1791 Tullie Circle NE ▪ Atlanta, Georgia 30329-2305 ▪ Tel 678.539.1211 ▪ Fax 678.539.2211 ▪ http://www.ashrae.org

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

mvaughn@ashrae.org

TO: Monroe Shumate, Chair TC 1.8, shumate.monroe@gmail.com
Gordon Hart, Research Subcommittee Chair TC 1.8, gordonhhart@gmail.com
Shinsuke Kato, Research Liaison Section 1.0, kato@iis.u-tokyo.ac.jp

FROM: Michael Vaughn, MORTS, MORTS@ASHRAE.net

DATE: January 23, 2019

SUBJECT: Work Statement (1703-WS), "Performance of Vapor Retarder Systems Used on Mechanical Insulation"

During their recent winter meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted to return with comments.

Below are the issues, concerns, and questions that must be addressed in your next submission of the WS if you choose to resubmit.

1. TC 4.4 listed as co-sponsor however votes are not included. Must have TC 4.4 committee vote.
2. Need to improve the task breakdown and include intermediate deliverables.
3. Revise the test matrix to investigate the size effect.
4. The budget needs to be revised. Budget does not account for the cost of running the environmental chamber for more than 6 month to be able to test all 23 samples!

Please coordinate changes to this Work Statement with your Research Liaison, Shinsuke Kato, kato@iis.u-tokyo.ac.jp or RL1@ashrae.org prior to resubmitting it to the Manager of Research and Technical Services for further consideration by RAC.

Also, it is necessary that you provide a new TC vote on the revised Work Statement, and a letter describing how each of the above items were addressed in the revision.

If you wish for this work statement to be reconsidered at the next RAC meeting, the revised Work Statement must be sent (electronically) to Michael Vaughn, Manager of Research and Technical Services (morts@ashrae.net) by **March 15, 2019**. The next opportunity for consideration after this deadline is May15, 2019.

Project ID	**1703**	
Project Title	**Performance of Vapor Retarder Systems Used on Mechanical Insulation**	
Sponsoring TC	TC 1.8, (Mechanical Systems Insulation); Co-sponsors;TC 4.4, (Building Materials & building Envelope Performance) & TC 10.3, (Refrigerant Piping, Controls, & Accessories)	
Cost / Duration	$50,000 - $70,000 - 8 to 12 M	
Submission History	**2nd WS Submission, WS Returned A17, 2nd RTAR Submission accepted July 2015, - RTAR 1st Sub. REC. 13.05 - Ret. 13.06**	
Classification: Research or Technology Transfer	Basic/Applied Research	
RAC 2019 Winter 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. Is this research topic appropriate for ASHRAE funding? If not, Reject. **RTAR Review Criterion**		**12** - The WS authors have set a very ambitious plan; however their description for the tasks and milestones have certainly crippled the potential impact and benefits to ASHRAE. In my opinion this WS is much needed; however the approach needs to be revised.
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.		**10** - 3 identified. **4** - I see 4.4 is a co sponsor but no vote documented
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** - in my opinion the size of the pipe is an important consideration in mass transfer due to the impact of mass transfer in cylindrical coordinates as well as the size effects in assembly and specimen preparation. Furthermore, it is important to describe the way of holding the desiccant inside the fiberglass insulation - are they going to use a perforated tube? what are the guidance for the perforation? **10** - But many of the issues raised previously by RAC has been rejected or not been addressed, e.g., the effect of the temperature gradients and humidity gradients on the driving potential for moisture permeation. The use of a desiccant pack creates only a humidity gradient. A method needs to be included for accounting for the combined effect of temperature and humidity gradients, or on how to correct for the effect of a temperature gradient on test results obtained through a humidity gradient alone. (the water vapor pressure at 40F is 0.12 psia and at 90F it is 0.70 psia -- a big difference). **4** - Title missing on WS. The project description is clear and detailed and includes a proposed test method.
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** - There is no correlation between the Task Breakdown and the Milestones - this is quite important: while the milestones mention literature review as the first milestone - there is no mention of it in the task breakdown! Furthermore, the task breakdown doesn't mention any quality assurance. **10** - The WS provides detailed description of the work to be done, but lists 7 task titles with no details of the work to be performed under each task. The authors should restructure this section so some of the detailed narrative included in the description of the scope be included under the tasks, including expected task deliverables. A matrix of the VR system configurations is included as an appendix. **13** - I have several concerns with this . **4**- Task breakdown provided and it is logical.
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** - not mentioned in the deliverables section - however there are reasonable intermediate milestones. **10** - The deliverables listed are project reports to be delivered at end of project. **CW** - Intermediate deliverables are not defined. **4** - However they are not directly, but indirectly tied to tasks. Better alignment to the task would provide a better alignment to mile stones
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.		**10** - After revising the WS to address Task Breakdown and Intermediate Deliverables. **13** - I am not an expert regarding ASTM E96, but I have some concerns regarding the test procedures. The contractor is to prepare multiple cylindrical insulation systems with a desiccant inside the cylindrical void space and place the specimens in an environmental chamber. It was suggested that the test period may be several months duration, but multiple specimens can be tested at once. If the desiccant becomes saturated, it will no longer provide the virtual 0% RH boundary condition and that test would probably have to be repeated. I can envision many repeated tests if the permeability of the system is significantly different from the permeability rating of the components. You are asking a contractor to develop a new test procedure, but do not include any sort of calibration requirements for this new test apparatus and procedures. I would suggest specifying a calibration test using a material with well characterized permeability properties so the results can be trusted. Finally, requiring a TC member to physically inspect the VR system specimens before they can be tested could become a logistical nightmare for a contractor if the test specimens are prepared over multiple weeks or months.
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** - the suggested time is reasonable - however the cost is not; it didn't account for the cost of running the environmental chamber for more than 6 month to be able to test all 23 samples! **10** - Not sure if the $ and duration are sufficient for this scope of work. **4** - These tests are not hard, only the assembly integrity will be an art as mentioned by the authors. I have done similar work on individual materials.
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.		**10** - After revising the WS to address Task Breakdown and Intermediate Deliverables. **13** - The WS says that a matrix of component combinations will be developed by the PMS. A bidder would not be able to budget time and effort without knowing this matrix and the number of samples that the PMS will require.
Decision Options	**Initial Decision**	**Final Approval Conditions**
ACCEPT		**12** - need to improve the task breakdown; include intermediate deliverables; revise the test matrix to investigate the size effect; and revise the project cost accordingly. **10** - Title is missing from WS form. TC4.4 listed as cosponsor but TC4.4 votes not included. There are a few typos that need to be corrected. Need to revise the scope to provide task breakdown details and include intermediate task deliverables. It appears that the authors rejected or did not address many of the comments and issues raised previously by RAC. **5** - Correct weighting for PES evaluation of bids, need a revision of Proposal evaluation criterial #3, #4, and #5. Remove "conscientious". Revise "Orderly, clean" facility.; revise "level of effort to remove "sophisticated equipment or instrumentation should not be required". **13** - The test matrix needs to be included in the work statement so the bidders know the scope of required tests. This new test procedure needs to have some additional calibration test requirements so the measured results can be trusted. VR materials are listed and said to be applied according to manufacturer's instructions. It may be appropriate to be more specific regarding thicknesses and certain other properties since manufacturer directions may not be specific if the product is to be used in a wide variety of applications. **7** - The TC has clearly made significant effort to address previous comments but I am still not seeing a clear justification or application for the work. The authors state that is research is NOT intended to support development of improved products but rather to establish performance of existing products as systems rather than as individual components. **4** - I would like to see more alignment (similar wording) between the tasks and the milestones. Also the description of the tasks should be better aligned and more detail. This project does not seem to contain any definite go/no-go stages to the milestones. I am not asking there be some, just an observation
COND. ACCEPT		
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: November 6, 2018

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

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

Title:
Performance of Vapor Retarder Systems Used on Mechanical Insulation

WS# 1703
(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:
Fundamentals, Chapter 23; Refrigeration, Chapter 10

Responsible TC/TG: 1.8 Mechanical Systems Insulation

Date of Vote: January 30, 2017

For		9
Against	*	0
Abstaining	*	0
Absent or not returning Ballot	*	0
Total Voting Members		9

This W/S has been coordinated with TC/TG/SSPC (give vote and date):
TC 10.3/April 27, 2017: 10 For/0 Against/0 Abstain/1 no vote

Has RTAR been submitted?
Strategic Plan
Theme/Goals
Yes- "Navigation for a Sustainable Future" Goal 1: Maximize the actual operational energy performance of buildings and facilities; Goal 9: Support the development of improved HVAC&R components ranging from

Work Statement Authors: **
Charles Petty-Lead
Jim Young
Gordon Hart

Proposal Evaluation Subcommittee:
Chair: TBD
Members:
W. Brayman G. Hart C. Petty M. Shumate J. Young

Project Monitoring Subcommittee:
(If different from Proposal Evaluation Subcommittee)
Same as PES

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

R&D Services
102 Mill Drive
Cookeville, TN 38501
(931) 372-8871
Stuart Ruis
Stuart@rdservices.com

PRI Construction Materials Technologies LLC
6412 Badger Drive
Tampa, FL 33610

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

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

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

* Reasons for negative vote(s) and abstentions

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

WORK STATEMENT# 1703

Title:

Sponsoring TC/TG/MTG/SSPC:

1.8, Mechanical Systems Insulation

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

4.4, Building Materials & building Envelope Performance
10.3, Refrigerant Piping, Controls, & Accessories

Executive Summary:

Preventing the passage of moisture in ambient air into the insulation of mechanical piping and equipment operating at below ambient temperature is critical in assuring the long-term function of the insulation and service life of the piping and equipment. The performance of vapor-retarding products (system components) such as flexible vapor retarders, tapes and mastics is verified and published as technical data by manufacturers. However, the performance of these component products together as a system has not been tested and therefore system performance data is not available to the designer.

It is the aim of this project to develop this vapor retarder system performance data to make it available to designers of insulation for mechanical systems operating at below ambient temperatures. The system performance data obtained will make it possible to predict the water gain over time, and therefore the life expectancy, of the insulation system based on the rate of moisture vapor passage through an installed vapor retarder system. Water vapor migration and condensation in mechanical insulation on below ambient surfaces can particularly be a problem when located in unconditioned spaces for long durations, i.e., up to twenty-five years.

The theme of the ASHRAE Research Strategic Plan (RSP) is “Navigation for a Sustainable Future”. Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the equation for sustainability and energy efficiency. In the context of the RSP, this research project aligns well with two of the goals- Goal 1: Maximize the actual operational energy performance of buildings and facilities, and Goal 9: Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety.

