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Michael R. Vaughn, P.E.
Manager Research & Technical Services

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TO: Michael Corbat, Chair TC 2.4, mcorbat@customfilter.net

FROM: Michael R. Vaughn
Manager of Research and Technical Services

CC: Pawel Wargocki, Research Liaison 2.0, paw@byg.dtu.dk
Brent Stephens, Research Subcommittee Chair TC 2.4, brent@iit.edu
Thad Ptak, Gemma Kerr, Rahul Bharadwaj, Geoff Crosby, Keith Chesson, Work Statement Author(s), tptak@aosmith.com; gkashrae@magma.ca; rbharadwaj@aafintl.com; gcrosby@lydall.com; keith.chesson@clarcor.com

DATE: October 11, 2017

SUBJECT: Work Statement (1784-WS), "Repeatability and reproducibility assessment of ASHRAE Standard 52.2 as currently amended"

During their recent fall meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted 10-1-0 CNV to conditionally accept it for bid provided that the RAC approval conditions are addressed to the satisfaction of your Research Liaison in either written responses or revisions to the work statement.

1. It is not clear how the data from various labs will be compared.
2. Not clear about three different labs? What is criteria for which lab is good or bad?
3. Need higher level of testing which is gold standard.
4. Proposals must address problem of variables.

See the bottom of the attached WS review summary for the approval conditions.

The WS review summary also contains comments from individual members of RAC that the TC may or may not choose to also consider when revising the WS; some of these comments may indicate areas of the WS where readers require additional information or rewording for clarification.

If PES roster changes are required, please review them with your RL, Pawel Wargocki, paw@byg.dtu.dk, for approval.

Lastly, please provide ASHRAE staff with the final names and contact information for the Proposal Evaluation Subcommittee (PES) roster, and the Technical Contact that will respond to questions from prospective bidders during the bid posting period (typically this is a WS author or PES member). The technical contact and all members of the PES must also agree to not bid on this project.

Please coordinate changes to this Work Statement with your Research Liaison, paw@byg.dtu.dk, or RL2@ashrae.net. Once he is satisfied that the approval conditions have been met, the project will be ready to bid.

The first opportunity that you will have for this project to possibly bid is winter 2018. To be eligible for this bid cycle, a revised work statement that has been approved for bid by your research liaison should be sent (electronically) to Mike Vaughn, Manager of Research and Technical Services, mvaughn@ashrae.org or morts@ashrae.net, before December 15, 2017. The next opportunity for bid after that will be spring 2018.

Project ID	**1784**	
Project Title	**Repeatability and reproducibility assessment of ASHRAE Standard 52.2 as currently amended**	
Sponsoring TC	TC 2.4, Particulate Air Contaminants and Particulate Contaminant Removal Equipment, Co sponsored: SSPC 52.2, Method of Testing General Ventilation Air Cleaning Devices for Removal Effiency by Particle Size	
Cost / Duration	$195,000 / 18 Months	
Submission History	**1st WS Submission, RTAR accepted F15**	
Classification: Research or Technology Transfer	Basic/Applied Research	
RAC 2017 Fall Meeting Review	**RTAR STAGE FOLLOWED**	
Check List Criteria	**Voted NO**	**Comments & Suggestions**
State-of-the-Art (Background): The WS should include some level of literature review that documents the importance/magnitude of a problem. If not, then the WS should be returned for revision. **RTAR Review Criterion**		
Advancement to the State-of-the-Art Is there enough justification for the need of the proposed research. Will this research significantly contribute to the advancement of the State-of-the-Art. **RTAR Review Criterion**		
Relevance and Benefits to ASHRAE: Evaluate whether relevance and benefits are clearly explained in terms of: a. Leading to innovations in the field of HVAC & Refrigeration b. Valuable addition to the missing information which will lead to new design guidelines and valuable modifications to handbooks and standards.		
IF THE THREE CRITERIA ABOVE ARE NOT ALL SATISFIED - MARK "REJECT" BELOW BUT ADDRESS THE FOLLOWING CRITERIA AS APPROPRIATE		
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.		**#12 -** 3 potential bidders. Should add more. **#8** - are there more than 3 bidders available? #3 - 3 bidders
Proposed Project Description Correct? Are there technical errors and/or technical omissions that the WS has that prevents it from correctly describing the project? If there are, than the WS needs major revision.		**#12** -Although one of the objectives of this project is to identify and determine sources of variability, the Task descriptions do not mention that. They use generic terms such as analyze the results, prepare a report….
Task Breakdown Reasonable? Is the project divided into tasks that make technical and practical sense? Are the results of each task such that the results of the former naturally flow into the latter? If not, then major revisions are needed to the WS that would include: adding tasks, removing tasks, and re-structuring tasks among others.		**#12** -Insufficient details, especially vis a vis determination of sources of variability both inside he same lab (repeatability) and between labs (variability). and suggestions for future MOT improvements made on the basis of this determination.
Adequate Intermediate Deliverables? The project should include the review of intermediate results by the PMS at logical milestone points during the project. Before project work continues, the PMS must approve the intermediate results.		**#12** -Deliverables are in the form of reports. Need more specific deliverables about outcomes.
Proposed Project Doable? Can the project as described in the WS be accomplished? If difficulties exist in the project's WS that prevent a successful conclusion of the project, then the project is not doable. In this situation, major revision of the WS is needed to resolve the issues that cause the difficulty.		**#3** - Seems like a follow on to 1088-RP with a similar methodology, so doable.
Time and Cost Estimate Reasonable? The time duration and total cost of the project should be reasonable so that the project can be as it is described in the WS.		**#12**-Period of performance is reasonable but cost is too high in view of the fact that tests of this kind has been performed before and this projects is to update the standard. **#3**- $195k seems a bit high. How much do these tests typically cost?
Proposed Project Biddable? Examining the WS as a whole, is the project described in the WS of sufficient clarity and detail such a potential bidder can actually understand and develop a proposal for the project? This criterion combines the previous three criteria into an overall question concerning the usefulness of the WS. If the WS is considered to not be biddable, then either major revisions are in order or the WS should be rejected.		
Decision Options	**Initial Decision**	**Final Approval Conditions**
ACCEPT		**#11 -** need to revise the part where they refer to the old ASHRAE strategic plan (2010-2015).. **#12** - Need to emphasize the analysis of the sources of variability and how to reduce them and how the knowledge gained can be used to improve future MOT. **#8** - Not sure if the cost will be justified with the results. #13 - It is not clear how the data from various labs will be compared. Is the comparison against each other or is the comparison against a higher order baseline test? How will it be assured that all labs carry out the tests in the same manner? #3 - Provide better justification for cost. ADDITIONAL COMMENTS: Not clear three different labs?? What is criteria for which lab is good or bad? Need higher level of testing which is gold standard. Proposals must address problem of variables.
COND. ACCEPT	X	
RETURN		
REJECT		

