INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

1703-TRP, "Performance of Vapor Retarder Systems Used on Mechanical Insulation"

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you decide not to submit a proposal, please circulate it to any colleague who might have interest in this subject.

Sponsoring Committee: TC 1.8 Mechanical Systems Insulation
Co-sponsored by: TC:10.3, Refrigerant Piping, Controls, & Accessories

Budget Range: $150,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **September 1, 2020** or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EDT, May 15, 2020. NO EXCEPTIONS, NO EXTENSIONS. Electronic copies must be sent to rpbids@ashrae.org. Electronic signatures must be scanned and added to the file before submitting. The submission title line should read: 1703-TRP, "Performance of Vapor Retarder Systems Used on Mechanical Insulation", ***and "Bidding Institutions Name"*** **(electronic pdf format, ASHRAE's server will accept up to 10MB)**

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

For Technical Matters
Technical Contact
Charles Petty
Lamtec Corporation
5010 River Rd
Mount Bethel, PA 18343-5610
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E-Mail: pettycharlie@lamtec.com

For Administrative or Procedural Matters:
Manager of Research & Technical Services (MORTS)
Michael R. Vaughn
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Contractors intending to submit a proposal should so notify, by mail or e-mail, the Manager of Research and Technical Services, (MORTS) by May 4, 2020 in order that any late or additional information on the RFP may be furnished to them prior to the bid due date.

All proposals must be submitted electronically. Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below. **ALL electronic proposals are to be sent to rpbids@ashrae.org.**

All other correspondence must be sent to ddaniel@ashrae.org and mvaughn@ashrae.org. In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EDT, May 15, 2020. NO EXCEPTIONS, NO EXTENSIONS.

The following forms (Application for Grant of Funds and the Additional Information form have been combined) must accompany the proposal:

(1) ASHRAE Application for Grant of Funds (electronic signature required) and
(2) Additional Information for Contractors (electronic signature required)

ASHRAE reserves the right to reject any or all bids.

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 but tests to date only show performance of the individual materials. However, these materials are never used by themselves; they are always joined or sealed to other materials to form what is intended to be a low water vapor permeance 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 retarders, tapes for overlap and butt joints, VR mastics, adhesives and sealants, and low permeability pipe insulation. 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 materials without joints in a flat form but there exists no permeance data on the VR joints nor a test method for examining these in actual final form. The performance difference between VR materials and systems is related almost exclusively to how the joints between similar or dissimilar materials are sealed. Manufacturer data on the performance of VR materials without joints in a flat form exists but no permeance data on the VR joints nor a test method for examining these in actual final form exists.

Research has been conducted by ASHRAE and other institutions with the objective of determining installed thermal performance of insulation on systems operating at below ambient temperatures. [14 15, 16] ASHRAE 90.1 [17] and codes include requirements for insulation system performance; however, system performance is not the same as performance of the insulation materials themselves. The project proposed here is analogous to the above noted research on insulation systems. The precedent for systems testing where manufacturers have not done so is firmly established in the insulation arena.

Objective

The objective is to determine the water vapor permeance performance of various commonly used combinations of vapor retarder, sealing material, and method- i.e., "the vapor retarder system"- to establish the knowledge base of quantified system permeance performance.

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:

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 results) 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 test the vapor retarder system on a small-scale basis in a pipe insulation configuration and will include both longitudinal and circumferential joints. Also included will be sealed joints that represent those encountered at tees and elbows, that will use the type of sealing methods employed. For the sheet and film materials and vapor retarder mastics, the test specimens will be physically supported by a highly permeable pipe insulation of specific inside diameter, outside diameter, and length. These specimens will include the vapor retarder, joint sealing tape, adhesive and mastic in various system combinations. For low permeability insulation materials, the specimen will include the appropriate insulation joint sealing, with no separately applied VR system. Assembly technique will follow manufacturers' instructions.

Specimens will encompass a sampling of vapor retarders, tapes, VR mastics, and pipe insulation. Using a modified European Standard test method EN 13469: 2012, Determination of Water Vapor Properties of Preformed Pipe Insulation, 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 90F and 90 percent RH. A given test is expected to run one to two months. With an adequately sized environmental chamber or room, it will be possible to test many specimens simultaneously so this test duration is manageable.