This research is directly related to sustainability in the context of maintaining the efficiency, and assuring the longevity, of thermal insulation systems. Insulation of new mechanical systems provides an immediate, significant energy efficiency boost and very quick payback. Minimizing moisture ingress into the system to offset or negate the energy efficiency gains is critical in efforts to achieve ever-higher levels of sustainability.

The results of this research will be included in Fundamentals Chapter 23, Mechanical Systems Insulation. and in Refrigeration Chapter 10, Insulation Systems for Refrigerant Piping. A research report will generated and presented at a future ASHRAE conference.

The ultimate application of the results will be in the design and installation of the vapor retarder system to help assure optimum performance and longevity of the mechanical insulation system of which it is a part. The results should confirm what materials and methods work best and which may have shortcomings. Applying this knowledge, designers can make informed decisions on the preferred systems to be employed, based on demonstrated test performance.

Applicability to the ASHRAE Research Strategic Plan:

The theme of the ASHRAE Research Strategic Plan (RSP) is “Navigation for a Sustainable Future”. Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the equation for sustainability and energy efficiency. In the context of the RSP, this research project aligns well with two of the goals- Goal 1: Maximize the actual operational energy performance of buildings and facilities, and Goal 9: Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety.

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Application of Results:

The results of this research will be included in Fundamentals Chapter 23, Mechanical Systems Insulation. and in Refrigeration Chapter 10, Insulation Systems for Refrigerant Piping. A research report will generated and presented at a future ASHRAE conference.

The ultimate application of the results will be in the design and installation of the vapor retarder system to help assure optimum performance and longevity of the mechanical insulation system of which it is a part. The results should confirm what materials and methods work best and which may have shortcomings. Applying this knowledge, designers can make informed decisions on the preferred systems to be employed, based on demonstrated test performance.

State-of-the-Art (Background):

Failures occur in chilled water and other below-ambient piping systems due to the passage of water vapor through the vapor retarder system that covers the insulation on the pipe and the resultant condensation that forms on the pipe and in the insulation. Papers documenting problems and failures apparently due to vapor retarder system shortcomings have been published [1,2]. The performance of the materials used in the vapor retarder system is tested and available to designers and specifiers; [3-13] however, quantified performance of the total system that utilizes these materials in combination is not published. To the knowledge of TC 1.8 members, there has been no research or testing done in this area that is available in the public domain.

Many materials are available that are excellent vapor retarders, or "vapor barriers", but tests to date only show performance of the individual materials. However, these products are never used by themselves; they are always joined or sealed to other materials to form what is intended to be a vapor-tight system. To the knowledge of our Technical Committee, there is no data available that represents how the total system made up of these various materials, joints and seals performs. These materials include flexible sheet vapor retarder/barriers, tapes for overlap and butt joints, mastics, adhesives and sealants. While designers may be satisfied that the materials themselves provide excellent vapor retarding performance, it is known that moisture can intrude into below-ambient systems in sufficient quantities to cause loss of efficiency, damage and failures.

Simply, there is a major unknown in these installed vapor retarder systems, that being how much moisture vapor is passing through various types of joints and seals that are present in large numbers in such systems. Quantifying the rate of moisture ingress into installed vapor retarder systems and understanding where and how the significant breaches occur is an undertaking that needs to be initiated by independent testing such as is proposed here. The performance difference between VR materials and systems is related almost exclusively to how the joints between similar or dissimilar materials are sealed. Much manufacturer data exists on the performance of homogeneous VR

Advancement to the State-of-the-Art:

The data for system performance that will be obtained is not available in the public domain. This does not extend previously conducted research, but rather is establishing a baseline or foundation. The proposed research project would establish an initial database of vapor retarder system performance. Expected outputs are new or revised recommendations for vapor retarder joint sealing methods, and VR system performance. Quantifiable assessment of performance is critical in being able to measure, and predict performance and advance vapor retarder system technology.

Justification and Value to ASHRAE:

The primary output will be to provide published reference information in Chapter 23 of the Fundamentals HB and Chapter 10 of the Refrigeration HB that provides guidance in how to minimize or eliminate moisture transfer in below-ambient mechanical insulation systems, where it is a constant and harmful phenomenon. The type of VR system failures which this research relates to are a huge problem for specifiers and owners of cold piping and equipment systems. Research into this issue and publication/presentation of the results by ASHRAE will directly benefit ASHRAE members and make the ASHRAE handbooks even more valuable.

It will provide base data to those engineers and specifiers involved in the design of mechanical systems insulation so that compromises in insulation performance and costly failures are avoided in the operation of below-ambient piping and equipment. The results from the proposed research would indicate which commonly used VR joint sealing methods work and which do not work, which VR materials have joints which can be sealed and how and which VR materials have joints that are difficult to seal. These results will also yield a test methodology that can be used to investigate the performance of new VR systems and joint sealing methods developed in the future.

Advancing, if not establishing, the knowledge base of the dynamics of moisture intrusion in below-ambient mechanical systems insulation is critical to improving efficiency and longevity of the equipment and piping, which is sometimes lost in the focus on the equipment itself. This research will be of benefit to users of ASHRAE 90.1 [17] who are designing mechanical systems for compliance.

To repeat, the theme of the ASHRAE Research Strategic Plan (RSP) is “Navigation for a Sustainable Future”. Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the discussion on sustainability and energy efficiency. In the context of the RSP, this research project aligns well with two of the goals:

Goal 1: Maximize the actual operational energy performance of buildings and facilities.

Objectives:

Develop a reliable test method for evaluating water vapor transmission of vapor retarder systems that is based on a configuration that approaches actual installations. Current standard methods are intended for, and typically only accommodate, singular materials. These tests do not lend themselves to testing combinations of two or more components, nor does the specimen preparation mimic real-world applications. The test should be based on a pipe insulation configuration.

Determine the water vapor permeance performance of various combinations of vapor retarder, sealing material, and method- i.e., "the system"- both commonly used and of interest due to potential performance advantages.

Obtain data that will be presented and discussed, with conclusions and recommendations, in the Mechanical Insulation chapter of the Fundamentals Handbook. Similar content could be included, and at the very least will be referenced, in the Insulation Systems for Refrigerant Piping chapter of the Refrigeration Handbook.

Scope/Technical Approach:

The systems to be studied will include vapor retarder components and insulation materials used on pipes and equipment that operate at below ambient temperatures.

Water vapor permeance (derived from water vapor transmission) testing is the basis of the project. A high vapor pressure differential between sides of the systems being tested must be induced, and a specimen configuration large enough to accommodate sealed joints must be employed.

The project will involve testing pipe insulation on a small-scale basis, and will include both longitudinal and circumferential joints. Also included will be sealed junctions (such as encountered at tees and els) and sealed penetrations (such as at probes) that, if not exactly duplicating actual field installation, will closely represent the type of sealing methods employed. In concept, a test specimen will consist of pipe insulation of specified inside diameter, outside diameter, and length. The specimen, in addition to the base insulation, will include the vapor retarder, joint sealing tape and mastic in various combinations. Assembly technique will be as close as possible to field practice.

Specimens will encompass a sampling of vapor retarders, tapes, mastics, insulation and techniques. A sealed cylindrical specimen will contain a mass of desiccant in the inner void of the insulation, and will be placed in an environmental chamber running at probably 90F and 90 percent RH; essentially an ASTM E96 test in cylindrical form. A given test could run one to two months, but could be shorter if permeance is high. Fortunately, many specimens can be tested simultaneously so this lengthy duration for one test is not a major problem.

While the sole purpose of this testing relates to moisture intrusion into systems operating below ambient, the test will be isothermal in that there will be no temperature differential between the test chamber conditions and the internal void of the insulation (where in actual application, the cold pipe would reside). However, the desiccant pack in the void will produce a virtual 0% RH condition, and hence a strong vapor drive into the insulation, equal to actual cold system applications, will be duplicated.

It is envisioned that the basic test specimen will be a piece of pipe insulation eighteen inches long and nominally six inches in outside diameter. The different system configurations will include:

Longitudinal seam only in the sheet vapor retarder
Longitudinal and butt tape joint in the sheet vapor retarder
Simulated fitting/penetration treatment with appropriate sealant coating or other appropriate sealing at joint and termination

Vapor retarder types:
ASJ (All Service Jacket)
PVdC (PolyVinylideneChloride)
PFP (Poly-Foil-Poly) zero permeance
Laminate jacketing
PVC (Polyvinylchloride), as outer cover

Pressure sensitive tapes:
Most commonly used/recommended tapes

Vapor retarder coating/sealant ("mastic"):
Most commonly used/recommended coating

Base insulation:

Fiberglass pipe insulation

Scope/Technical Approach (Continued 2):

A matrix of component combinations that duplicates common systems will be provided, and those combinations will be tested. The matrix accompanies and forms part of this WS but the PMS will be able to change the makeup of this matrix to some small degree at their discretion.

The PMS will direct the investigator as to the specific products to be procured for the study. If necessary, it can advise of the type of outlet from which to procure them, but will not participate in said procurement.

3 ft. long Insulation sections would be placed over a supported pipe whose OD matches the ID of the insulation sections. Seam and joint sealing would be done on the pipe and allowed to stabilize or dry as necessary, then carefully cut to test specimen length and removed by sliding off pipe for testing.

The test sections will be prepared per manufacturers instructions for the products being evaluated.
A person from the TC who is knowledgable in the correct installation of the products will supervise/approve the preparation.

Three specimens per test configuration are to be tested.

The test to be employed will use elements of ASTM E96, Standard Test Method for Water Vapor Transmission of Materials and European Standard EN 13469, Determination of Water Vapor Properties of Preformed Pipe Insulation. However, as neither of these test methods exactly fits the objectives of the project, a new test method will have to be developed by the contractor as part of this project.

It is critical that non-test seals at end caps be totally water vapor impermeable. It is anticipated that a suitable wax or wax blend, as is typically used in ASTM E 96, or silicone sealant would be used to make these seals.

Project Tasks/Intermediate Milestones:

1. Develop proposed test method
2. Construct test apparatus and validate test method
3. Prepare test specimens
4. Conduct testing
5. Evaluate test results
6. Re-test where necessary due to questionable result
7. Issue report

The PMS will review the above as milestones prior to contractor proceeding to subsequent task.

Scope/Technical Approach (Continued 3):

This page not used.

Deliverables/Where Results Will Be Published:

A research report providing all requisite information on equipment, method, test data, observations and any other relevant information will be provided by the contractor.

The primary results to be delivered will be the permeance of each of the tested vapor retarder system configurations, with full description of those configurations.

Results will be published as a research report.
Results will be discussed/presented in Chapter 23 of Fundamentals HB.
Results will be discussed/referenced in Chapter 25, 26, or 27 as appropriate and Chapter 10 of Refrigeration HB.