ACCEPT Vote - Work statement(WS) ready to bid as-is
CONDITIONAL ACCEPT Vote - Minor Revision Required - RL can approve WS for bid without going back to RAC once TC satisfies RAC's approval condition(s) to his/her satisfaction
RETURN Vote - WS requires major revision before it can bid
REJECT Vote - Topic is no longer considered acceptable for the ASHRAE Research Program due to duplication of work by another project or because the work statement has a fatal flaw(s) that makes it unbiddable

WORK STATEMENT COVER SHEET

Date: July 21, 2017

(Please Check to Insure the Following Information is in the Work Statement)

A. Title	x
B Executive Summary	x
C. Applicability to ASHRAE Research Strategic Plan	x
D. Application of the Results	x
E. State-of-the-Art (background)	x
F. Advancement to State-of-the-Art	x
G. Justification and Value to ASHRAE	x
H. Objective	x
I. Scope	x
J. Deliverables/Where Results will be Published	x
K. Level of Effort	
Project Duration in Months	X
Professional-Months: Principal Investigator	X
Professional-Months: Total	X
Estimated $ Value	X
L Proposal Evaluation Criteria & Weighting Factors	X
M. References	X
N. Other Information to Bidders (Optional)	

Title:

Repeatability and reproducibility assessment of ASHRAE Standard 52.2 as currently amended.

WS# 1784

(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

HVAC Systems and Equipment Handbook. Chapter 29: Air for particulate contaminants.

Responsible TC/TG: TC 2.4

Date of Vote: June 27, 2017

For		13
Against	*	0
Abstaining	*	1
Absent or not returning Ballot	*	4
Total Voting Members		18

This W/S has been coordinated with TC/TG/SSPC (give vote and date):

SSPC 52.2 – Vote 12-0-0-0-(12) Letter Ballot closed 8/4/17

Has RTAR been submitted? Yes

Strategic Plan Theme/Goals

Work Statement Authors: **

Thad Ptak, Gemma Kerr, Rahul Bharadwaj, Geoff Crosby, Keith Chesson

Proposal Evaluation Subcommittee:

Chair: Thad Ptak

Members: Gemma Kerr, Rahul Bharadwaj, Geoff Crosby, Keith Chesson

Project Monitoring Subcommittee:
(If different from Proposal Evaluation Subcommittee)

N/A

Recommended Bidders (name, address, e-mail, tel. number): **

Kathleen Owen, RTI, mko@rti.org; 919-541-6941
Al Vatine, LMS, alvatine@lmstechnology. com; 952-918-9060
Bob Burkhead, Blue Heaven, bob@blueheaven.com; 502-819-0204

Potential Co-funders (organization, contact person information):

NA

(Three qualified bidders must be recommended, not including WS authors.)

	Yes	No	How Long (weeks)
Is an extended bidding period needed?		x	
Has an electronic copy been furnished to the MORTS?	x		
Will this project result in a special publication?	x		
Has the Research Liaison reviewed work statement?	x		

* Reasons for negative vote(s) and abstentions

** Denotes WS author is affiliated with this recommended bidder
Use additional sheet if needed.

WORK STATEMENT# 1784

Title:

Repeatability and reproducibility assessment of ASHRAE Standard 52.2 as currently amended.

