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Built Environment Today

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FROM: Michael Vaughn, MORTS, [mvaughn@ashrae.org](mailto:mvaughn@ashrae.org)

DATE: November 6, 2018

SUBJECT: Research Topic Acceptance Request (1856-RTAR), "Moisture Tolerance and Effects in CO2 Refrigeration systems"

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During their fall meeting, the Research Administration Committee (RAC) reviewed the subject Research Topic Acceptance Request (RTAR) and voted 5-0-0 to reject it. The following list summarizes the consensus review comments and questions on this RTAR:

1. RTAR is very brief. Should provide better justification for the research need and refer to the work done previously on the topic at a much extended version than it is done in the present version.
2. No evidence provided that the lack of this information is a problem to the industry.
3. No description of the expected approach is provided.
4. No references, and its importance cannot be validated.

By rejecting this RTAR, RAC is strongly suggesting to the TC that this particular topic be dropped from the TC research plan based on the information that has been provided.

An RTAR evaluation sheet is attached as additional information and it provides a breakdown of comments and questions from individual RAC members based on specific review criteria. This should give you an idea of how your RTAR is being interpreted and understood by others.

If the TC wishes to pursue this topic further, please incorporate the above information into the RTAR with the help of your Research Liaison, Stephen Kujak [RL3@ashrae.net](mailto:RL3@ashrae.net), 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 RTAR. The response to each item should explain how the RTAR has been revised to address the comment, or a justification for why the Technical Committee feels a revision is unnecessary or inappropriate. The RTAR and response to these comments and questions must be approved by the Research Liaison prior to submitting it to RAC.

The next realistic submission deadline for RTARs and WSs is May 15, 2019 for consideration at the Society's 2019 annual meeting. The submission deadline after that is August 15, 2019 for the RAC fall meeting.

<b>Project ID</b>	<b>1856</b>	
<b>Project Title</b>	Moisture Tolerance and Effects in CO2 Refrigeration systems	
<b>Sponsoring TC</b>	TC 3.3 Refrigerant Contaminant Control	
<b>Cost / Duration</b>	\$35,000 / 9 Months	
<b>Submission History</b>	1st Submission	
<b>Classification: Research or Technology Transfer</b>	Basic/Applied Research	
<b>RAC 2018 Fall Meeting Review</b>		
<b>Essential Criteria</b>	<b>Voted NO</b>	<b>Comments &amp; Suggestions</b>
<b>Background:</b> 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.		2 - No references. 4 - References are missing. 7 - No references listed. 9 - Very limited, with no references cited. It is merely asserted that nothing significant has been done before, but without any supporting discussion. Is there any literature to confirm what is known on this topic, and hence confirm the gaps in knowledge that way? 10 - No references listed or cited. 8 - Can there be some broader discussion of the "CO2" systems and how it relates to refrigeration?
<b>Research Need:</b> Based on the background provided is the need for additional research clearly identified? If not, then the RTAR should be rejected.		7 - CO2 systems have been operating for years without this knowledge. What evidence is there to prove that this information is needed. 9 - Unclear...'basic refrigerant chemistry' is stated, but what exactly? 10 - No justification provided. 12- needs development. Why is moisture relevant? Does anyone care? What could possibly go wrong? BTW, I do think this research is important! 8 - Can you describe in greater detail what the basic refrigerant chemistry research need is?
<b>Relevance and Benefits to ASHRAE:</b> 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.		9 - Work would add information on CO2 refrigeration, which would be useful, but the RTAR in its present form is too brief to properly evaluate. 10 - The topic is of interest for ASHRAE but AHRI could be willing to fund this project too.
<b>IF ABOVE THREE CRITERION ARE NOT ALL SATISFIED - MARK "REJECT" BELOW &amp; CONTINUE REVIEW BELOW</b>		
<b>Other Criteria</b>	<b>Voted NO</b>	<b>Comments &amp; Suggestions</b>
<b>Project Objectives:</b> 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.		9 - These need to be specific and focused. 10 - The project objectives are not detailed. Just one sentence with generic objectives. The authors should be more specific. CS - Assume this is GPC 38 or SPC 97 testing? What conditions would you like to look at?
<b>Expected Approach and Budget:</b> 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:		4 - no description of the expected approach. 9 - Nothing stated. 10 - No text in the expected approach section. The budget is limited such as the duration. Not possible to evaluate the funding level since the tasks are not clearly defined.
<b>References:</b> Are the references provided?		2 - No references, 9 - No. 10 - The box is empty.
<b>Decision Options</b>	<b>Initial Decision?</b>	<b>Final Approval Conditions</b>
ACCEPT AS-IS		2 - No references, and its importance cannot be validated. 4 - RTAR is very brief. Should provide better justification for the research need and refer to the work done previously on the topic at a much extended version than it is done in the present version. 7 - No references listed. No evidence provided that the lack of this information is a problem to the industry. 9 - Topic might be fine, but lack of case for support in the current RTAR makes it impossible to evaluate with confidence. 10 - The authors should complete the form including the expected approach and references. The research needs and project objectives sections are not enough detailed. 8- need further information on research need.
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: **1/23/18**