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, equivalent to actual cold system applications, will be duplicated.

The basic test specimen will be a pipe insulation system segment nominally eighteen inches long and six inches in outside diameter. The different system configurations will include:

Longitudinal seam only in the sheet vapor retarder
Longitudinal and butt joint in the sheet vapor retarder
Longitudinal seam only in the foam insulations
Longitudinal and butt joint in the foam insulations
Fabric and VR mastic only with no seams
Simulated fitting/penetration treatment with appropriate VR mastic or PVC tape sealing at joint

Vapor retarder types:
Conventional ASJ with exposed Kraft paper surface and matching pressure sensitive adhesive (PSA) tape
Poly Surface ASJ with matching PSA tape
PVdC (Poly~~V~~vinylidene-Chloride) with matching PSA tape
PFP (Poly-Foil-Poly) zero permeance with matching PSA tape
Laminate jacketing with matching PSA tape
Vapor retarder mastic with open-weave fabric
PVC (Polyvinyl-Chloride) outer jacket, solvent sealed, over poly surface ASJ with matching PSA tape.

Low permeability pipe insulations, no additional sheet or film vapor retarder jacket applied:
NBR/PVC standard permeance flexible elastomeric insulation with joint seals and no separate vapor retarder.
EPDM very low permeance flexible elastomeric insulation with joint seal~~a~~s and no separate vapor retarder.
Fabricated cellular glass pipe insulation with joint sealants and no separate vapor retarder.

A matrix of component combinations that represents common systems will be created, and those combinations will be tested. A list of sheet or film vapor retarders to be tested as materials (without joints) per ASTM E96, desiccant method at 90°F/90%RH, will also be created. The matrix and list will be provided to the contractor.

The PMS will direct the investigator as to the specific materials to be procured for the study. See the “References:” on pages 7 & 8 can add detail requirements for identification purpose. If necessary, it can advise of the type of outlet from which to procure them, but the PMS will not participate in said procurement.

3 ft. or 2 ft. long pipe insulation sections would be placed over a supported pipe whose OD matches the ID of the fiber glass pipe 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 while maintaining no joint separation.

The test sections will be prepared per manufacturers' instructions for the materials being evaluated, with PMS approval required for all system assemblies prior to commencement of testing.

Three specimens per test configuration will be tested.

The sheet and film vapor retarders, fabric & mastic, and low permeability equivalent flat insulations will be tested alone in flat form per ASTM E96 to establish the production lot permeance of the base materials used in the EN 13469 : 2012 system tests so that the permeance of the joints themselves can be calculated.

The test to be employed for the pipe insulation sections will be European Standard EN 13469, Determination of Water Vapor Properties of Preformed Pipe Insulation, modified for test ambient conditions as noted above. Testing of the base vapor retarder sheet and film materials will be separately per ASTM E96, Standard Test Method for Determination of Water Vapor Transmission of Materials, modified Procedure C for test ambient relative humidity as noted above.

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, would be used to make these seals.

Tasks and Milestones:

- Task 1: Contractor conducts literature review, including test methods and manufacturers' installation instructions.
  Milestone 1: Resolve any questions about conducting the testing through discussion with PMS.
  Deadline 1: End Month 1
- Task 2: Contractor to assemble one specimen from test matrix per EN 13469: 2012 and one specimen from test matrix per ASTM E96, to demonstrate ability to make acceptable test specimens. Contractor will then conduct short-term weighing exercise under specified environmental conditions to verify integrity of specimens and proper operation of environmental chamber or room.
  Milestone 2: PMS reviews and approves completion of Task 2.
  Deadline 2: End Month 3
- Task 3: Contractor to demonstrate proper installation for all vapor retarder systems for EN 13469 : 2012 tests.
  Milestone 3: PMS approves vapor retarder system installations.
  Deadline 3: End Month 5
  Task 4: Conduct testing of 25% of vapor retarder system matrix specimens
  Milestone 4: PMS evaluates results and authorizes remaining testing
  Deadline 4: End Month 7
- Task 5: Conduct remaining 75% of tests
  Milestone 5: PMS evaluates results and approves work as acceptable
  Deadline 5: End Month 11
- Task 6: Contractor issues preliminary report and proposed chapter language.
  Milestone 6: PMS approves report and chapter language to allow creation of final report
  Deadline 6: End Month 12

Deliverables:
Intermediate Deliverables from contractor:

Quarterly progress and financial reports
Draft final report by upon completion of testing
Draft technical paper

Final Deliverables:

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 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.