Sponsoring TC/TG/MTG/SSPC:

TC 2.4

Co-Sponsoring TC/TG/MTG/SSPCs (List only TC/TG/MTG/SSPCs that have voted formal support)

SSPC 52.2

Executive Summary:

ASHRAE Standard 52.2 – *Method of Testing General Ventilation Air Devices for Removal Efficiency by Particle Size* was issued in 1999 and it is under continuous maintenance. The main goal of this project is to evaluate the repeatability and reproducibility of ASHRAE Standard 52.2-2017, and to identify additional sources of variability. This project will test selected commercially available particle air filters to validate recent changes to ASHRAE Standard 52.2.

The PI will procure, pre-test and distribute the filters, coordinate laboratory testing, and analyze the results to form conclusions and recommendations. ASHRAE should fund this research to help establish the reliability and tolerance of this key standard.

Because Standard 52.2 is under continuous maintenance for continuous improvement, the results from this project will contribute directly to improving reliability and credibility of ASHRAE Standard 52.2.

Applicability to the ASHRAE Research Strategic Plan:

By reducing the variability of testing performance of air cleaning devices, this project will achieve greater industry acceptance and confidence, will advance the art of HVAC&R, and will improve the ability of engineers to specify air cleaning devices. Air cleaning devices have a critical role in the industry due to their potential to reduce energy use in buildings by reducing the amount of outdoor air needed to comply with Standard 62.1 through use of the IAQ procedure.

This project supports the Adapt Goal of the ASHRAE 2014 Strategic Plan. It will "Work to translate science and technology into practical tools and resources that drive effective building design, operations and management".

The research also supports goal 4 in the 2010 - 2015 Research Strategic Plan. In Goal 4, "Research on the effects of gas- and particle-phase air cleaning were considered a high priority, despite the absence of clear evidence of effects on health and performance, because a survey of ASHRAE members indicated a strong interest in the effects of air cleaning."

Application of Results:

The results from this project will contribute directly to the improvement of the ASHRAE Standard 52.2: *Method of Testing General Ventilation Air Devices for Removal Efficiency by Particle Size.*

State-of-the-Art (Background):

ASHRAE Standard 52.2, which specifies test equipment and procedures for determining particle filter efficiencies, was first published in 1999. Results are used to classify tested filters according to their Minimum Efficiency Reporting Value (MERV). Commercial filter MERVs range from 4-16.

In 2001, several laboratories participated in ASHRAE research project 1088-RP Coordinate and analyze inter-laboratory testing of filters under ASHRAE Standard 52.2 to determine the adequacy of the Apparatus Qualification Tests (final report 2005). That project organized inter-laboratory testing to validate the new standard. It found that there were variations in results that sometimes led to the unacceptable situation that some laboratories determined different MERVs for the same filter. Recommendations were presented to address this situation. The 52.2 Committee has further investigated and addressed variation through informal inter-laboratory testing by 52.2 participants, and through ASHRAE research projects such as 1287-RP Particle Counter Specifications for use with Standard 52.2.

Based on these efforts, SSPC 52.2 has recently approved changes to the Standard, including restricting measuring instruments to optical particle counters, laying down specifications for the counters, narrowing the acceptable range of relative humidity to use in the test rig, and changing some of the efficiency ranges used to calculate MERV. These changes have been published as 52.2-2017. Today, there is no data to establish the combined effect of all changes since 2005 on measured filter efficiencies.

Furthermore, Appendix J: Optional Method of Conditioning a filter Using Fine KCl Particles to Demonstrate Efficiency Loss that Might be Realized in Field Applications was adopted after the 1088-RP round robin was completed. This also needs to be evaluated for variability.

It would be expected that labs recruited for this research will be able to run 52.2-2017 by the time this research is approved.

Advancement to the State-of-the-Art:

ASHRAE Standard 52.2 has become a widely (US and worldwide) accepted method for determining efficiencies of air cleaning devices. It is used in many areas concerned with air filtration and Indoor Air Quality (IAQ). It is critical to the 52.2 Standard and to the filtration industry, that testing and test data from different organizations and laboratories be comparable and with low test variability.

Results from this project and their implementation will allow for future improvements to the test method. By identifying root causes for variation, the results of this project would be reviewed and evaluated by SSPC 52.2 and TC 2.4 for possible action items to further improve Standard 52.2.

Justification and Value to ASHRAE:

ASHRAE Standard 52.2 is under continuous maintenance, and this project provides an opportunity for test method improvements. The standard is currently widely used in areas concerned with filtration and Indoor Air Quality, including implementation of ASHRAE Standards 62.1 and 62.2. People affected by the standard include building operators, filter manufacturers, HVAC PIs, HVAC manufacturers, government, and research facilities. Many people working in these areas are ASHRAE members and will be impacted by the effectiveness of the Standard. Improving Standard 52.2 will also make it more acceptable to filter manufacturers and suppliers, testing laboratories, and international standard developers.

