages) for inclusion in the ASHRAE Handbook – HVAC Applications that includes final results from the analysis. Additionally, recommendations for further research and continuous development & updating of this table shall be provided.

This task will require approximately 2 months.

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.

d. *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 (2027-SP) at the end of the title in parentheses, e.g., (2027-SP).

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.

e. Data

Data is defined in General Condition VI, “DATA”

f. 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

\$270,000 over 21 months

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Project Phase 1: Missing Data Literature Review (primary immediate need, existing data sets) Estimated time needed for review: 3 Months	3
2	Phase 2: Data Collection Estimated time for Collection: 1 yr minimum; Ongoing	15
3	Phase 3: Best Practices Guide for Avoiding Refrigerant Leakage Estimated time for Guide: 6 months	21

Proposal Evaluation Criteria

Proposals submitted to ASHRAE for this project should include the following minimum information:

No.	Proposal Review Criterion	Weighting Factor
1	Experience in previous refrigerant research work and/or industry collaborations and proposed engagement plan with partners	20%
2	Proposed partners experience with refrigerant recharge/leakage tracking and/or demonstrated access to partners with portfolio wide leakage data available for the study; Preference will be given to bidders able to show access to a sufficient number of sites and pieces of equipment to achieve the required uncertainty requirements as well as with roughly equal distribution across ASHRAE Climates zones 1-6 and by equipment type.	30%
3	Contractors’ understanding of the Work Statement as expressed in the Proposal	20%
4	Contractors’ understanding of the Work Statement as expressed in the Proposal	10%

	Probability that proposed research plan will meet work statements objectives: 1) Detailed and logical work plan with major tasks and key milestones; 2) All technical and logistical factors considered; 3) Reasonableness of project schedule.	20%
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References

1. Woods, J., J. Nelson, E. Kozubal, et.al, “Humidity’s impact on greenhouse gas emissions from air conditioning.”: Joule, Volume 6, Issue 4, 726 – 741.
2. Pistochini, T., R. Silveira, D. Ross, R. McMurry, A. Umarani, “Analysis of Refrigerant Use for AC Equipment Maintenance.”: OCT 2022 ASHRAE Journal,44.