Progress, Financial and Final Reports, Technical Paper(s), and Data shall constitute the deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals, specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

Furthermore, the Institution's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Report

A written report, design guide, or manual, (collectively, "Final Report"), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement, including a summary of the control strategy and savings guidelines. Unless otherwise specified, the final draft report shall be furnished, electronically for review by the Society's Project Monitoring Subcommittee (PMS).

Tabulated values for all measurements shall be provided as an appendix to the final report (for measurements which are adjusted by correction factors, also tabulate the corrected results and clearly show the method used for correction).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

-An executive summary in a form suitable for wide distribution to the industry and to the public.
-Two copies; one in PDF format and one in Microsoft Word.

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

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either *Science & Technology for the Built Environment* or *ASHRAE Transactions*. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an *ASHRAE Transactions* Technical or HVAC&R Research papers. The paper title shall contain the research project number (1703-RP) at the end of the title in parentheses, e.g., (1703-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

d. Data

Data is defined in General Condition VI, "DATA"

e. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience documenting: (i) the main findings of the research project, (ii) why the findings are significant, and (iii) how the findings benefit ASHRAE membership and/or society in general.

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

Level of Effort

The methodology 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: Up to 12, including report generation
Professional-Months, Principal Investigator: 1
Professional-Months, total: 2
Estimated $ Value: $150,000

Proposal Evaluation Criteria

No.	**Proposal Review Criteria**	**Weighting Factors**
1	Experience in water vapor transmission testing of very low permeance materials, at a minimum utilizing ASTM E96. Experience in using the less common EN 13469 test method would be considered advantageous.	20%
2	Availability of accurate, reliable environmental chamber and appropriate balance	20%
3	Qualified, capable, conscientious personnel	20%
4	Quality of both client references and example(s) of completed report(s)	15%
5	Contractor's understanding of Work Statement as revealed in proposal	25%

Project Milestones

1	Resolve any questions about conducting the testing through discussion with PMS.	1 Month
2	PMS reviews and approves completion of Task 2.	3 Months
3	PMS approves vapor retarder system installations.	5 Months
4	PMS evaluates results and authorizes remaining testing	7 Months
5	PMS evaluates results and approves work as acceptable	11 Months
6	PMS approves report and chapter language to allow creation of final report	12 Months

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. Proto LoSmoke PVC jacketing
12. Avery Fasson 0839 WMP-ASJ tape
13. ITW SARAN 560-CX vapor retarder tape
14. ITW SARAN 540-CX vapor retarder
15. Cellular glass pipe insulation, 1½ inch thick, fabricated from Owens Corning® Foamglas® ASTM C552, Type 6, Block using Hot Asphalt, ASTM C312, Type III, 100% fabrication adhesive coverage.
16. Owens Corning® -Foamglas® Pittseal® #444N^{S} construction joints sealant
17. NBR/PVC, elastomeric foam, 1inch thick, Armacell® AP Armaflex® pipe insulation with no self-seal joints **or**
18. NBR/PVC, elastomeric foam, 1inch thick, K-Flex® Insul-Tube® pipe insulation with no self-seal joints
19. EPDM, elastomeric foam, 1inch thick, Armacell® UT SolaFlex pipe insulation with no self-seal joints **or**
20. EPDM, elastomeric foam, 1inch thick, K-Flex® HT pipe insulation with no self-seal joints
21. AP Armaflex® 520 / 520 BLV Contact Adhesive **or** K-Flex® 360 Contact Adhesive for elastomeric foam joints
    ASHRAE Research:
22. RP 1646
23. RP 1356
    Other Research:
24. NAIMA-contracted Cold Pipe Test Project; reported in September 2001 Insulation Outlook
25. ASHRAE Standards:
26. 90.1

* Other products, made by these and other manufacturers, are available for mechanical insulation as well.