This project also supports the ASHRAE 2014 Strategic Plan. One Goal in the Strategic Plan is "Adapt: Work collaboratively within the global community to increase the value, usefulness and accessibility of building sciences and technology". This includes working to "ensure that ASHRAE's products, programs, and services are well aligned to meet the needs of the global building industry." Likewise, INITIATIVE 3: Applied Product Development is aimed at the changing "world of prescriptive and performance-based standards." ASHRAE plans to make sure that its standards are applicable to the changing needs of the world. Also, under the OUTCOMES AND MEASURES: THE PLAN'S STRATEGIC IMPACT section, ASHRAE will continue its work to "Improve building performance" by assessing progress and making needed adjustments". This project aims to improve the outcome of the ASHRAE 52.2 test, and so will help building owners and operators choose filters that will improve the air quality portion of building performance. An improved Standard 52.2 will increase the test method's use and world-wide acceptance. Therefore, this project readily meets these three goals in the 2014 Strategic Plan.

The knowledge gained from this project may be used to improve ASHRAE 52.2 as well as test methods related to ASHRAE 52.2, such as ASHRAE Standard 145.2 and the ISO particle filter test method 16890-2, and methods for ultrafine particle filter testing.

This project will provide information for inclusion in the HVAC Systems and Equipment Handbook, Chapter 29: Air cleaners for particulate contaminants.

Objectives:

The objective of this project is to determine repeatability and variability of the ASHRAE 52.2-2017 (inclusive of all changes since 2001) test method and to recommend improvements to the methods. Testing will include measurement of the pressure drop, initial efficiency, and efficiency after dust loading. Appendix J conditioning with fine KCl particles would be conducted as a subset on high efficiency filters. As recommended in 1088-RP, dust holding capacity testing will not be included (revisions to Standard 52.2 did not affect these procedures).

A scheme of initial efficiency testing needs to be devised that will explore variances in filter media, filter type and filter efficiency etc. Data collected should permit ranking of the sources of variance examined, and should also deliver information on whether the overall variance of the test method has improved since 1088-RP was conducted. Current standard states acceptable variability of +/- five percentage points on any given particle size channel when comparing reference efficiency curves as a starting point.

The results of this project would be reviewed and evaluated by SSPC 52.2 and TC 2.4 for possible action items (further research, tightening methodology / practices, etc.) to further improve Standard 52.2.

Scope/Technical Approach:

This project is divided into 4 tasks as shown below. The completion of each task will serve as a project milestone.

1) Selection of laboratories
2) Test design and filter selection
3) Data collection
4) Data analysis and reporting

Task 1 - Selection of laboratories:

In this task, the PI will determine which labs are running ASHRAE 52.2-2017 and contact them to determine their capabilities and willingness to participate in the project. The PI should include in their bid the criteria, process and method in lab selection. Since ASHRAE has agreed that the labs may be compensated for their testing as this is an expensive test to run, testing service agreements, including cost and timeframes, should be discussed with the labs at this point.

The PI will prepare a short report for PMS, which should include at least two proposals that should include overall estimated costs, number of labs (at least 5), number of filters planned to test, other useful information for PMS so that it enables their evaluation. The costing information is intended to help the PMS understand the tradeoffs in terms of number of possible tests; the total cost of the project is not changeable, but the distribution of the testing could be if the discussion leads in that direction. The PMS should reply within 2 weeks so that the project may continue.

Results will be reported blind, but the participating laboratories will receive their own test results to allow them to compare their data with the group results.

Task 2 - Test Design and Filter Selection:

In this task, the PI will prepare the test design which will include repeated tests from one lab to allow examination of intra-lab variation and from the multiple labs for inter-lab comparisons. Also, during this stage the PI should contact the labs and start collecting the QA data for analysis. To consider the task complete the PI will submit a written report on the test design which would typically include, test set-up, data collection methods and reporting format. Also, as part of the report, the PI is expected to submit a list of filters selected for testing.

Filters for consideration should at least include MERV 8, MERV 11, MERV 14, MERV 14A (per 52.2 Appendix J) and MERV 16.

Task 3 -Data Collection:

Once the Task 1 and 2 reports have been approved, the test labs should begin testing as soon as possible. As part of this task it is expected that the PI will prepare a timeline/schedule of the data collection process and keep track of the testing schedules at the different test labs, and will submit timely (biweekly) updates to the PMS committee via email.

Task 4 -Data Analysis and Reporting:

As the data is received for the QA and for the specific tests, the PI will analyze the data per the approved test plan. During this period, data updates should be presented at ASHRAE meetings. The final report will be written; however, it is suggested that the findings be communicated, as reasonable, even before the final report is completed. The final report should include recommendations for improvements in the MOT, if improvements prove to be needed. The final report will be submitted to the committee for review and approval.

Deliverables/Where Results Will Be Published:

Progress, Financial and Final Reports, Research or Technical Paper(s), and Data shall constitute required deliverables ("Deliverables") and shall be provided as follows:

a. Progress and Financial Reports required by ASHRAE Society
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. These reports will also be reviewed by the Project Monitoring Subcommittee (PMS).

