Water Infiltration Testing Using Infrared Thermography

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INTRODUCTION

The objective of field testing is to correlate paths of moisture infiltration with the observed damages. Anyone can observe moisture coming into a building during harsh weather events but the most reliable way to test for moisture is to actually recreate the leakage in a controlled manner so the path of the leak can be traced to its origin. Water intrusion testing with the use of infrared thermography allows verification of the hypothesis for the cause of water infiltration without destructive testing. This paper contains the basic types of water intrusion testing and their descriptions, testing procedures, and the implementation of infrared thermography.

TYPES OF TESTING

Water Spray Rack - This test simulates a wind-driven rain condition on a subject. It can assist in determining the specific cause and origin of moisture infiltration when it is used to test independent components of the envelope. Spraying water over a large area in an uncontrolled fashion will not reveal specific causes of moisture infiltration.

Hose Spray Test - This test method also simulates wind-driven rain in small, segmented areas using a standard garden hose in which a calibrated nozzle is attached with a pressure gauge. The spray is directed at a specific joint, crack, or defect to reveal potential moisture intrusion.

Differential Pressure Test - A pressure chamber is typically constructed on the interior of the facility at a specific location to test moisture driven through an assembly or component. The assembly or component is subjected to a negative force while simultaneously a spray rack test is directed at the assembly to draw the moisture into the facility to simulate a negative pressure under a wind-driven rain condition.

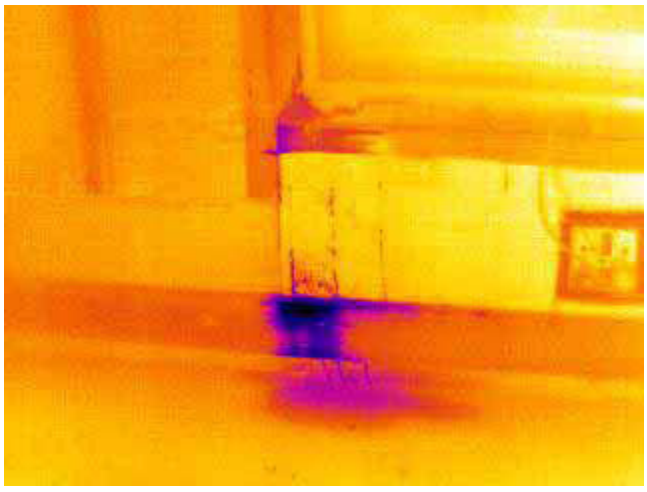

Figure 1. Thermogram documenting window leak. Calibrated spray rack system.

Figure 2. Photo of chamber system, negative air fan, pressure monitor, and calibrated spray rack system.

TESTING PROCEDURES

A thorough inspection using infrared thermal imaging equipment must be performed on the interior area surrounding the subject area or fenestration product to note any moisture present, if any, prior to any type of water testing.

Water penetration resistance tests using uniform static pressure testing and cyclic static pressure testing shall be conducted at a static test pressure equal to 2/3 (0.667) of the test pressure specified for the applicable product designation in the ANSI/AAMA/NWWDA 101/I.S.2., unless otherwise specified by the specifying party. Unless otherwise specified by the specifying party, uniform static pressure testing will be applied to Architectural Class fenestration products and cyclic static pressure testing will be applied to Residential, Light Commercial, and Commercial Performance Class fenestration products. Both test methods may be applied to Heavy Commercial Class fenestration products.

When performing a test which requires negative pressure, a negative pressure chamber must be constructed around the test subject. Due to the infrared transmissive properties of polyethylene plastic, the negative pressure chambers should be constructed with 4 mil visqueen. This will allow a thermographer to detect any infiltration which occurs during testing without disrupting the test in progress. If large quantities of water infiltration are occurring during the test, the test can be terminated early to prevent flooding the interior of the structure and causing more damage.

Uniform static pressure testing – Perform as follows:
Adjust the valve on the water-spray system so that the intake water is being delivered at a rate of not less than 4gal/hr or more than 10gal/hr on one square foot area. Apply the specified static air pressure difference within 15 seconds and maintain this pressure, along with the specified rate of water spray for not less than 15 minutes. Observe and note points of water penetration, if any, that occur during the test using infrared thermal imaging equipment. Remove the air pressure difference and stop the water spray. Carefully inspect the test specimen for any additional evidence of water penetration and note any such evidence for the report.

Cyclic static pressure testing – Perform as follows:
Adjust the valve on the water-spray system so that the intake water is being delivered at a rate of not less than 4gal/hr or more than 10gal/hr on one square foot area. Apply the specified static air pressure difference across the test specimen promptly and maintain this pressure, along with the specified rate of water spray, for the period of time stipulated by the specifications of the ANSI/AAMA/NWWDA 101/I.S.2. or the specifying party. Unless otherwise specified, the duration of the pressure cycle shall be 5 minutes. While maintaining the water spray, reduce the air pressure difference to zero for a period of not less than 1 minute. Unless

otherwise indicated by the specifying party, the zero pressure periods shall be 5 minutes. Repeat the preceding two steps for the specified number of cycles. In no case, however, shall the total time of pressure application be less than 15 minutes. Observe and note points of water penetration, if any, that occur during the test using infrared thermal imaging equipment. At the conclusion of the required number cycles, remove the air pressure difference and stop the water spray. Carefully inspect the test specimen for any additional evidence of water penetration and note any such evidence for the final report.

Figure 3. Infrared thermography allows visible access within the testing chamber – Photo of exterior spray rack system

Figure 5. Thermogram/photo showing water migrating behind siding, additional testing found water coming from the above deck.

SUMMARY

The utilization of infrared thermal imaging equipment in conjunction with water testing provides irrefutable evidence on the cause and origin of moisture infiltration. The combination of field testing and infrared thermal imaging allows the path of moisture intrusion to be correlated with observed damages along with documentation. Depending on the type of water test performed, infrared will allow the testing party to determine the precise point of penetration and the faulty component allowing water infiltration to occur. Infrared thermal imaging also allows the testing party to observe the test in progress without disturbing the testing chamber. With further study and development of water testing, the utilization of infrared thermography should become integrated as part of the standard practice for water testing.

REFERENCES

ASTM Standard E 1105-00 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

AAMA Standard 502-02 Voluntary Specification for Field Testing of Windows and Sliding Glass Doors

AAMA Standard 501-05 Methods of Tests for Exterior Walls