Additional Information for Bidders

RP 1703 MATRIX OF VAPOR RETARDER SYSTEM CONFIGURATIONS TO BE TESTED PER EN13469 @ 90°F / 90% RH (3 specimens and 1 blank per test)

IMPORTANT INFORMATION: PLEASE NOTE! This table isa listing of all configurations/assemblies that will be tested. It is not practical to include every detail of the individual assemblies or installation instructions in this table. Such detail will be finalized through input of the PES/PMS communicated to the contractor, and should have negligible impact on the project cost. The bidder is encouraged to ask questions of the Technical Contact for the project when preparing a proposal.

							PREPARATION NOTES		
	SERIES	ITEM	VAPOR RETARDER or INSULATION	LONGITUDINAL SEAM	BUTT JOINT SEAM	FITTING REPLICATION	BASE TEST MATERIAL	FINISHED ASSEMBLY BY ITEM	UNIVERSAL FOR ALL ASSEMBLIES
1	**A: LONGITUDINAL JOINT ONLY (except fabric & mastic)**	1	Conventional ASJ (outside paper layer)	PSA Self-Seal Lap (SSL)	None	None	No prep needed	Seal seam with factory-applied SSL tape	The preparation of specimens is to be guided by elements of manufacturers' instructions and best industry practice. Proper materials, workmanship and the experience of the specifier and installer are critical in real-world field installation, and this criticality must carry over into preparation of test specimens. As noted in the task/milestone 3, the intent of the PMS is to assure all materials are correct, and properly installed/assembled.
2		2	Poly Surface ASJ (outside film layer)	SSL	"	"	"	"	
3		3	PVdC	SSL	"	"	Requires fab shop or lab application to base fiberglass with adhesive normally used for this application . SSL applied to sheets prior to attachment to insulation	Seal seam with SSL	Assemble systems on rigid pipe of appropriate OD to match insulation ID. Test specimen sections will be carefully cut from this assembly.
4		4	PFP (zero permeance (PET/1 mil foil/PET)	SSL	"	"	"	"	Apply tapes using a tape squeegee, laying down and smoothing in a manner to achieve full contact under pressure and to minimize the occurrence of tunnels or "fish mouths".
5		5	Self-adhering Laminate Jacket (C1775)	Self-seal overlap	"	"	Cut sheets of jacket sized to fit pipe insulation	Apply to fiberglass and seal overlap. May required filament tape to hold insulation on pipe	Carefully cut finished test sections from the full pipe section, avoiding excessive hand pressure and damage from cutting. Ends must be flat, and perpendicular to the longitudinal axis.
6		6	Fabricated cellular glass pipe insulation with no vapor retarder	Butyl joint sealant	"	"	Requires fabrication of block insulation into clamshells to appropriate test specimen size	Band clamshells together with filament tape after joining with sealant	
7		7	NBR/PVC standard permeance flexible elastomeric pipe insulation with no vapor retarder	Contact adhesive joint	"	"	No prep needed	Seal seam with contact adhesive. May need some form of internal support once sealed	The integrity of the end caps on finished specimens is as critical as the elements of assemly of the vapor retarder system. End caps must be of virtually zero permeance.
8		8	EPDM very low permeance flexible elastomeric pipe insulation with no vapor retarder	Contact adhesive joint	"	"	"	"	
9		9	Open weave fabric and solvent-based vapor retarder mastic	None	"	"	"	Apply per manufacturers' instructions to required thickness, to be confirmed by PMS.	
10		10	Open weave fabric and water-based vapor retarder mastic	None	"	"	"	"	
11	**B: LONGITUDINAL AND BUTT JOINTS**	1	Conventional ASJ (outside paper layer)	SSL	ASJ tape	None	Add ASJ 3" butt strip to item 1 in section A	Seal per item 1 in section A and butt two factory ends; seal with butt strip tape	
12		2	Poly Surface ASJ (outside film layer)	SSL	ASJ tape	"	Add ASJ 3" butt strip to item 1 in section B	Seal per item 2 in section A and butt two factory ends; seal with butt strip tape	