A defined method of test, or guidelines on application of existing test method(s) will be derived from the research.

Guidance & recommendations applicable to Vapor Retarder systems design and installation will be derived from the research.

A presentation on the research project will be given at an ASHRAE technical conference.

Deliverables/Where Results Will Be Published (Continued):

This page not used.

Level of Effort:

The methodology that is envisioned to be employed in this project is not thought to be complex. Sophisticated equipment or instrumentation should not be required. Reasonable replication of actual field installation and impermeable sealing of end caps are critical. Sample preparation will be the most challenging and labor-intensive aspect. Although seemingly simple, making the impermeable seals can be somewhat of an art.

Project Duration in Months: 8-12, including report generation
Professional-Months, Principal Investigator: 1
Professional-Months, total: 2
Estimated $ Value: $50,000-$70,000

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	Experience in water vapor transmission testing of very low permeance materials, at a minimum utilizing ASTM E96 and, preferably, EN 13469	25
2	Availability of accurate, reliable environmental chamber and appropriate balance	25
3	Qualified, capable, conscientious personnel	25
4	Client references, and example(s) of completed report(s)	15
5	Orderly, clean facility	10

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Literature review	1
2	Demonstration of ability to make test specimens with non-leaking end caps	3
3	Preparation of satisfactory test specimens- (a) assembly of vapor retarder system insulation sections and (b) assembly of finished specimens for exposure in chamber	5

Authors:

Charles Petty-Lead
Jim Young
Gordon Hart

References:

Published papers:

[1] "Prevention of Condensation Problems on Insulated Chilled Water Pipes Located in Unconditioned Spaces in Hot, Humid Climates"; G. Hart, ASHRAE seminar June 2011, Montreal
[2] "Case Study: "Economic Justification for Replacing Ice-laden Refrigerant Pipe Thermal Insulation with New Insulation" G. Hart, IIAR Meeting Technical Paper June 2015, San Diego

Manufacturers' Data:
Product data sheets (available on manufacturers' websites)*:

[3] Lamtec WMP-ASJ vapor retarder
[4] Lamtec R-3035 vapor retarder
[5] Lamtec 30J vapor retarder
[6] 3M/Venture 1540CW ASJ insulation tape
[7] 3M/Venture VentureClad 1577 CW insulation cladding
[8] Foster C.I. mastic 30-25
[9] Foster 62-05 vapor barrier jacketing
[10] Avery Fasson Fas-Clad insulation cladding
[11] Avery Fasson 0839 WMP-ASJ tape
[12] ITW SARAN 560-CX vapor retarder tape
[13] ITW SARAN 540-CX vapor retarder

ASHRAE Research:
[14] RP 1646
[15] RP 1356

Other Research:

[16] NAIMA-contracted Cold Pipe Test Project; reported in September 2001 Insulation Outlook

ASHRAE Standards:
[17] 90.1

* Many other products, made by these and other manufacturers, are available for mechanical insulation as well. All of these data sheets cite the permeance of the product itself. None cite performance of the product in conjunction with other vapor retarder system components, such as those used in combination at joints, fittings and penetrations. T.C. 1.8 is not aware of where such information is obtainable, either as manufacturer's data, in standards, or in research reports.

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.

RP 1703 PROPOSED MATRIX OF VAPOR RETARER SYSTEM CONFIGURATIONS (23 sets of 3 tests and 1 "dummy" = 92 total specimens) Re-dated 11-6-18

	SERIES	TEST	VAPOR RETARDER	LONGITUDINAL OVERLAP SEAM	BUTT JOINT SEAM	FITTING REPLICATION	TEST NOTES
1	A	1	Conventional ASJ	SSL	None	None	
2		2	"Next Gen" ASJ	SSL			
3		3	PVdC	SSL			
4		4	PFP (zero permeance (PET/1 mil foil/PET)	SSL			
5		5	Self-adhering Laminate Jacket (C1775)	Self-overlap			
6	B	1	Conventional ASJ	SSL	ASJ tape	None	
7		2	"Next Gen" ASJ	SSL	ASJ tape		
8		3	"Next Gen" ASJ with PVC outer jacket	SSL	ASJ tape		#3- Use two pieces PVC with solvent weld longitudinal and circumferential joints
9		4	PVdC	SSL	PVdC tape		
10		5	PFP (zero permeance (PET/1 mil foil/PET)	SSL	PFP tape		
11		6	Self-adhering Laminate Jacket (C1775)	Self-overlap	Matching tape		
12	C	1	Conventional ASJ	SSL	None	Incorporate a segment of test pipe with straight PVC cover material with most common VR (underneath) and cover seal and with common joint treatment at transition from vapor retarder to cover. Length of PVC covered segment to be 1/3 of total pipe test section length.	All-use PVC tape to seal PVC cover to vapor retarder
13		2	"Next Gen" ASJ	SSL			
14		3	PVdC	SSL			
15		4	PFP (zero permeance (PET/1 mil foil/PET)	SSL			
16	D	1	Conventional ASJ	SSL	None	Incorporate a segment of test pipe with straight PVC cover material with most common VR (underneath) and cover seal, with common alternative joint treatment at transition from vapor retarder to cover. Length of PVC covered center segment to be 1/3 of total pipe test section length.	All- use coating to seal PVC cover to vapor retarder
17		2	"Next Gen" ASJ	SSL			
18		3	PVdC	SSL			
19		4	PFP (zero permeance (PET/1 mil foil/PET)	SSL			
20	E	1	"Next Gen" ASJ	SSL	None	Incorporate a segment of test pipe with fab & VR mastic coating. Length of fab & mastic coated center segment to be 1/3 of total pipe test section length.	No transition joint; full center segment all fab & mastic
21		2	PVdC	SSL			
22		3	PFP (zero permeance (PET/1 mil foil/PET)	SSL			
23	F	1	Self-adhering Laminate Jacket (C1775)	Self-overlap	None	Incorporate a segment of test pipe with spiral-wrapped laminate jacketing. Length of wrapped center section to be 1/3 of total pipe test section length.	

COMMENTS RECEIVED AFTER RAC REVIEW AND RETURN JULY 19, 2017 and CO-AUTHOR RESPONSES of NOVEMBER 6, 2018	
ART GEISLER GUIDANCE	
Verbal input	Comments in the review spread sheet are to be considered and addressed, as well as the cover letter points.
COVER LETTER	
"Issues, concerns, and questions that must be addressed in your next submission of the WS if you choose to resubmit."	1. Clarification needed whether guidelines for ambient conditions, or if more about design? If we understand the question, this project is about vapor retarder system design, not "guidelines for ambient conditions". The project utilizes extreme ambient conditions – chosen to provide high water vapor drive and challenge the vapor retarder system. While the performance of individual vapor retarder materials is well documented, the industry lacks an understanding of the vapor retarder system that includes the vapor retarder, joints, closures, terminations, and seals between similar and dissimilar materials. The output from this project will be vital to the engineer/specifier in their design of the vapor retarder system. 2. Specify which of two issues will help designers. We do not understand this question. What two issues are being asked about? The word "issue" is only used once in the work statement and does not appear to be related to the question: "The type of VR system failures which this research relates to are a huge problem for specifiers and owners of cold piping and equipment systems. Research into this issue and publication/presentation of the results by ASHRAE will directly benefit ASHRAE members and make the ASHRAE handbooks even more valuable." 3. At least two experiments needed. The work statement as submitted proposes multiple experiments as described in the Scope/Technical Approach section, so we do not understand this requirement. Explanation is requested. 4. Include systematic review of practical application issues with vapor retarder systems. Researchers should include study of at least one of the solutions to these problems. The scope of this work statement does not involve examining the performance of improperly installed vapor retarder systems or use of improper materials, i.e., "application issues". Rather, the intent is to test the performance of vapor retarder systems including joints, closures, terminations, and seals between similar and dissimilar materials – information that to date is not available in the public domain - to establish a reference resource or guide for designers. Systematic review of practical application issues is outside the scope of this work statement, as is exploration of solutions to these issues.
CRITERION	**RAC REVIEW 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.	No comments
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.	#11- In the project summary, the WS authors refer to the existence of a European test method that mirrors the proposed test method, yet there is no mention in the rest of the document about that European test method and its applicability to the present project. If a European test method exists, why not just adopt it? It is our intent to use it, as indicated in the Technical Approach section. As neither of these test methods exactly fits the objectives of the project, a new test method will have to be developed by the contractor as part of this project. #13 - It is not clear what advancement will result from this project. Is the goal to develop better tapes or better methods to apply tapes? Objective is not clear. How do ambient conditions affect efficacy of joint installation? Dust? Humidity? Goal not to develop better products; goal is to determine performance of existing products installed as vapor retarder systems, to include all common sealing methods. Good question, but objective here is to establish baseline data and is not intended to explore variation in installation conditions. Such exploration is of importance and could be undertaken in a subsequent research project using the test method developed in this project.
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	No comments
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- but only 3 proposed. ASHRAE requires identification of three bidders, which was provided in WS. There are undoubtledly other potential bidders, and nothing in the WS precludes bidding by other contractors. #11 - 3 potential bidders identified. #7 Three bidders provided.
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, then the WS needs major revision.	#12 -I am fundamentally uncomfortable with the approach proposed. The WS authors assert that the principal vapor-retarding issues are joints and seams, particularly involving dissimilar materials. It would seem that that first task should be a field study large enough to what fails, and under what conditions (including time to failure). This could be bid, perhaps by engineering firm working with a large system owner (e.g., groceries) or large servicing mechanical contractor. The product of such a project would be descriptions and illustrations of best and worst practices. A second, sequential, project would be the development of an actual method of test and proposed standard for jointing methods. This might even be segmented by service class, much like the SMACNA duct leakage classes - I'd want a better installation for my very cold industrial process (gas liquefying, frozen food prep,...) than for chilled water piping in buildings. Such research products will be vastly more used and useful than the proposed report and additions to Handbook data tables. What the commenter proposes is a very different and valuable project, but one which could be done in follow-up to this WS. The performance of individual vapor retarder materials free of joints and seams is well known and addressed by manufacturer testing. What is not known and what is proposed in this work statement is the performance of these materials when joints and seams are present in their installed geometry. Measuring the performance of installed systems would benefit the designer and the design process, by helping assure that appropriate components and joint sealing methods are employed. #11 - Again, in the Summary there is reference to a European test method that is applicable to this project but there is no mention of this European method in the rest of the document. It is our intent to use it, as indicated in the Technical Approach section. As neither of these test methods exactly fits the objectives of the project, a new test method will have to be developed by the contractor as part of this project. Also, in the approach, the authors mention that the test will be done under isothermal conditions where the temperature of the insulation is the same as the ambient, while the motivation for the work is all based on insulation of pipes and components that are below ambient. The WS states that a desiccant pack will be used to create the driving gradient for moisture permeation. Does this approach emulate real applications where moisture and temperature gradients are coupled? While it would be ideal to employ temperature and humidity gradients, temperature gradients are extremely difficult to implement, as sophisticated constant low temperature refrigeration systems are required. The WS authors believe that this approach does emulate the vapor drive induced in real applications even though permeation is induced solely by differences in relative humidity. This approach of not having a temperature gradient is the standard methodology of ASTM E96 and EN 13469. Also, since failure of the insulation due to moisture penetration also depends on workmanship, it is not clear whether the reported failures of insulation in actual installations are due to poor workmanship or just the fact that multiple components are used (VR, Sealants, Tape...etc.) without reliable characterization of their combined effects. Will properly applied VR, joints, eals, tape, etc.) still cause problems or diminish the effectiveness of VR? While certainly workmanship is a critical element, we must first establish a baseline of joint seal performance under controlled conditions before the impact of workmanship can be determined. A research project to study workmanship could be a valuable next step. #7 - Technically correct, but this sounds like product testing. Is this an appropriate activity for ASHRAE? What seems to be needed is a Method of Test. Product testing has already been done by the manufacturers. This is not product testing; rather this is testing the performance of joints and seals between system components. We agree that a test method that addresses joints and seals is needed, and that is an objective of this project.
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 - None, just milestones. #11- There is a narrative with many details built no task breakdown. Task list added to WS. #7- Development of a method of test is usually a process in an of itself, and requires consensus. The work proposed here seems to involve development of a test method by the contractor (albeit based on "elements" of some existing MOTs), coupled with testing of commercially-available products. Not testing products.... But even if the proposed project were to be acceptable, it does not contain a clear breakdown of the tasks involved, nor are there any intermediate milestones. Task list added to WS. We believe that the major milestones as listed are adequate.
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.	#7 - No intermediate milestones that I can see. Added in Technical Approach section.
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.	#12 -But of marginal utility as structured. We believe that revisions made to the WS provide clarity to the utility of project.
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 -seems reasonable, no experience bidding this type of work
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.	#12 -I'm all for customizing bid evaluation criteria to emphasize what is important for a particular project, but the criteria proposed feel under-specified and have very unusual weightings. We reviewed these, and believe the criteria and weighting are appropriate and reasonable. #11 - Need to address the issues raised above. #9- The WS needs to be re=written to include task to be accomplished, review and approval to proceed by the PMS. We have made revisions to the Technical Approach section to address these points. Suggest the authors review the Research Manual discussion on tasks.
RAC VOTE: RETURN > WS requires major revision before it can bid	#12 - It does not appear that the authors have much experience specifying a research request for proposals, or looking for the most important paths to get to the most useful results. We believe we have addressed this concern through revisions made to WS. #13 - I do not feel that the justification, in terms of advancement of the state of the art, has been established. We have addressed with revisions to the WS. Tasks are also not well defined regarding number of tests, facility required. WS revised to include number of specimens per test. Facility criteria are listed in WS Proposal Evaluation Criteria. #7- No intermediate milestones that I can see. Have been added in revision. #9-This appears to be a worthy project. Make sure someone from 10.3 is included in the PES/PMS. One of the co-authors is a 10.3 member and will be part of the PMS. Also, authors need to follow the procedures discussed in the Research Manual regarding tasks.