In addition, 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 at a meeting arranged by the sponsoring Technical and Standards Committees at the ASHRAE annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Task Completion Reports required by the PMS
During the project, the PI will be required to obtain approval from the PMS before proceeding further at the following milestones (not necessarily in chronological order):

1. Selection of laboratories
2. Test design and filter selection
3. Data collection
4. Data analysis and reporting

It is anticipated that a short-written report will be submitted by the PI at all four of these decision points, and that the PMS will provide the PI with a response within one month of submittal.

While the exact payment schedule will be negotiated between the PI and ASHRAE, a proposed payment schedule would be:

1. 25% down at the signing of the contract
2. 15% upon completion of Scope Milestone 1
3. 20% upon completion of Scope Milestone 2
4. 15% upon completion of Scope Milestone 3
5. 15% upon completion of Scope Milestone 4
6. 10% upon completion of final report and submission of technical papers.

Payment and milestone completion are contingent upon PMS review and approval.

c. Final Report

A written 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. Unless otherwise specified, six copies of the final report shall be furnished for review by the Society's Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the sponsoring Technical and Standards Committees, 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 bound copies
- One unbound copy, printed on one side only, suitable for reproduction.
- Two copies on CD-ROM; one in PDF format and one in Microsoft Word.

Level of Effort:

The estimated cost is of the project is $195,000 and it is expected to take 12-18 months. It is anticipated that 4 professional-months of effort will be needed from the principal investigator. In addition to the PI, the testing will be compensated. Since these are expensive tests to run, these costs must be covered in the proposal costing.

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	PI's understanding of Work Statement as revealed in proposal. a) Logistical and technical problems associated	20
2	PI's capability in terms of facilities and methodology for conducting project. a) Organization of the project and plan b) Data collection c) Technical expertise	25
3	Qualification of personnel for this project a) Team qualifications and experience b) Responsibility of project manager	30
4	Detailed work plan with well-defined milestones	10
5	Probability of PI's research plan meeting the objectives	10
6	Student involvement a) Extent of student participation on PI team b) Likelihood that involvement in project will encourage entry into HVAC&R industry.	5

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	1. Selection of laboratories and challenge gas for the tests	2
2	2. Test Design and filter selection	3
3&4	3. Data Collection (12th month) 4. Data Analysis and Reporting (18th month)	18

Authors:

Thad Ptak, Gemma Kerr, Rahul Bharadwaj, Geoff Crosby, Keith Chesson

References:

ASHRAE 2017. Standard 52.2-2017: Method of testing general ventilation air-cleaning devices for removal efficiency by particle size.

ASHRAE 2009. Standard 62.1: Ventilation for acceptable indoor air quality.

ASHRAE 2005. 1088-RP: Coordinate and analyze inter-laboratory testing of filters under ASHRAE Standard 52.2 to determine the adequacy of the Apparatus Qualification Tests.

ASTM International 1999. ASTM E-691-99: Standard practice for conducting an inter-laboratory study to determine the precision of a test method.

Other Information for Bidders (Optional):

Feedback to RAC and Suggested Improvements to Work Statement Process

Now that you have completed the work statement process, RAC is interested in getting your feedback and suggestions here on how we can improve the process.

WS 1784 “Repeatability and Reproducibility Assessment of ASHRAE 52.2 as Currently Amended.”

Responses to questions from RAC, dated November 13, 2015.

Criteria: Project Objectives

13- The objective of the research is not clear. Results from multiple labs will be compared, but there is no definition of what would be considered good uniformity of results. It is also not clear what is to be done with the results if they are good or bad.

Under Objectives:

Current standard states acceptable variability of +/- five percentage points on any given particle size channel when comparing reference efficiency curves as a starting point.

The results of this project would be reviewed and evaluated by SSPC 52.2 and TC 2.4 for possible action items (further research, tightening methodology / practices, etc.) to further improve Standard 52.2.

Criteria: Expected Approach and Budget

13 - The RTAR includes the following statement "The laboratories carrying out the tests on the filters are expected to provide their services to the project free of charge" but then the calculation provided for the estimated budget is based on an estimated cost of testing for 37 tests. These seem contradictory. 2 - It may be described how many external labs should perform the tests and how they should be selected (randomly or using certain approach). Also it may be suggested which filters should be tested. Based on the budget estimate 37 filter tests are proposed so with 3 tests per lab would mean 12 labs of same filter or 6 labs of 2 filters etc. 6 - Research is highly needed. It was mentioned that "The laboratories carrying out the tests on the filters are expected to provide their services to the project free of charge." Was this common practice in the past for this type of research? How many participating laboratories would be considered as enough?

PI will negotiate with individual labs for cost of filter testing and services. It is not assumed free of charge as stated in RTAR 1784.

Filters efficiency selected for testing consideration are MERV 8, 11, 14, 14A (per 52.2 Appendix J) and MERV 16. Total number of filters would be determined based on number of participating labs. PI would propose number of filters and mix in their proposal.

Criteria: References

ASHRAE standards 52.2, 62.1, 1088-RP and ASTM E-691-99 on practice for conducting inter-laboratory study.

