White Paper: Water Vapor Permeance Testing

Of Chilled Water Fittings, Inc.'s Jacket Systems (Rev. 0)

by R&D Services, Inc.

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Summary: R&D Services conducted water vapor permeance testing of two different jacket systems supplied by Chilled Water Fittings, Inc. (CWFI). These tests are covered by Report Number RD15385 (dated July 21, 2015). The two sets of tests were each conducted following ASTM E96/E96M-14, Test Method A and each with three specimens, as required by E96. The first set of specimens (Sample A) included a joint between two types of jacket: Proto's 0.015 inch thick PVC jacket with CWFI's foam tape adhered to it and All Service Jacket (ASJ) taken from Knauf Earthwool® 1000 Pipe Insulation. The second set of specimens (Sample B) included a joint between two identical pieces of jacket made of Proto 0.015 inch thick PVC jacket with CWFI's foam tape between the two, adhered to one of the two PVC pieces. Proto's Product Data Sheet gives the water vapor permeance of their 0.015 inch thick PVC jacket as 0.058 perm and Knauf's Product Data Sheet gives the water vapor permeance of their ASJ as 0.020 perm. The result of testing Sample A was a system permeance of 0.055 perm and the result of testing Sample B was a system permeance of 0.069 perm. The significance of these results is that CWFI's jacket systems, with joints, now has performance results that the mechanical designer can use in his insulation system design. Further, each is within 15% of the value of homogeneous PVC jacket with no joints.

Objective: The objective of running these tests was to obtain performance data on the jacket system water vapor permeance with joints. These two types of joints (PVC jacket to ASJ and PVC jacket to PVC jacket) are commonly used in insulation systems used to insulate chilled water pipes in HVAC applications.

Background: In North America, fiberglass with ASJ pipe insulation is the most commonly used pipe insulation for HVAC applications. It is installed on both above ambient and below ambient (i.e., chilled water) pipes. For below ambient applications, one major design objective is a significant reduction in the quantity of water vapor intrusion from the ambient air to the cold pipe surface. For fiberglass with ASJ, this is accomplished using ASJ itself since it has a water vapor permeance of 0.02 perm, per ASTM test method E96, Procedure A. 0.02 perm is a low permeance value. The lap joints have a pressure sensitive adhesive and the butt joints are taped with a matching pressure sensitive tape, both to assure a low leakage system.

Pipe fittings on these fiberglass with ASJ insulation systems are typically insulated with pieces of low density fiberglass blanket material placed inside of shaped PVC fitting covers. The product data sheet from one PVC fitting cover manufacturer, Proto, gives the water vapor permeance of their 0.015 inch thick sheet as 0.058 perm (i.e., almost three times greater than that of ASJ). A PVC fitting, such as for a 90° elbow, typically has two halves, or "clamshells", that match one another and, when sealed thoroughly, are expected to provide a low permeance elbow insulation system, or at least when perfectly sealed. The permeance of the 0.015 inch thick PVC jacket with perfect joint seals would be

0.058 perm. Imperfectly sealed fittings would result in a permeance greater than 0.058 perm. There are three different sealing methods typically used for PVC to PVC jacket. One is to use a special PVC glue applied during installation. The second is to use PVC, pressure sensitive tape. A third, and most common, is to use vapor retarder mastic; this type of joint is assumed to be vapor tight although there is no publicly available data substantiating this.

The PVC fitting cover to ASJ joints are typically sealed using vapor retarder mastic. Such a joint is assumed to be vapor tight although there is no publicly available data substantiating this.

In a typical HVAC application, there are hundreds if not thousands of these PVC fitting covers, each with two PVC to PVC joints and each with two PVC to ASJ joints to be sealed. For the contractor, installing and sealing the PVC fitting covers is time consuming if he is to assure that each is tightly sealed. Contractor installation time saved is of potential value to all entities involved: the facility owner, the general contractor, the mechanical contractor, and the insulation contractor.

Methodology: CWFI hired R&D Services to conduct water vapor permeance tests using test method ASTM E96, Method A. This test method is designed to test a single vapor retarder sheet or film. Hence, there was one major variation in the test method from that typically used, namely to include a joint in the middle of each test specimen. With each of the two samples, the joint included CWFI's proprietary strip of foam rubber as the sealant (i.e., this consists of a thin strip of foam rubber adhered to a PVC fitting cover with a pressure sensitive adhesive). Other than this variation, the E96 test method was strictly followed by R&D Services.

Test Results: The results for Sample A (i.e., PVC sheet and Knauf's ASJ) were an average permeance, of three specimens), of 0.55 perm. The results for Sample B (i.e., two PVC sheets) were an average permeance of 0.69 perm.

Conclusions: There is no publicly available water vapor permeance performance data on the commonly used joints for PVC sheet and ASJ or for PVC with PVC sheet. Therefore, the only comparison that can be made is to the homogeneous material itself. With the permeance of 0.015 inch thick PVC sheet given by the manufacturer as 0.58 perm and that of the ASJ being given as 0.02 perm, we would expect the 0.58 perm to be the limiting permeance (i.e., we wouldn't expect the results of our tests to be lower than that, plus or minus 20%). Therefore, the 0.55 perm obtained with Sample A is as low as we would expect. The result for Sample B was 19% greater than that for PVC sheet by itself, a value which shows very good performance since it is within 20% of the homogenous material. Furthermore, it is a value which can be used by mechanical designers when they design an insulation system for chilled water pipes using fiberglass with ASJ pipe insulation and PVC fitting covers.

Recommendations for further testing: Since no manufacturers have apparently performed permeance testing on standard joints of PVC sheet to ASJ and PVC sheet to PVC sheet, it is recommended that these tests be performed. Also, with at least three different types of ASJ being available on the market, it is recommended that each of these be tested with the standard joints. These can now be done using Practice ASTM C1809 in conjunction with test method ASTM E96.

References:

1. Test Report: Water Vapor Transmission Measurements According to ASTM E96 on Proto Samples Supplied by Chilled Water Fittings Company, R&D Services Report # RD15385, July 21, 2015.
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3. Proto Fitting Covers, Proto Regular PVC, Product Data Sheet, Dated 05/01/07.
4. Knauf Earthwool® 1000 Pipe Insulation Data Sheet, February, 2015.
5. ASTM International C1809-15: Standard Practice for Preparation of Specimens and Reporting of Results for Permeance Testing of Pressure Sensitive Adhesive Sealed Joints in Insulation Vapor Retarders, 2015.