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1791 Tullie Circle NE ▪ Atlanta, Georgia 30329-2305 ▪ Tel 678.539.1211 ▪ Fax 678.539.2211 ▪ http://www.ashrae.org

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

TO: Willis Brayman, Chair TC 1.8, brayman.bicllc@att.net
Andre Desjarlais, Research Subcommittee Chair TC 1.8, desjarlaisa@ornl.gov
Charles Petty, Jim Young, Gordon Hart, Work Statement Author(s), gordon.hart@artekengineering.com; gordon.hart@artekengineering.com; pettycharlie@lamtec.com

FROM: Michael Vaughn, Manager of Research and Technical Services (MORTS)

CC: Shinsuke Kato, Research Liaison 1.0, kato@iis.u-tokyo.ac.jp

DATE: July 19, 2017

SUBJECT: Work Statement (1703-WS), "Performance of Vapor Retarder Systems Used on Mechanical Insulation"

During their recent Annual meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted to return with comments.

Below are the issues, concerns, and questions that must be addressed in your next submission of the WS if you choose to resubmit.

1. Clarification needed whether guidelines for ambient conditions, or if more about design?
2. Specify which of two issues will help designers.
3. At least two experiments needed.
4. Include systematic review of practical application issues with vapor retarder systems. Researchers should include study of at least one of the solutions to these problems.

Please coordinate changes to this Work Statement with your Research Liaison, Shinsuke Kato, RL1@ashrae.net or kato@iis.u-tokyo.ac.jp prior to resubmitting it to the Manager of Research and Technical Services for further consideration by RAC.

Also, it is necessary that you provide a new TC vote on the revised Work Statement, and a letter describing how each of the above items were addressed in the revision.

If you wish for this work statement to be reconsidered at the next RAC meeting, the revised Work Statement must be sent (electronically) to Michael Vaughn, Manager of Research and Technical Services (morts@ashrae.net) by August 15, 2017. The next opportunity for consideration after this deadline is December 15, 2017 or consideration at RAC's 2018 winter meeting.

Project ID	**1703**	
Project Title	**Performance of Vapor Retarder Systems Used on Mechanical Insulation**	
Sponsoring TC	TC 1.8, (Mechanical Systems Insulation)	
Cost / Duration	$50,000 -$70,000/ 2M	
Submission History	**1st WS Submission, 2nd RTAR Submission accepted July 2015, - RTAR 1st Sub. REC. 13.05 - Ret. 13.06**	
Classification: Research or Technology Transfer	Basic/Applied Research	
RAC 2017 Annual 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**		**#11**- In the project summary, the WS authors refer to the existence of a European test method that mirrors the proposed test method, yet there is no mention in the rest of the document about that European test method and its applicability to the present project. If a European test method exists, why not just adopt it? **#13** - It is not clear what advancement will result from this project. Is the goal to develop better tapes or better methods to apply tapes? Objective is not clear. How do ambient conditions affect efficacy of joint installation? Dust? Humidity?
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**- but only 3 proposed. I bet there are a lot of folks who can do this well. **#11** - 3 potential bidders identified. **#7** Three bidders provided.
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 -**I'm fundamentally uncomfortable with the approach proposed. The WS authors assert that the principal vapor-retarding issues are joints and seams, particularly involving dissimilar materials. It would seem that that first task should be a field study large enough to what fails, and under what conditions (including time to failure). This could be bid, perhaps by engineering firm working with a large system owner (e.g., groceries) or large servicing mechanical contractor. The product of such a project would be descriptions and illustrations of best and worst practices. A second, sequential, project would be the development of an actual method of test and proposed standard for jointing methods. This might even be segmented by service class, much like the SMACNA duct leakage classes - I'd want a better installation for my very cold industrial process (gas liquefying, frozen food prep,...) than for chilled water piping in buildings. Such research products will be vastly more used and useful than the proposed report and additions to Handbook data tables. **#11** - Again, in the Summary there is reference to a European test method that is applicable to this project but there is no mention of this European method in the rest of the document. Also, in the approach, the authors mention that the test will be done under isothermal conditions where the temperature of the insulation is the same as the ambient, while the motivation for the work is all based on insulation of pipes and components that are below ambient. The WS states that a desiccant pack will be used to create the driving gradient for moisture permeation. Does this approach emulate real applications where moisture and temperature gradients are coupled? Also, since failure of the insulation due to moisture penetration also depend on workmanship, it is not clear whether the reported failures of insulation in actual installations are due to poor workmanship or just the fact that multiple components are used (VR, Sealants, Tape...etc.) without reliable characterization of their combined effects. Will properly applied VR, joints, eals, tape, etc.) still cause problems or diminish the effectiveness of VR? **#7** - Technically correct, but this sounds like product testing. Is this an appropriate activity for ASHRAE? What seems to be needed is a Method of Test.
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 -** None, just milestones. **#11**- There is a narrative with many details built no task breakdown. **#7**- Development of a method of test is usually a process in an of itself, and requires consensus. The work proposed here seems to involve development of a test method by the contractor (albeit based on "elements" of some existing MOTs), coupled with testing of commercially-available products. But even if the proposed project were to be acceptable, it does not contain a clear breakdown of the tasks involved, nor are there any intermediate milestones.
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.		**#7 -** No intermediate milestones that I can see.
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.		**#12 -**But of marginal utility as structured.
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 -**seems reasonable, no experience bidding this type of work
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.		**#12 -**I'm all for customizing bid evaluation criteria to emphasize what is important for a particular project, but the criteria proposed feel under-specified and have very unusual weightings. **#11** - Need to address the issues raised above. **#9**- The WS needs to be re=written to include task to be accomplished, review and approval to proceed by the PMS. Suggest the authors review the Research Manual discussion on tasks.
Decision Options	**Initial Decision**	**Final Approval Conditions**
ACCEPT		**#12** - It does not appear that the authors have much experience specifying a research request for proposals, or looking for the most important paths to get to the most useful results. **#13** - I do not feel that the justification, in terms of advancement of the state of the art, has been established. Tasks are also not well defined regarding number of tests, facility required. **#7**- No intermediate milestones that I can see. **#9**-This appears to be a worthy project. Make sure someone from 10.3 is included in the PES/PMS. Also, authors need to follow the procedures discussed in the Research Manual regarding tasks.
COND. ACCEPT		
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: November 6, 2018

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

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

Title:
Performance of Vapor Retarder Systems Used on Mechanical Insulation

WS# 1703
(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:
Fundamentals, Chapter 23; Refrigeration, Chapter 10

Responsible TC/TG: 1.8 Mechanical Systems Insulation

Date of Vote: January 30, 2017

For		9
Against	*	0
Abstaining	*	0
Absent or not returning Ballot	*	0
Total Voting Members		9

This W/S has been coordinated with TC/TG/SSPC (give vote and date):
TC 10.3/April 27, 2017: 10 For/0 Against/0 Abstain/1 no vote

Has RTAR been submitted?
Strategic Plan
Theme/Goals
Yes- "Navigation for a Sustainable Future" Goal 1: Maximize the actual operational energy performance of buildings and facilities; Goal 9: Support the development of improved HVAC&R components ranging from

Work Statement Authors: **
Charles Petty-Lead
Jim Young
Gordon Hart

Proposal Evaluation Subcommittee:
Chair: TBD
Members:
W. Brayman G. Hart C. Petty M. Shumate J. Young

Project Monitoring Subcommittee:
(If different from Proposal Evaluation Subcommittee)
Same as PES

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

R&D Services
102 Mill Drive
Cookeville, TN 38501
(931) 372-8871
Stuart Ruis
Stuart@rdservices.com

PRI Construction Materials Technologies LLC
6412 Badger Drive
Tampa, FL 33610

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

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

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

* Reasons for negative vote(s) and abstentions

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

WORK STATEMENT# 1703

Title:

Sponsoring TC/TG/MTG/SSPC:

1.8, Mechanical Systems Insulation

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

4.4, Building Materials & building Envelope Performance
10.3, Refrigerant Piping, Controls, & Accessories

Executive Summary:

Preventing the passage of moisture in ambient air into the insulation of mechanical piping and equipment operating at below ambient temperature is critical in assuring the long-term function of the insulation and service life of the piping and equipment. The performance of vapor-retarding products (system components) such as flexible vapor retarders, tapes and mastics is verified and published as technical data by manufacturers. However, the performance of these component products together as a system has not been tested and therefore system performance data is not available to the designer.