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Michael R. Vaughn, P.E.
Manager Research & Technical Services
mvaughn@ashrae.org

TO: Michael Corbat, Chair SSPC 52.2, mcorbat@customfilter.net
Kathleen Owens, SSPC 52.2 Vice-chair, mko@rti.org
Pawel Wargocki, Research Liaison 2.0, RL2@ashrae.net

FROM: Michael Vaughn, MORTS, mvaughn@ashrae.org

DATE: November 13, 2015

SUBJECT: Research Topic Acceptance Request (1784-RTAR), "Repeatability and Reproducibility Assessment of ASHRAE Standard 52.2 as Currently Amended"

During their fall meeting, the Research Administration Committee (RAC) reviewed the subject Research Topic Acceptance Request (RTAR) and voted to accept it for further development into a work statement (WS).

An RTAR evaluation sheet is attached as additional information and it provides a breakdown of comments and questions from individual RAC members based upon a specific review criteria used for review. This should give you an idea of how your RTAR is being interpreted and understood by others. Some of these comments may indicate areas of the RTAR and subsequent WS where readers require additional information or rewording for clarification.

Please review the RAC feedback on this RTAR with the help of your Research Liaison (Pawel Wargocki– RL2@ashrae.net or paw@byg.dtu.dk) and try to incorporate the key feedback points into the work statement prior to submitting it to the Manager of Research and Technical Services for further consideration by RAC. In addition, a separate document providing a point-by-point response to each of these comments and questions must be submitted with the work statement. The response to each item should explain how the work statement has been revised to address the comment, or a justification for why the Technical Committee feels a revision is unnecessary or inappropriate. The work statement and response to these comments and questions must be approved by the Research Liaison prior to submitting it to RAC.

The first draft of the work statement should be submitted to RAC no later **August 15, 2017** or it will be dropped from display on the Society's Research Implementation Plan. The next realistic submission deadline for new work statements is **May 15, 2016** for consideration at RAC's 2016 annual meeting. The submission deadline after that for work statements is **August 15, 2016** for consideration at RAC's 2016 fall meeting.

Project ID	**1784**	
Project Title	**Repeatability and Reproducibility Assessment of ASHRAE Standard 52.2 as Currently Amended**	
Sponsoring TC	SSPC 52.2 (METHOD OF TESTING GENERAL VENTILATION AIR CLEANING DEVICES FOR REMOVAL EFFICIENCY BY PARTICLE SIZE)	
Cost / Duration	$100,000 - $125,000 / 18M - 24M	
Submission History	**1st Submission**	
Classification: Research or Technology Transfer	Technology Transfer	
RAC 2015 Fall Meeting Review		
Essential Criteria	**Voted NO**	**Comments & Suggestions**
Background: The RTAR should describe current state of the art with some level of literature review that documents the importance/magnitude of a problem. References should be provided. If not, then note it in your comments.		
Research Need: Based on the background provided is the need for additional research clearly identified? If not, then the RTAR should be rejected.		
Relevance and Benefits to ASHRAE: Evaluate whether relevance and benefits are clearly explained in terms of: a. Leading to innovations in the field of HVAC & Refrigeration b. Valuable addition to the missing information which will lead to new design guidelines and valuable modifications to handbooks and standards. Is this research topic appropriate for ASHRAE funding? If not, Reject.		**10** - I believe that acceptance of this RTAR and the resulting WS is mandatory: we did the prior work for which this continuation is required by the continuous maintenance (CM) status of the standard.
IF ABOVE THREE CRITERION ARE NOT ALL SATISFIED - MARK "REJECT" BELOW & CONTINUE REVIEW BELOW		
Other Criteria	**Voted NO**	**Comments & Suggestions**
Project Objectives: Based on the background and need, evaluate whether the project objectives are: 1. Aligned with the need 2. Specific 3. Clear without ambiguity 4. Achievable If not, then appropriate feedback should be provided.	**13**	**13**- The objective of the research is not clear. Results from multiple labs will be compared, but there is no definition of what would be considered good uniformity of results. It is also not clear what is to be done with the results if they are good or bad.
Expected Approach and Budget: Is there an adequate description of the approach in order for RAC to be able to evaluate the appropriateness of the budget? If not, then the RTAR should be returned for revision. Anticipated funding level and duration:	**13**	**13** - The RTAR includes the following statement "The laboratories carrying out the tests on the filters are expected to provide their services to the project free of charge" but then the calculation provided for the estimated budget is based on an estimated cost of testing for 37 tests. These seem contradictory. **2** - It may be described how many external labs should perform the tests and how they should be selected (randomly or using certain approach). Also it may be suggested which filters should be tested. Based on the budget estimate 37 filter tests are proposed so with 3 tests per lab would mean 12 labs of same filter or 6 labs of 2 filters etc. **6** - Research is highly needed. It was mentioned that "The laboratories carrying out the tests on the filters are expected to provide their services to the project free of charge." Was this common practice in the past for this type of research? How many participating laboratories would be considered as enough?
References: Are the references provided?		**9** - Only ASHRAE Standard and so on.
Decision Options	**Initial Decision?**	**Final Approval Conditions**
ACCEPT AS-IS		**13** - This topic should only move forward to WS stage after the objectives of the research are better defined. **2** - Important work. The comments can be addressed in full WS
ACCEPT W/COMMENTS		
REJECT		