13		3	Poly Surface ASJ with PVC jacket cover	Solvent weld	Solvent weld	"	PVC cut into sheets; to be applied over item 2 in section A	Overlap and solvent weld longitudinal and butt joints	
14		4	PVdC	SSL	PVdC tape	"	Add 3" PVdC tape to item 3 in section A	Butt insulation sections and seal joints with tapes	
15		5	PFP (zero permeance (PET/1 mil foil/PET)	SSL	PFP tape	"	Add 3" PFP or, if not available, 3" 2 mil foil tape to item 4 in section A	"	
16		6	Self-adhering Laminate Jacket (C1775)	Self-overlap	Self-overlap	"	Same as item 5 of section A	Per item 5 of section A; circumferentially overlap adjoining sheets of jackets and self-seal	
17		7	Fabricated cellular glass pipe insulation with no vapor retarder jacket	Butyl joint sealant	Butyl joint sealant	"	Add joint sealant for butt joint	A means of holding the two sections of butted insulation together after sealing must be devised.	
18		8	NBR/PVC standard permeance flexible elastomeric pipe insulation with no vapor retarder	Contact adhesive joint	Contact adhesive joint	"	Add contact adhesive to item 7 of section A	Per item 7 of section A (applies to butt joint as well as longitudinal joint)	
19		9	EPDM very low permeance flexible elastomeric pipe insulation with no vapor retarder	Contact adhesive joint	Contact adhesive joint	"	Add contact adhesive to item 8 of section A	"	
20	**C: LONGITUDINAL JOINT AND PVC COVER SECTION SEALED WITH PVC TAPE**	1	Conventional ASJ (outside paper layer)	SSL	None	PVC fitting cover material in rectangular shape; solvent weld longitudinal overlap; PVC tape for transition to jacket	PVC material cut to fit pipe section OD and chosen length of test section	Insert fiberglass blanket insulation with vapor retarder under the PVC. Solvent weld longitudinal overlap of PVC. Wrap jacket/PVC joint with PVC tape	
21		2	Poly Surface ASJ (outside film layer)	"	"				
22		3	PVdC	"	"				
23		4	PFP (zero permeance (PET/1 mil foil/PET)	"	"				
24	**D: LONGITUDINAL JOINT AND PVC COVER SECTION SEALED WITH MASTIC**	1	Conventional ASJ (outside paper layer)	SSL	None	PVC fitting cover material in rectangular shape; solvent weld longitudinal overlap; mastic coating for transition to jacket	"	Insert fiberglass blanket insulation with vapor retarder under the PVC. Apply VPC and solvent weld longitudinal overlap. Seal PVC/jacket joint with vapor-retarder mastic	
26		2	Poly Surface ASJ (outside film layer)	"	"				
27		3	PVdC						
28		4	PFP (zero permeance (PET/1 mil foil/PET)	"	"				
29	**E: LONGITUDINAL JOINT AND SECTION WITH WATER- BASED FAB & VR MASTIC**	1	Poly Surface ASJ (outside film layer)	SSL	None	Fabric and mastic only	Center section of specimen installed as fabric & vapor retarder mastic coating.	Use only vapor-retarder mastic, applied per manufacturers' instructions to required thickness.	
30		2	PVdC	"	"	"			
31		3	PFP (zero permeance (PET/1 mil foil/PET)	"	"	"			
32	**F: LONGITUDINAL JOINT AND SECTION WITH SOLVENT-BASED FAB & VR MASTIC**	1	Poly Surface ASJ (outside film layer)	SSL	None	Fabric and mastic only	"	Use only vapor-retarder mastic, applied per manufacturers' instructions to required thickness.	
33		2	PVdC	"	"	"			
34		3	PFP (zero permeance (PET/1 mil foil/PET)	"	"	"			

VAPOR RETARDERS & LOW PERMEANCE INSULATIONS
TO BE TESTED PER ASTM E96
DRY CUP @ 90°F / 90% RH

3 SPECIMENS & 1 BLANK PER PRODUCT

	VAPOR RETARDER
1	Conventional ASJ
2	Poly Surface ASJ
3	PVdC
4	PFP (zero permeance (PET/1 mil Foil/PET)
5	Self-adhering Laminate Jacket (C1775)
6	PVC protective jacket
7	Water-based VR mastic and fabric
8	Solvent-based VR mastic and fabric
9	Cellular glass
10	NBR/PVC standard permeance flexible elastomeric insulation with no vapor retarder
11	EPDM very low permeance flexible elastomeric insulation with no vapor retarder