It is the aim of this project to develop this vapor retarder system performance data to make it available to designers of insulation for mechanical systems operating at below ambient temperatures. The system performance data obtained will make it possible to predict the water gain over time, and therefore the life expectancy, of the insulation system based on the rate of moisture vapor passage through an installed vapor retarder system. Water vapor migration and condensation in mechanical insulation on below ambient surfaces can particularly be a problem when located in unconditioned spaces for long durations, i.e., up to twenty-five years.

The theme of the ASHRAE Research Strategic Plan (RSP) is “Navigation for a Sustainable Future”. Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the equation for sustainability and energy efficiency. In the context of the RSP, this research project aligns well with two of the goals- Goal 1: Maximize the actual operational energy performance of buildings and facilities, and Goal 9: Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety.

This research is directly related to sustainability in the context of maintaining the efficiency, and assuring the longevity, of thermal insulation systems. Insulation of new mechanical systems provides an immediate, significant energy efficiency boost and very quick payback. Minimizing moisture ingress into the system to offset or negate the energy efficiency gains is critical in efforts to achieve ever-higher levels of sustainability.

The results of this research will be included in Fundamentals Chapter 23, Mechanical Systems Insulation. and in Refrigeration Chapter 10, Insulation Systems for Refrigerant Piping. A research report will generated and presented at a future ASHRAE conference.

The ultimate application of the results will be in the design and installation of the vapor retarder system to help assure optimum performance and longevity of the mechanical insulation system of which it is a part. The results should confirm what materials and methods work best and which may have shortcomings. Applying this knowledge, designers can make informed decisions on the preferred systems to be employed, based on demonstrated test performance.

Applicability to the ASHRAE Research Strategic Plan:

The theme of the ASHRAE Research Strategic Plan (RSP) is “Navigation for a Sustainable Future”. Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the equation for sustainability and energy efficiency. In the context of the RSP, this research project aligns well with two of the goals- Goal 1: Maximize the actual operational energy performance of buildings and facilities, and Goal 9: Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety.

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Application of Results:

The results of this research will be included in Fundamentals Chapter 23, Mechanical Systems Insulation. and in Refrigeration Chapter 10, Insulation Systems for Refrigerant Piping. A research report will generated and presented at a future ASHRAE conference.

The ultimate application of the results will be in the design and installation of the vapor retarder system to help assure optimum performance and longevity of the mechanical insulation system of which it is a part. The results should confirm what materials and methods work best and which may have shortcomings. Applying this knowledge, designers can make informed decisions on the preferred systems to be employed, based on demonstrated test performance.

State-of-the-Art (Background):

Failures occur in chilled water and other below-ambient piping systems due to the passage of water vapor through the vapor retarder system that covers the insulation on the pipe and the resultant condensation that forms on the pipe and in the insulation. Papers documenting problems and failures apparently due to vapor retarder system shortcomings have been published [1,2]. The performance of the materials used in the vapor retarder system is tested and available to designers and specifiers; [3-13] however, quantified performance of the total system that utilizes these materials in combination is not published. To the knowledge of TC 1.8 members, there has been no research or testing done in this area that is available in the public domain.

Many materials are available that are excellent vapor retarders, or "vapor barriers", but tests to date only show performance of the individual materials. However, these products are never used by themselves; they are always joined or sealed to other materials to form what is intended to be a vapor-tight system. To the knowledge of our Technical Committee, there is no data available that represents how the total system made up of these various materials, joints and seals performs. These materials include flexible sheet vapor retarder/barriers, tapes for overlap and butt joints, mastics, adhesives and sealants. While designers may be satisfied that the materials themselves provide excellent vapor retarding performance, it is known that moisture can intrude into below-ambient systems in sufficient quantities to cause loss of efficiency, damage and failures.

Simply, there is a major unknown in these installed vapor retarder systems, that being how much moisture vapor is passing through various types of joints and seals that are present in large numbers in such systems. Quantifying the rate of moisture ingress into installed vapor retarder systems and understanding where and how the significant breaches occur is an undertaking that needs to be initiated by independent testing such as is proposed here. The performance difference between VR materials and systems is related almost exclusively to how the joints between similar or dissimilar materials are sealed. Much manufacturer data exists on the performance of homogeneous VR

Advancement to the State-of-the-Art:

The data for system performance that will be obtained is not available in the public domain. This does not extend previously conducted research, but rather is establishing a baseline or foundation. The proposed research project would establish an initial database of vapor retarder system performance. Expected outputs are new or revised recommendations for vapor retarder joint sealing methods, and VR system performance. Quantifiable assessment of performance is critical in being able to measure, and predict performance and advance vapor retarder system technology.

Justification and Value to ASHRAE:

The primary output will be to provide published reference information in Chapter 23 of the Fundamentals HB and Chapter 10 of the Refrigeration HB that provides guidance in how to minimize or eliminate moisture transfer in below-ambient mechanical insulation systems, where it is a constant and harmful phenomenon. The type of VR system failures which this research relates to are a huge problem for specifiers and owners of cold piping and equipment systems. Research into this issue and publication/presentation of the results by ASHRAE will directly benefit ASHRAE members and make the ASHRAE handbooks even more valuable.

It will provide base data to those engineers and specifiers involved in the design of mechanical systems insulation so that compromises in insulation performance and costly failures are avoided in the operation of below-ambient piping and equipment. The results from the proposed research would indicate which commonly used VR joint sealing methods work and which do not work, which VR materials have joints which can be sealed and how and which VR materials have joints that are difficult to seal. These results will also yield a test methodology that can be used to investigate the performance of new VR systems and joint sealing methods developed in the future.

Advancing, if not establishing, the knowledge base of the dynamics of moisture intrusion in below-ambient mechanical systems insulation is critical to improving efficiency and longevity of the equipment and piping, which is sometimes lost in the focus on the equipment itself. This research will be of benefit to users of ASHRAE 90.1 [17] who are designing mechanical systems for compliance.

To repeat, the theme of the ASHRAE Research Strategic Plan (RSP) is “Navigation for a Sustainable Future”. Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the discussion on sustainability and energy efficiency. In the context of the RSP, this research project aligns well with two of the goals:

Goal 1: Maximize the actual operational energy performance of buildings and facilities.

Objectives:

Develop a reliable test method for evaluating water vapor transmission of vapor retarder systems that is based on a configuration that approaches actual installations. Current standard methods are intended for, and typically only accommodate, singular materials. These tests do not lend themselves to testing combinations of two or more components, nor does the specimen preparation mimic real-world applications. The test should be based on a pipe insulation configuration.

Determine the water vapor permeance performance of various combinations of vapor retarder, sealing material, and method- i.e., "the system"- both commonly used and of interest due to potential performance advantages.

Obtain data that will be presented and discussed, with conclusions and recommendations, in the Mechanical Insulation chapter of the Fundamentals Handbook. Similar content could be included, and at the very least will be referenced, in the Insulation Systems for Refrigerant Piping chapter of the Refrigeration Handbook.

Scope/Technical Approach:

The systems to be studied will include vapor retarder components and insulation materials used on pipes and equipment that operate at below ambient temperatures.

Water vapor permeance (derived from water vapor transmission) testing is the basis of the project. A high vapor pressure differential between sides of the systems being tested must be induced, and a specimen configuration large enough to accommodate sealed joints must be employed.

The project will involve testing pipe insulation on a small-scale basis, and will include both longitudinal and circumferential joints. Also included will be sealed junctions (such as encountered at tees and els) and sealed penetrations (such as at probes) that, if not exactly duplicating actual field installation, will closely represent the type of sealing methods employed. In concept, a test specimen will consist of pipe insulation of specified inside diameter, outside diameter, and length. The specimen, in addition to the base insulation, will include the vapor retarder, joint sealing tape and mastic in various combinations. Assembly technique will be as close as possible to field practice.

Specimens will encompass a sampling of vapor retarders, tapes, mastics, insulation and techniques. A sealed cylindrical specimen will contain a mass of desiccant in the inner void of the insulation, and will be placed in an environmental chamber running at probably 90F and 90 percent RH; essentially an ASTM E96 test in cylindrical form. A given test could run one to two months, but could be shorter if permeance is high. Fortunately, many specimens can be tested simultaneously so this lengthy duration for one test is not a major problem.

While the sole purpose of this testing relates to moisture intrusion into systems operating below ambient, the test will be isothermal in that there will be no temperature differential between the test chamber conditions and the internal void of the insulation (where in actual application, the cold pipe would reside). However, the desiccant pack in the void will produce a virtual 0% RH condition, and hence a strong vapor drive into the insulation, equal to actual cold system applications, will be duplicated.

It is envisioned that the basic test specimen will be a piece of pipe insulation eighteen inches long and nominally six inches in outside diameter. The different system configurations will include:

Longitudinal seam only in the sheet vapor retarder
Longitudinal and butt tape joint in the sheet vapor retarder
Simulated fitting/penetration treatment with appropriate sealant coating or other appropriate sealing at joint and termination

Vapor retarder types:
ASJ (All Service Jacket)
PVdC (PolyVinylideneChloride)
PFP (Poly-Foil-Poly) zero permeance
Laminate jacketing
PVC (Polyvinylchloride), as outer cover

Pressure sensitive tapes:
Most commonly used/recommended tapes

Vapor retarder coating/sealant ("mastic"):
Most commonly used/recommended coating

Base insulation:

Fiberglass pipe insulation

Scope/Technical Approach (Continued 2):

A matrix of component combinations that duplicates common systems will be provided, and those combinations will be tested. The matrix accompanies and forms part of this WS but the PMS will be able to change the makeup of this matrix to some small degree at their discretion.