ACCEPT Vote - Topic is ready for development into a work statement (WS).
ACCEPT W/COMMENTS Vote - Minor Revision Required - RL can approve RTAR for development into WS without going back to RAC once TC satisfies RAC's approval condition(s)
REJECT Vote - Topic is not acceptable for the ASHRAE Research Program

Research Topic Acceptance Request Cover Sheet

Date: August 12, 2015

(Please Check to Insure the Following Information is in the Work Statement)

- A. Title ☑
- B. Applicability to ASHRAE Research Strategic Plan ☑
- C. Application of the Results ☑
- D. State-of-the-Art (background) ☑
- E. Advancement to State-of-the-Art ☑
- F. Justification and Value to ASHRAE ☑
- G. Objective ☑
- H. Estimated Duration ☑
- I. References ☑

Title:
Repeatability and reproducibility assessment of ASHRAE Standard 52.2 as currently amended.

RTAR# 1784
(To be assigned by MORTS)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

HVAC Systems and Equipment Handbook, Chapter 29: Air cleaners for particulate contaminants.

Responsible TC/TG: SSPC 52.2

Date of Vote: June 27, 2015

For		16
Against	*	0
Abstaining	*	0
Absent or not returning Ballot	*	2
Total Voting Members		18

Co-sponsoring TC/TG/MTG/SSPCs (give vote and date):
TC 2.4 15-0-2-0-17 8.3.2015

RTAR Lead Author: Gemma Kerr
Expected Work Statement Lead Author: Gemma Kerr

Potential Co-funders (organization, contact person information):
NA

Research Classification:
- ☑ Basic/Applied Research
- ☐ Advanced Concepts
- ☐ Technology Transfer

	Yes	No
Has an electronic copy been furnished to the MORTS?	✔	
Has the Research Liaison reviewed the RTAR?	✔	

* Reasons for negative vote(s) and abstentions

DRAFT RTAR Template

Title: Repeatability and reproducibility assessment of ASHRAE Standard 52.2 as currently amended.

Summary

Describe in summary form the proposed research topic, including what is proposed, why this research is important, how it will be conducted, and why ASHRAE should fund it (50 words maximum)

This project will test selected commercially-available particle air filters to validate recent changes to ASHRAE Standard 52.2. The contractor will procure and distribute the filters, coordinate laboratory testing, and analyze the results to form conclusions and recommendations. ASHRAE should fund this research to help establish the reliability and tolerance of this key standard.

Because Standard 52.2 standard is under continuous maintenance for continuous improvement, research of the impact of the new addenda to the standard is necessary.

Background

Provide the state of the art with key references (at the end of this document) substantiating it (300 words maximum)

ASHRAE Standard 52.2, which specifies test equipment and procedures for determining particle filter efficiencies, was first published in 1999. Results are used to classify tested filters according to their Minimum Efficiency Reporting Value (MERV). Commercial filter MERVs range from 4-16.

In 2001, several laboratories participated in ASHRAE research project 1088-RP Coordinate and analyze inter-laboratory testing of filters under ASHRAE Standard 52.2 to determine the adequacy of the Apparatus Qualification Tests (final report 2005). That project organized inter-laboratory testing to validate the new standard. It found that there were variations in results that sometimes led to the unacceptable situation that some laboratories determined different MERVs for the same filter. Recommendations were presented to address this situation. The 52.2 Committee has further investigated and addressed variation through informal inter-laboratory testing by 52.2 participants, and through ASHRAE research projects such as 1287-RP Particle Counter Specifications for use with Standard 52.2. Based on these efforts, SSPC 52.2 has recently approved changes to the Standard, including restricting measuring instruments to optical particle counters, laying down specifications for the counters, narrowing the acceptable range of relative humidity to use in the test rig, and changing some of the efficiency ranges used to calculate the MERV. It is expected that all of these changes will be published as addenda in 2015. Today, there are no data to establish the combined effect of all changes since 2005 on measured filter efficiencies.

It would be expected that labs recruited for this research will be able to run 52.2 per the 2015 addenda by the time this research is approved.

Research Need

Use the state of the art described above as a basis to specify the need for the proposed effort (250 words maximum)

ASHRAE Standard 52.2 is under continuous maintenance, which means there is an ongoing need for research to move the standard forward. An earlier research project 1088-RP obtained data from six different laboratories, using filters in three MERV ranges and testing two matched filters of each model selected. Results from that project, and later investigations, have led to the changes in the Standard mentioned in the previous Section. These should reduce lab-to-lab variances, but data needs to be obtained to verify this.

ASHRAE research project 1088-RP utilized matched filters in testing, i.e. they were pretested to be similar in performance. The project thus did not explore variations between same-model filters that arise from media and manufacturing differences. It also did not investigate the repeatability of the test method when applied to the same filter several times. There is very little public domain data on these subjects, and they do contribute to data variability when testing randomly-selected filters as is done in the HVAC marketplace.