(Please Check to Insure the Following Information is in the RTAR)

- A. Title
- B. Executive Summary
- C. Background
- D. Research Need
- E. Project Objectives
- F. Expected Approach
- G. Relevance and Benefits to ASHRAE
- H. Anticipated Funding Level and Duration
- I. References

Title:  
**Moisture Tolerance and Effects in CO2 Refrigeration systems**

**RTAR # 1856**  
 (To be assigned by MORTS)

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

**Chapters 3, 6 and 7 of ASHRAE refrigeration handbook**

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

Responsible Committee: **TC 3.3 Refrigerant Contaminant Control**

Date of Vote: **1/23/2018**

For		<b>10</b>
Against	*	<b>0</b>
Abstaining	*	<b>1 CNV</b>
Absent or not returning Ballot	*	<b>0</b>
Total Voting Members		<b>11</b>

RTAR Authors  
 Lead:  
 Ivan Rydkin  
 Chris Repic

Co-sponsoring TC/TG/MTG/SSPCs (give vote and date)  
**TC 10.6 (7-0-0) 06/25/2017**

Expected Work Statement Authors  
 Lead:  
 Ivan Rydkin, Chris Repice  
 Others:

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

Has an electronic copy been furnished to the MORTS?  
 Has the Research Liaison reviewed the RTAR?

Yes	No
<b>Y</b>	
<b>Y</b>	

\* Reasons for negative vote(s) and abstentions

**Title:**

Moisture Tolerance and Effects in CO2 Refrigeration systems

**Executive Summary**

Evaluate the effects of various moisture levels on CO2 refrigeration systems operating with PAG and POE oil at typical operating conditions. This research will identify appropriate moisture limits to update AHRI 700 and the relevant ASHRAE handbook chapters.

**Background**

No significant work regarding moisture tolerance in CO2 systems has been conducted to date. Thermo-physical properties of CO2 determine its maximum moisture carrying capacity and are well known. Similarly, breakdown of CO2 to carbonic acid in the presence of high moisture is also well understood.

However, effects of lubricant oil and phase change transition on said tolerance within refrigeration systems have not been evaluated.

Manufacturers recommend the use of 'refrigerant grade CO2'. However, the AHRI 700 which determines refrigerant grade, itself bases the moisture value by transferring it from previously calculated limits for CFC/HFC refrigerants.

**Research Need**

Basic refrigerant chemistry research is needed, EG sealed stability testing, to identify the moisture tolerance baseline.

**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)

- Evaluate CO<sub>2</sub> refrigerant, as well as refrigerant + POE and PAG oil at various moisture levels with m coupons in a sealed vessel at elevated temperatures for acid formation, degradation and stability.

### 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) ( )

### 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)

The proposal supports goals #8 and #9 described in the 2010-2018 ASHRAE Strategic Research Plan:

Goal #8: Facilitate use of natural and low global warming potential (GWP) synthetic refrigerants and see methods to reduce refrigerant charge.

- Needed Research Topic #1: Conduct experimental system performance tests on practical equipment designs to assess “real” system performance of various natural and low GWP synthetic refrigerants, and identify design optimizations based on results.
- Needed Research Topic #6: Identify work already done on heat and fluid flow characteristics for low GWP refrigerants and support work to fill in the blanks, viz., with and without lubricants.

Goal #9 Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety

- Needed Research Topic #15: Conduct studies and experiments to fully optimize system performance.

The proposal advances the state of the art for CO<sub>2</sub> refrigeration by creating research based contamination limits and providing insight into contamination issues and effects.

Other stakeholders would include TC’s working with CO<sub>2</sub> products such as 10.1, 10.6 and 10.7, as well as chemistry and contaminants TC’s 3.2 and 3.3

**Anticipated Funding Level and Duration**

Funding Amount Range: \$ 35,000

Duration in Months: 9

**References**

List the key references cited in this RTAR

**Feedback to RAC and Suggested Improvements to RTAR Process**

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