The PMS will direct the investigator as to the specific products to be procured for the study. If necessary, it can advise of the type of outlet from which to procure them, but will not participate in said procurement.

3 ft. long Insulation sections would be placed over a supported pipe whose OD matches the ID of the insulation sections. Seam and joint sealing would be done on the pipe and allowed to stabilize or dry as necessary, then carefully cut to test specimen length and removed by sliding off pipe for testing.

The test sections will be prepared per manufacturers instructions for the products being evaluated.
A person from the TC who is knowledgable in the correct installation of the products will supervise/approve the preparation.

Three specimens per test configuration are to be tested.

The test to be employed will use elements of ASTM E96, Standard Test Method for Water Vapor Transmission of Materials and European Standard EN 13469, Determination of Water Vapor Properties of Preformed Pipe Insulation. However, as neither of these test methods exactly fits the objectives of the project, a new test method will have to be developed by the contractor as part of this project.

It is critical that non-test seals at end caps be totally water vapor impermeable. It is anticipated that a suitable wax or wax blend, as is typically used in ASTM E 96, or silicone sealant would be used to make these seals.

Project Tasks/Intermediate Milestones:

1. Develop proposed test method
2. Construct test apparatus and validate test method
3. Prepare test specimens
4. Conduct testing
5. Evaluate test results
6. Re-test where necessary due to questionable result
7. Issue report

The PMS will review the above as milestones prior to contractor proceeding to subsequent task.

Scope/Technical Approach (Continued 3):

This page not used.

Deliverables/Where Results Will Be Published:

A research report providing all requisite information on equipment, method, test data, observations and any other relevant information will be provided by the contractor.

The primary results to be delivered will be the permeance of each of the tested vapor retarder system configurations, with full description of those configurations.

Results will be published as a research report.
Results will be discussed/presented in Chapter 23 of Fundamentals HB.
Results will be discussed/referenced in Chapter 25, 26, or 27 as appropriate and Chapter 10 of Refrigeration HB.

A defined method of test, or guidelines on application of existing test method(s) will be derived from the research.

Guidance & recommendations applicable to Vapor Retarder systems design and installation will be derived from the research.

A presentation on the research project will be given at an ASHRAE technical conference.

Deliverables/Where Results Will Be Published (Continued):

This page not used.

Level of Effort:

The methodology that is envisioned to be employed in this project is not thought to be complex. Sophisticated equipment or instrumentation should not be required. Reasonable replication of actual field installation and impermeable sealing of end caps are critical. Sample preparation will be the most challenging and labor-intensive aspect. Although seemingly simple, making the impermeable seals can be somewhat of an art.

Project Duration in Months: 8-12, including report generation
Professional-Months, Principal Investigator: 1
Professional-Months, total: 2
Estimated $ Value: $50,000-$70,000

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	Experience in water vapor transmission testing of very low permeance materials, at a minimum utilizing ASTM E96 and, preferably, EN 13469	25
2	Availability of accurate, reliable environmental chamber and appropriate balance	25
3	Qualified, capable, conscientious personnel	25
4	Client references, and example(s) of completed report(s)	15
5	Orderly, clean facility	10

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Literature review	1
2	Demonstration of ability to make test specimens with non-leaking end caps	3
3	Preparation of satisfactory test specimens- (a) assembly of vapor retarder system insulation sections and (b) assembly of finished specimens for exposure in chamber	5

Authors:

Charles Petty-Lead
Jim Young
Gordon Hart

References:

Published papers:

[1] "Prevention of Condensation Problems on Insulated Chilled Water Pipes Located in Unconditioned Spaces in Hot, Humid Climates"; G. Hart, ASHRAE seminar June 2011, Montreal
[2] "Case Study: "Economic Justification for Replacing Ice-laden Refrigerant Pipe Thermal Insulation with New Insulation" G. Hart, IIAR Meeting Technical Paper June 2015, San Diego

Manufacturers' Data:
Product data sheets (available on manufacturers' websites)*:

[3] Lamtec WMP-ASJ vapor retarder
[4] Lamtec R-3035 vapor retarder
[5] Lamtec 30J vapor retarder
[6] 3M/Venture 1540CW ASJ insulation tape
[7] 3M/Venture VentureClad 1577 CW insulation cladding
[8] Foster C.I. mastic 30-25
[9] Foster 62-05 vapor barrier jacketing
[10] Avery Fasson Fas-Clad insulation cladding
[11] Avery Fasson 0839 WMP-ASJ tape
[12] ITW SARAN 560-CX vapor retarder tape
[13] ITW SARAN 540-CX vapor retarder

ASHRAE Research:
[14] RP 1646
[15] RP 1356

Other Research:

[16] NAIMA-contracted Cold Pipe Test Project; reported in September 2001 Insulation Outlook

ASHRAE Standards:
[17] 90.1

* Many other products, made by these and other manufacturers, are available for mechanical insulation as well. All of these data sheets cite the permeance of the product itself. None cite performance of the product in conjunction with other vapor retarder system components, such as those used in combination at joints, fittings and penetrations. T.C. 1.8 is not aware of where such information is obtainable, either as manufacturer's data, in standards, or in research reports.

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.

1791 Tullie Circle NE ▪ Atlanta, Georgia 30329-2305 ▪ Tel 678.539.1211 ▪ Fax 678.539.2211 ▪ http://www.ashrae.org

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

TO: Patrick Noonan, Chair TC 1.8, pat.noonan@us.knaufinsulation.com
Andre Desjarlais, Research Subcommittee Chair TC 1.8, desjarlaisa@ornl.gov

CC: Shinsuke Kato, NEW Research Liaison Section 1.0, kato@iis.utokyo.ac.jp
Arthur Giesler, PAST Research Liaison Section 1.0, art.giesler@att.net

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

DATE: July 29, 2015

SUBJECT: Research Topic Acceptance Request (1703-RTAR), "Performance of Vapor Retarder Systems Used on Mechanical Insulation

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During their annual meeting, the Research Administration Committee (RAC) reviewed the subject Research Topic Acceptance Request (RTAR) and voted to accept with comments it for further development into a work statement (WS) provided that the two approval comment(s) below are addressed to the satisfaction of your Research Liaison in a revision to the RTAR.

1. The value to ASHRAE was not established. For this project to proceed, would need to understand why the manufacturers are not interested and how having the results would actually improve the product.
2. Need to clarify the possible cause of performance differences between materials and systems. How can the data obtained be representative? How long will the test last?

Please coordinate changes to the RTAR with the help of your Research Liaison, Shinsuke Kato, kato@iis.utokyo.ac.jp, or RL1@ashrae.net and Art Giesler (former RL1) in response to the two approval comment(s) only so that the revised RTAR can be submitted to the Manager of Research and Technical Services and posted by ASHRAE as part of the Society's Research Implementation Plan.

Once the revised RTAR is posted, please develop a work statement also with the help of your Research Liaison prior to submitting it to the Manager of Research and Technical Services for consideration by RAC. The work statement must be approved by the Research Liaison prior to submitting it to RAC.

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. Some of these comments may indicate areas of the RTAR and subsequent WS where readers require additional information or rewording for clarification.

The first draft of the work statement should be submitted to RAC no later than **May 15, 2017** or it will be dropped from display on the Society's Research Implementation Plan. The next likely submission deadline for work statements is **December 15, 2015** for consideration at RAC's 2016 winter meeting. The submission deadline after that for work statements is **May 15, 2016** for consideration at the RAC's 2016 Annual meeting.

Project ID	**1703**	
Project Title	**Performance of Vapor Retarder Systems Used on Mechanical Insulation**	
Sponsoring TC	**TC 1.8 (Mechanical Systems Insulation)** Co-sponsored by: TC 4.4 (Building Materials and Building Envelope Performance) and TC 10.3 (Refrigerant Piping, Controls, and Accessories)	
Cost / Duration	$50k -$70k / + or - 12M	
Submission History	**2nd Submission -** RTAR 1st Sub. REC. 13.05 - Ret. 13.06	
Classification: Research or Technology Transfer	Basic/Applied Research	
RAC 2015 Annual 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.		**#2** - Testing of systems will provide important data to allow for more effective insulation systems to be specified. **#9** - Did not see literature review. The need for literature review was identified in July 25, 2013 letter from RAC to TC. **#7 -** Project description is not clear. It seems the real issue is with the installation of insulation systems rather than the vapor retarder material. There could be several variations of installations which could not be tested in a single project. Authors are encouraged to do homework in this regard and submit a new RTAR related to development of best practices for insulation installation. **#15** - But I had to dig around a bit. Need to describe types of products and why current standards aren't applicable even though they are in use. **#4** - TC responded well to all comments on prior submission.
Research Need: Based on the background provided is the need for additional research clearly identified? If not, then the RTAR should be rejected.		**#2**- Important for specifiers, end users and the industry. **#9** - Background states "Manufacturers apparently have not been motivated, nor required, to conduct his type of evaluation." Why should ASHRAE? **#7** - Need is not well established other than stating that "failure" occurs. What could be probable causes of failure and how this research project would demonstrate and establish the best practices of installation. **#4** - No indication how this fits into the portfolio with 1761 and current work in this are sponsored by largely by the same TCs. **#8** - It was mentioned that the performance data for individual materials are available, but not the integrated system. Would this difference be due to the construction process? If so, how to ensure the systems tested are representative? How long will the test last?
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.		**#9** - If the industry does not support, why should ASHRAE? **#7** - It seems the value to ASHRAE is not clearly established. **#15** - But is looks like alignment with ASTM would be in order. **#4** - Satisfies "b", so yes. **#8** - It is still hard to understand why ASHRAE is the sole entity to collect such data. Why do manufacturers not have similar data?
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.		**#2** - Should include a proceed or not to proceed project milestone based upon the ability to come up with a test protocol that will meet the goals of the project.
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:		**#15** - Not really, examining enough products to determine workable test method would probably be a bigger effort than estimated. **#4** - small, clearly stated project, but bids may come in at or above upper end.
References: Are the references provided?		**#15** - Just a list of product data sheets
Decision Options	**Initial Decision?**	**Final Approval Conditions**
ACCEPT AS-IS		**#9** - The value to ASHRAE was not established. For this project to proceed, would need to understand why the manufacturers are not interested and how having the results would actually improve the product. **#7** - Authors need put more efforts into properly articulating the need for this research. Project description is vague. **#4** - This work must be done; my only question is who should fund what fraction of the work. My sense is that completion of this work is one of the criteria required for EPA "SNAP" approval for 2L refrigerants in HVAC equipment that uses refrigerant-to-air HX. SNAP approval is required for legal sale in the US, so it is critical path for the phase-out of HFCs and their replacement with 2L low GWP alternatives. On the other hand, the responsibility for this work likes principally with the refrigerant manufacturers and their OEM customers; it's not clear how much ASHRAE funds need to be involved. Or, even the extent to which ASHRAE credibility is essential for the SNAP process. To illustrate by example, I think ASHRAE has much more 'skin in the game' for studies of the potential efficiency and economic impact of A2L refrigerant in equipment classes than more basic studies (as suggested here) of minimum ignition energy. Of course, MIE is a key element in terms of selection (and design) of components such as contactors, but it is well down-stream. **#8** - Need to clarify the possible cause of performance differences between materials and systems. How can the data obtained be representative? How long will the test last?
ACCEPT W/COMMENTS	X	
REJECT		