Project Objectives

Based on the identified research need(s), specify the objectives of the solicited effort that will address all or part of these needs (150 words maximum)

The objective of this project is to validate the revised Standard 52.2 by carrying out tests on commercially-available particle air filters. As recommended in 1088-RP, loading and capacity testing will not be included (revisions to Standard 52.2 did not affect these procedures).

A scheme of initial efficiency testing needs to be devised that will explore variances in filter media, filter type and filter efficiency etc. Data collected should permit ranking of the sources of variance examined, and should also deliver information on whether the overall variance of the test method has improved since 1088-RP was conducted.

Expected Approach

Describe in a manner that may be used for assessment of project viability, cost, and duration, the approach that is expected to achieve the proposed objectives (200 words maximum).

Check all that apply: Lab testing ☑, Computations ☐, Surveys ☐, Field tests ☐, Analyses and modeling ☐, Validation efforts ☑, Other (specify) ( )

Planning, managing and designing test sequences for this project will be critical to its success. The contractor need not belong to a laboratory, but needs lab experience. He or she will be responsible for:
• recruiting and contracting with the laboratories that will carry out the testing;
• acquiring and distributing the filters;
• reviewing participating laboratory test equipment, test procedures, environmental control procedures, and quality assurance packages for acceptability'
• co-ordinatingcoordinating the initial efficiency tests;
• correlating the data, and examining the variances; and
• recommending specification and procedural improvements to ASHRAE Standard 52.2 if needed.

The laboratories carrying out the tests on the filters are expected to provide their services to the project free of charge. Results will be reported blind, but the participating laboratories will receive their own test results to allow them to compare their data with the group results.

Relevance and Benefits to ASHRAE

Describe why this effort is of specific interest to ASHRAE, its impact, and how it will benefit ASHRAE and the society. How does it align with ASHRAE Strategic Plans and Initiatives? How does it advance the state of the art in this area in general? Are there other stakeholders that should be approached to obtain relevant information or co-funding? (350 words maximum)

Because ASHRAE Standard 52.2 is under continuous maintenance, the project allows opportunity for validation and improvement. The standard is currently widely used in areas concerned with filtration and Indoor Air Quality, including implementation of ASHRAE Standards 62.1 and 62.2. People affected by the standard include building operators, filter manufacturers, HVAC contractors, HVAC manufacturers, government, and research facilities. Many people working in these areas are ASHRAE members and will be impacted by the effectiveness of the Standard. Improving Standard 52.2 will also make it more acceptable to filter manufacturers and suppliers, testing laboratories, and international standard developers.

This project also supports the ASHRAE 2014 Strategic Plan. One Goal in the Strategic Plan is "Adapt: Work collaboratively within the global community to increase the value, usefulness and accessibility of building sciences and technology". This includes working to "ensure that ASHRAE's products, programs, and services are well aligned to meet the needs of the global building industry." Likewise, INITIATIVE 3: Applied Product Development is aimed at the changing "world of prescriptive and performance-based standards." ASHRAE plans to make sure that its standards are applicable to the changing needs of the world. Also, under the OUTCOMES AND MEASURES: THE PLAN'S STRATEGIC IMPACT section, ASHRAE will continue its work to "Improve building performance" by assessing progress and making needed adjustments". This project aims to improve the outcome of the ASHRAE 52.2 test, and so will help building owners and operators choose filters that will improve the air quality portion of building performance. An improved Standard 52.2 will increase the test method's use and world-wide acceptance. Therefore, this project readily meets these three goals in the 2014 Strategic Plan.

The knowledge gained from this project may be used to improve standards or test methods related to ASHRAE 52.2. Examples include the ISO particle filter test method 16890-2, and methods for ultrafine particle filter testing.

This project will provide information for inclusion in the HVAC Systems and Equipment Handbook, Chapter 29: Air cleaners for particulate contaminants.

Anticipated Funding Level and Duration

Funding Amount Range: $ $100-125K.

Duration in Months: 18-24

References

List the key references cited in this RTAR

ASHRAE 2012. Standard 52.2: Method of testing general ventilation air-cleaning devices for removal efficiency by particle size.
ASHRAE 2009. Standard 62.1: Ventilation for acceptable indoor air quality.
ASHRAE 2005. 1088-RP: Coordinate and analyze inter-laboratory testing of filters under ASHRAE Standard 52.2 to determine the adequacy of the Apparatus Qualification Tests.
ASTM International 1999. ASTM E-691-99: Standard practice for conducting an inter-laboratory study to determine the precision of a test method.

Budget Estimate:

- Detail listed in Expected Approach
- The average range of running a full test per 52.2-2012 by commercial labs is between $1,200 and $1,500 per test. We will take $1,300 as an average.
- The last 52.2 testing validation under 1088-RP consisted of a total of 37 filter tests.
- For budget purposes, we are assuming the total project cost per filter will be double the average test lab rate for a full 52.2 test ($2,600 per filter).
- Using the estimated $2,600 per filter over 37 filter tests in 1088-RP, the estimated cost would be $96,200. The funding range amount of $100-125K was selected to address any additional expenses such as travel, damage to product shipped and replication if needed.