ACCEPT Vote - Topic is rea#15 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: January 30, 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:
Performance of Vapor Retarder Systems Used on Mechanical Insulation (#1703)

RTAR# 1703
(To be assigned by MORTS)

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

Chapter 23

Responsible TC/TG: 1.8 Mechanical Insulation

Date of Vote: 27 January 2015

For		7
Against	*	0
Abstaining	*	0
Absent or not returning Ballot	*	
Total Voting Members		

Co-sponsoring TC/TG/MTG/SSPCs (give vote and date):

TC 4.4 9-0-0 to accept 1-20-14
TC 10.3 6-0-0 to accept 1-21-14

RTAR Lead Author: Charles Petty
Expected Work Statement Lead Author:

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

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

Performance of Vapor Retarder Systems Used on Mechanical Insulation

Title: _____

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)

Proposal: Measure the permeance of (moisture transmission through) select vapor retarder systems used on below-ambient pipe insulation. "System" consists of both the sheet or film vapor retarder and other materials used to seal it at joints and penetrations.

Importance: Critical information on system performance does not exist in the public domain.

Methodology: Permeance testing of assembled vapor retarder systems

Justification: Data on materials only is available, but actual system performance is not available for reference.

Background

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

Failures occur in chilled water and other below-ambient piping systems due to the passage of water vapor through the vapor retarder system that covers the insulation on the pipe and the resultant condensation that forms on the pipe and in the insulation. The performance of the materials used in the vapor retarder system is generally tested and available to designers and specifiers; [1-13] however, quantified performance of the total system that utilizes these materials in combination is not published. To our knowledge, there has been no research or testing done in this area that is available in the public domain.

Many materials are available that are excellent vapor retarders (or "vapor barriers"), but tests to date only show performance of the individual materials, but the problem is that they are never used by themselves. To the knowledge of our Technical Committee, there are no values or data available that represent how the total system made up of these various materials and sealed joints performs. These materials include flexible sheet vapor retarder/barriers, tapes for overlap and butt joints, mastics, adhesives and sealants. Manufacturers apparently have not been motivated, nor required, to conduct this type of evaluation.

Research has been, and is being, conducted by ASHRAE and other institutions with the objective of determining installed performance of insulation on systems operating at below ambient temperatures. [14-16] ASHRAE 90.1 and codes include requirements for installed system performance, and system performance invariably is not the same as performance of the insulation materials themselves. Obviously, requirements cannot be set without the tests to obtain performance values. This project proposed here is analogous to the above described research on insulation systems. An understanding and quantification of the performance of the vapor retarder system in order to enable determination of the cause for failures, provide for optimum insulation performance, and best provide longevity of the insulation is necessary, but missing.

Research Need

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

With critical data and information beyond that for the materials themselves simply not available, the research that will produce it becomes necessary. This data and information is needed so that, in the pre-construction phase, designers can plan the optimum vapor retarder system; in post-construction settings, the causes for failures and the remediation methods can be more efficiently determined and carried out.

Since various materials are available in the market, a number of vapor retarder system configurations needs to be tested for water vapor permeance in such a manner that the most commonly used vapor retarder materials, sealing materials, and methods are included, along with newer materials or systems that are claimed or thought to be improvements.
We can envision no effective means to convince or cause manufacturers to conduct these types of tests on their own. Code or standards requirements would be one way, but such requirements cannot be established if the baseline data is not available.

Unlike building envelopes, where many factors, such as the multitude of materials employed in the structure and varying vapor drives between regions and between seasons can influence and mitigate moisture ingress, the moisture drive through vapor retarders over below-ambient pipe insulation is incessant and unidirectional; being distinguished only by the magnitude of the driving force. As such, understanding and quantifying the dynamics of this ingress is of great importance.

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)

Develop a preferred method for testing vapor retarder systems, or components thereof. Current standard methods are intended for, and can only accommodate, singular materials, not combinations of two or more components.

Determine the performance of various combinations of vapor retarder, sealing material, and method, both commonly used and of interest due to potential performance advantages.

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) ( )

Water vapor transmission/permeance testing is the basis of the project. A high vapor pressure differential between sides of the systems being tested must be induced, and a specimen configuration large enough to accommodate sealed joints must be employed.

The project will involve testing pipe insulation on a small-scale basis, and will include both longitudinal and circumferential joints. In concept, a test specimen will consist of pipe insulation of specified inside diameter, outside diameter, and length. The specimen, in addition to the base insulation, will include the vapor retarder, joint sealing tape and mastic in various combinations.

Specimens will encompass a sampling of vapor retarders, tapes, mastics and techniques. It is anticipated that one insulation type will be used as the base material. The sealed cylindrical specimen will contain a mass of desiccant in the inner void of the insulation, and will be placed in an environmental chamber running at probably 90F and 80 or 90 percent RH; essentially an ASTM E96 test in cylindrical form. A given test should run one to two months.

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)

Specific interest to ASHRAE:

Provide published reference information in Chapter 23 that provides guidance in how to minimize or eliminate moisture transfer in below-ambient mechanical insulation systems, where it is a constant and harmful phenomenon.

Impact: Provide base data to those engineers and specifiers involved in the design of mechanical systems insulation so that compromises in insulation performance and costly failures are avoided in the operation of below-ambient piping and equipment.

Benefits: The benefit is derived through the impact of the knowledge gained, as noted above. Advancement in, and addition to, the knowledge base of the dynamics of moisture intrusion in below-ambient mechanical systems insulation is critical to improving efficiency and longevity of the equipment and piping, which is sometimes lost in the focus on the equipment itself. Will be of benefit to users of ASHRAE 90.1 [17] who are designing mechanical systems for compliance.

Strategic plan alignment: The theme of the ASHRAE Research Strategic Plan (RSP) is "Navigation for a Sustainable Future". Thermal Insulation, including mechanical insulation for pipes, ducts and equipment, is a distinct and critical part of the discussion on sustainability and energy efficiency. In the context of the RSP, this research project project aligns well with two of the goals: Goal 1: Maximize the actual operational energy performance of buildings and facilities, and Goal 9: Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety. While not directly involving insulation, the research is directly related to maintaining efficiency and longevity of insulation.

State of the art advancement: Data for, and a scientific understanding of, vapor retarder/barrier system performance will be obtained that either doesn't exist or is not available in the public domain. This does not extend previously conducted research, but is establishing a baseline or foundation.

Other stakeholders: Manufacturers of the materials that are used as components in vapor retarder systems, insulation manufacturers, contractors and installers.

Anticipated Funding Level and Duration

Funding Amount Range: $ 50,000-70,000

Duration in Months: 12 +/-

References

List the key references cited in this RTAR

Manufacturers' Data:
Product data sheets (available on manufacturers' websites)*:

[1] Lamtec WMP-ASJ vapor retarder
[2] Lamtec R-3035 vapor retarder
[3] Lamtec 30J vapor retarder
[4] 3M/Venture 1525CW FSK insulation tape
[5] 3M/Venture 1540CW ASJ insulation tape
[6] 3M/Venture VentureClad 1577 CW insulation cladding
[7] Foster Monolar mastic 60-91
[8] Foster C.I. mastic 30-25
[9] Foster 62-05 vapor barrier jacketing
[10] Avery Fasson Fas-Clad insulation cladding
[11] Avery Fasson 0839 WMP-ASJ tape
[12] ITW SARAN 560-CX vapor retarder tape
[13] ITW SARAN 540-CX vapor retarder

ASHRAE Research:

[14] RP 1646
[15] RP 1356

Other Research:

[16] NAIMA-contracted Cold Pipe Test Project; reported in September 2001 Insulation Outlook

ASHRAE Standards:

[17] 90.1

* Many other products, made by these and other manufacturers, are available for mechanical insulation as well.
All of these data sheets cite the permeance of the product itself. None cite performance of the product in conjunction with other vapor retarder system components, such as those used in combination at joints, fittings and penetrations. T.C. 1.8 is not aware of where such information is obtainable, either as manufacturer's data, in standards, or in research reports.

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1791 Tullie Circle NE ▪ Atlanta, Georgia 30329-2305 ▪ Tel 678.539.1211 ▪ Fax 678.539.2211 ▪ http://www.ashrae.org

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

TO: Charles Cottrell, Chair TC 1.8, ccottrel@naima.org

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

CC: Arthur Giesler, Research Liaison 1.0, art.giesler@att.net
Andre O Desjarlais, Research Subcommittee Chair TC 1.8, desjarlaisa@ornl.gov

DATE: July 25, 2013

SUBJECT: Research Topic Acceptance Request (1703-RTAR), "Performance of Vapor Retarder Systems Used on Mechanical Insulation"

During their winter meeting, the Research Administration Committee (RAC) reviewed the subject Research Topic Acceptance Request (RTAR) and voted to return it. The following list summarizes the mandatory comments and questions that need to be fully addressed in the RTAR re-submission:

1. No literature review provided. Seems like an interesting topic, but should provide more information about what is known and where the knowledge gaps and critical needs are to be met.
2. Stated on page 4-"The first stage will determine the protocol for the second (and thereby determine the total project cost)" is too open-ended and nebulous to make an assessment or solicit fixed-priced bids covering both stages of work; will stage two be bid separately? is the end product a theoretical model based on underlying principles of mass transfer and the data obtained? What kinds of vapor retardant materials are to be studied? How many? Are different temperature conditions to be considered?
3. Value to ASHRAE is not clearly established. Even if such data is available, how will it be used and what value will it bring to design engineers?..

Please address or incorporate the above information into the RTAR with the help of your Research Liaison prior to resubmitting 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 mandatory 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.

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. Some of these comments may indicate areas of the RTAR and subsequent WS where readers require additional information or rewording for clarification.

The next submission deadline for RTARs and WSs is **August 15, 2013** for consideration at the Society's falll meeting. The submission deadline after that is December 15, 2013.

Project ID	**1703**	
Project Title	**Performance of Vapor Retarder Systems Used on Mechanical Insulation**	
Sponsoring TC	TC 1.8, Mechanical Insulation Systems	
Cost / Duration	$70,000/ 12M	
Submission History	**1st Submission**	
Classification: Research or Technology Transfer	Basic/Applied Research	
RAC SPRING 2013	**REVIEW SUMMARY**	
Check List Criteria	**VOTED NO**	**Comments & Suggestions**
Is there a well-established need? The RTAR should include some level of literature review that documents the importance/magnitude of a problem. If not, then the RTAR should be returned for revision.	**#10, #15, #8**	**#10** - No literature review is provided. **#15** - There is an ASTM to test the components, this RTAR seeks to obtain information for a system made up of various components considering different conditions and installation practices. I am not convinced that it is necessary or even possible. **#8 -** No literature provided. Seems like an interesting topic, but should provide more information about what is known and where the knowledge gaps and critical needs are
Is this appropriate for ASHRAE funding? If not, then the RTAR should be rejected. Examples of projects that are not appropriate for ASHRAE funding would include: 1) research that is more appropriately performed by industry, 2) topics outside the scope of ASHRAE activities.	**#10, #15**	**#10** - This type of work should be done by manufacturers of these components. **#15 -** Not entirely, may be more appropriate for industry given the variation in products and installation practices.
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.	**#10, #15, #8**	**#15 -** Stated on page 4-"the first stage will determine the protocol for the second (and thereby determine the total project cost)" **#8** - Too open-ended and nebulous to make an assessment; is the end product a theoretical model based on underlying principles of mass transfer and the data obtained? What kinds of vapor retardant materials are to be studied? How many? Are different temperature conditions to be considered?
Is the budget reasonable for the project scope? If not, then RTAR could be returned for revision or conditionally accepted with a note that the budget should be revised for the WS.	**#8**	**#8** - Unable to assess without additional information
Have the proper administrative procedures been followed? This includes recording of the TC vote, coordination with other TCs, proper citing of the Research Strategic Plan, etc. If not, then the RTAR could be returned for revision or possibly conditionally accepted based on adequately resolving these issues.	**#15**	**#15 -** incomplete information on cover sheet

Decision Options	**Initial Decision**	**Approval Conditions**
ACCEPT		**#10** - Value to ASHRAE is not clearly established. Even if such data is available, how will it be used and what value will it bring to design engineers. It seems manufacturer of these components have this data and they recommend the appropriate material for appropriate situation. **#15** - This may provide valuable information, so I don't want to vote to reject, but this RTAR must be changed to follow a series of steps to acquire the right results. It is not clear in this RTAR. **#4** - Did not understand how testing to develop a protocol to obtain data and then RTAR states "at the conclusion of the first step, it well be determined if there is a correlation between the results of the two tests with the like material joints" I do not understand what correlation is being looked at. **#8** - Interesting topic, but did not do their HW, and did not specify the scope or potential approach adequately
COND. ACCEPT		
RETURN	**X**	
REJECT		

ACCEPT Vote - Topic is ready for development into a work statement (WS).
COND. ACCEPT 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)
RETURN Vote - Topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.
REJECT Vote - Topic is not acceptable for the ASHRAE Research Program

Research Topic Acceptance Request Cover Sheet

Date:

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

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	*

Title: Performance of Vapor Retarder Systems Used on Mechanical

RTAR# **1703**
(To be assigned by MORTS)

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

H. Estimated Duration	*
I. References	*

Responsible **TC 1.8**

Date of Vote:

For	**8**
Against	**0**
Abstaining	**0**
Absent or not	**0**
Total Voting	**0**

Co-sponsoring TC/TG/MTG/SSPCs (give vote and date):

RTAR Lead Author: **Charlie Petty**
Expected Work Statement Lead
Research Classification: (Basic/Applied Research; Advanced Concepts; or Technology Transfer)

Potential Co-funders (organization):

	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

RTAR- 1703:

Performance of Vapor Retarder Systems Used on Mechanical Insulation

Submitted by Technical Committee 1.8

Applicability to ASHRAE Research Strategic Plan

The theme of the ASHRAE Research Strategic Plan (RSP) is "Navigation for a Sustainable Future". Thermal Insulation, including mechanical insulation for pipes, ducts and equipment that TC 1.8 covers, is a distinct and critical part of any discussion on sustainability and energy efficiency. In the context of the RSP, this research project would apply the following goals listed therein:

- Goal 1: Maximize the actual operational energy performance of buildings and facilities
- Goal 9: Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety

The research project described herein does not involve insulation itself as a subject. Rather it is centered on the component of the insulation system that serves to protect the insulation so that it will function as intended over the life of the system. The project aims specifically to quantify the performance of vapor retarder systems that are made up of individual vapor-retarding components. The intent is not to acquire data on individual materials, except as may be required to extrapolate system data.

Properly designed and installed insulation systems are as important to sustainability as the proper design and efficiency of the equipment and distribution systems they insulate. Assuring that the insulation system conserves energy as intended for the longest possible time is of paramount importance and should be embedded in ASHRAE standards and documents that support the above goals. The research proposed here will produce new and useful knowledge so that design engineers and others using these standards can obtain appropriate guidance.

Research Classification

Basic/applied

Technical Committee Vote

8 for 0 opposed 0 abstentions

Reasons for Negative Votes and Abstentions

Not applicable

Estimated Cost

$70,000

Estimated Duration

12 months

RTAR Lead Author:

Charlie Petty

Expected Work Statement Lead Author:

Charlie Petty

Co-sponsoring Technical Committee and Votes:

Possible Co-funding Organizations:

North American Insulation Manufacturers Association (NAIMA); Charles Cottrell

Department of Energy (DOE); Karma Sawyer

National Insulation Association (NIA); Michelle Jones

Application of Results:

It is expected that the results will provide quantification of the rate of water vapor permeation into mechanical insulation on below ambient systems such as chilled water. This permeation is through the vapor retarder system, which is typically separate from the insulation, except in the case of cellular glass, flexible elastomeric foam rubbers, and polyethylene foams which have low permeability properties and hence in a large portion of installations do not use a separate vapor retarder.

This information will be of great use in understanding the dynamics of moisture migration into pipe insulation systems on chilled water lines and other below-ambient systems. This understanding will be transposed into guidance in future Chapter 23 revisions that will enable engineers to make informed decisions about the protective measures required to insure longevity of the insulation system.

State-of-the-art (background):

Currently, water vapor permeance data exists in the public domain as manufacturers' product data for various types of vapor retarders, tapes, cellular insulation, and certain sealants, primarily vapor retarder mastics. These are the primary components of the vapor retarder system for mechanical insulation used on pipe and equipment operating at below ambient temperatures.

In most all cases, these materials are tested for permeance (a derivative of moisture vapor transmission) in sheet form or as a coating on a flat substrate, by themselves. There may be some data available on certain closures. The test used is predominantly ASTM E96, *Test Method for Water Vapor Transmission of Materials*, Procedure A (desiccant method at 73°F/50% RH). In some cases, Procedure B of this standard (water method at 73°F/50% RH) is used.

Data that would characterize the performance of a vapor retarder *system* made up of these various components and includes joint and penetration seals is currently not available in the public domain. Further, permeance data for many vapor retarder materials is not available for high vapor pressure drive conditions (i.e., more severe conditions than those in the two ASTM E96 procedures noted above). In such cases, data on base materials may have to be obtained in the course of this project in order to calculate system results.

Very high pressure differentials can be encountered, especially when below-ambient pipes and equipment operate in unconditioned or inadequately conditioned spaces in hot, humid environments. Without such information, errors in design or installation techniques that can result in damaging effects on the insulation system frequently occurs.

Through RP 1356, it was clearly established that insulation that has become wet from water vapor condensing within loses its insulating performance, which reinforces the conclusion that an effective vapor retarder system must be employed on below ambient pipes and equipment. We know the permeance at certain conditions of the materials that are used in vapor retarder systems, some of which are impermeable, or zero permeance; however, the effective permeance of installed vapor retarder systems is not available in the public domain.

Advancement in State-of-the-art:

This project will provide heretofore non-existent data on how vapor retarder systems function as installed, under highly demanding conditions of high vapor pressure differential. This will greatly supplement a knowledge base that is solely empirical and theoretical at this point.

The successful contractor will have to design and build a special test apparatus, and write a test protocol, to carry out the proposed testing. This apparatus and the test protocol could become part of a standard test in the industry.

Justification and Value to ASHRAE:

The water vapor pressure differential between the ambient air outside the vapor retarder and the atmosphere immediately surrounding the cold pipe or equipment will drive water vapor toward the cold surface. To maintain as-designed long-term thermal performance, the vapor retarder system must prevent or greatly minimize this water vapor movement into the insulation system and to the pipe.

The thermal performance of chilled water or other below-ambient insulation systems can be severely compromised due to moisture intrusion, especially in unconditioned areas of buildings in hot and humid environments. In some cases, insulation system failure can result in much collateral damage to the pipe and equipment itself and to the surrounding structure, as well as creation of safety hazards. We need to gain a better scientific understanding of the mechanisms of vapor intrusion in order to have the best chance of preventing these costly failures.

Given the above considerations, a significant void would be filled in making the findings of this project available to those involved with mechanical insulation systems used on below-ambient pipes and equipment. The resultant handbook discussion and guidelines would be used by specifiers, designers, and installers of these systems. It is foreseeable and hoped that future codes and standards covering mechanical insulation and overall building performance requirements will reference the guidance developed.

Objectives:

Test vapor retarder systems under realistic conditions

Water vapor permeance testing of vapor retarder systems will be conducted at conditions producing vapor differentials representative of unconditioned spaces in hot and humid climates. This involves testing system joints and seals at high vapor pressure differentials. One outcome would be the development of a data base on the tested systems. A second outcome would be on improved specifications of installation requirements of water vapor retarder systems.

Develop a test method/protocol to obtain data

This project is conceived as having two stages. The first stage will determine the protocol for the second (and thereby also determine the total project cost).

A preliminary series utilizing two different tests will be conducted. One test will be run using ASTM E96 in such a way to accommodate an appropriately sized specimen of a system joint in a flat configuration. The other will be set up in a manner to accommodate a system joint in a cylindrical configuration, as per pipe insulation.

Obtain water vapor permeance data for vapor retarder systems under high vapor drive conditions

At the conclusion of the first step, it will be determined if there is a correlation between the results of the two tests with like materials and joints. If there is good correlation, the project can proceed using the simpler and less expensive standard E96 method. If similar results are not seen, testing of pipe sections would be dictated (it is anticipated that pipe section tests would show the higher permeance if they do not correlate).

The second stage then would consist of carrying out the chosen one of the above noted test protocols. The list of materials and types of joints and seals to be tested will be pre-determined.

A database of performance results of the tested systems would be developed. This information would be transferred into the ASHRAE handbook for design guidance, and code and specifications reference.