Holiday Inspection Technical Bulletin

MANUFACTURER

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DESCRIPTION

Holiday detection is an inspection procedure used to locate discontinuities or "holidays" in a coating film. A holiday is a hole or void in the coating film which exposes the substrate to corrosion. The term holiday dates back to the days of wooden sailing ships. A sailor would seal the mast of the ship with tar to prevent the wood from rotting. If the sailor missed coating an area of the mast the wood would rot. It was said, the sailor must have taken a "holiday" at that point, thus not achieving a good coat of tar on the mast. Typically, holiday inspection is performed using specialized equipment divided into two main groups; low and high voltage testers. Low voltage holiday testers are used for coatings up to 20 mils DFT. High voltage testers produce up to 40,000 volts of pulsed DC current. These units are used to test thick film coatings such as those used by Raven applicators. There are several industry standards regarding holiday testing including ASTM D-4787 & D-5162 and NACE RPO 188-88.

In most cases Raven coatings are applied at 40 to 250 mils in thickness. The accepted rule of thumb for a starting point test voltage is to use 100 volts per mil of coating thickness. Therefore, for 125 mils, a voltage of 12,500 volts should be used to begin with. The unit should be tested by dragging the electrode over a known or induced (a hole drilled in the coating to the substrate) holiday. If the unit does not detect the holiday, voltage and/or sensitivity should be increased until it the audible or visual alarm indicates a holiday. It is also important to ensure that the grounding cable is effectively connected to the substrate in order to complete the circuit. On concrete substrates this may be difficult depending upon the moisture content and conductivity of the concrete. The grounding cord may be connected to bare concrete using a method such as a wet sandbag with a piece of wire window screen, attaching to exposed rebar, or driving a masonry nail or screw into the concrete. If the conductivity of the concrete is not sufficient to complete the circuit, holiday testing may not be feasible. In such cases a conductive primer may be applied prior to the protective coating application. Alternatively, a close visual inspection should be performed and all possible holidays repaired.

A properly calibrated test unit, having a good ground and conductive substrate, will signal holidays via the units' audible or visual alarm. Depending upon the environment and the conditions present on the coating surface, there may be small visible electrical discharges which should not be considered holidays unless the test unit senses the completion of the circuit to the substrate as indicated by the alarm. Testing should not be performed on coatings which have been exposed to immersion service as the moisture content of the coating may provide erroneous results or possible coating damage. Testing should be performed strictly according to accepted standards and by qualified and trained personnel. Holiday testing in no way detects or confirms coating thickness and should not be used for such purposes.

Since holiday detectors generate high voltage and create sparks, there are important safety concerns which must be addressed. Never use a holiday detector in a flammable or otherwise hazardous atmosphere as fire or explosion could occur. Consult with the equipment manufacturer for safety procedures.

Listed below are critical excerpts from the ASTM and NACE standards:

ASTM D-4787

5.5 This practice is intended for use only with new linings applied to concrete substrates. Inspecting a lining previously exposed to an immersion condition could result in damaging the lining or produce an erroneous detection of discontinuities due to permeation or moisture absorption of the lining. Deposits may also be present on the surface causing telegraphing. The use of a high voltage tester on a previously exposed lining is not recommended because of possible spark through which will damage an otherwise sound lining. A low voltage tester can be used but could produce erroneous readings.

6.1 High Voltage Spark Tester—an electrical detector with a voltage rating in excess of 800 V. The detector is to consist of an electrical energy source, an exploring electrode, a ground connection, and ground wire. The detector shall be equipped with a visual or audible indicator, or both.

6.1.4 Visual or Audible Indicators, or both, to signal a closed electrical circuit. Such signals shall be essential for testing the underlayment for electrical conductivity and for exposing discontinuities in the lining after it has been applied.

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13.1 The surface of the applied lining shall be clean, dry, free of oil, grease, dirt, or other contaminants and be sufficiently cured in accordance with the manufacturer's latest published instructions at the time the testing is performed.

13.2 Attach the ground wire from the instrument ground terminal to the conductive underlayment or appropriate ground in the same manner as was required in 8.4.4. Make contact with the exploring electrode at a known discontinuity to verify that the instrument is properly grounded. For each ground location, make contact with a known discontinuity. A discontinuity may be produced by drilling a hole through the lining with a 1⁄16-in. (1.59-mm) diameter drill bit. Conduct this test periodically during the test.

13.3 With the exploring electrode in continuous contact with the lining surface, move it over the entire surface of the lining at a rate of 1 ft/s (0.3 m/s) maximum in a sweeping motion with overlapping passes to ensure that the entire surface has been subjected to the test.

13.4 Identify discontinuities that require repair with a compatible marker.

13.5 Completely test the lining one time only. Repair all defects found in the lining and retest only those repaired areas.

RPO 188

4.3.1 A high-voltage (in excess of 800 V) spark tester is an electronic device used to locate discontinuities in a nonconductive protective coating. It consists of an electrical energy source, an exploring electrode, and a ground connection from the indicator signaling current flow through a coating film discontinuity to the substrate.

4.4.4 The high-voltage spark tester shall be adjusted to the proper voltage for the coating thickness being tested. In selecting the inspection voltage, sufficient voltage shall be provided to break the air gap that exists at the holiday. This air gap varies depending on the total applied film thickness. Excessive voltage may produce a holiday in the coating film. The maximum voltage for the applied coating shall be obtained from the coating manufacturer. Table 1 contains suggested voltages that may be used as guides.

4.5.1.4 Touch the exploring electrode to the ground-cable alligator clip. The tester signal should actuate in accordance with the manufacturer's operating instructions.

4.5.1.5 If the tester fails to signal, it shall be considered inoperative.

4.4.7 The exploring electrode shall be moved over the surface of the dry coating at a rate of approximately 0.3 m/s (1 ft/s) using a single pass. Moisture on the coating surface can cause erroneous indications. If moisture exists, it shall be removed or allowed to dry before the test is conducted.

4.4.8 Discontinuities that require repair shall be identified with a marker that is compatible with the repair coating or one that is easily removable.

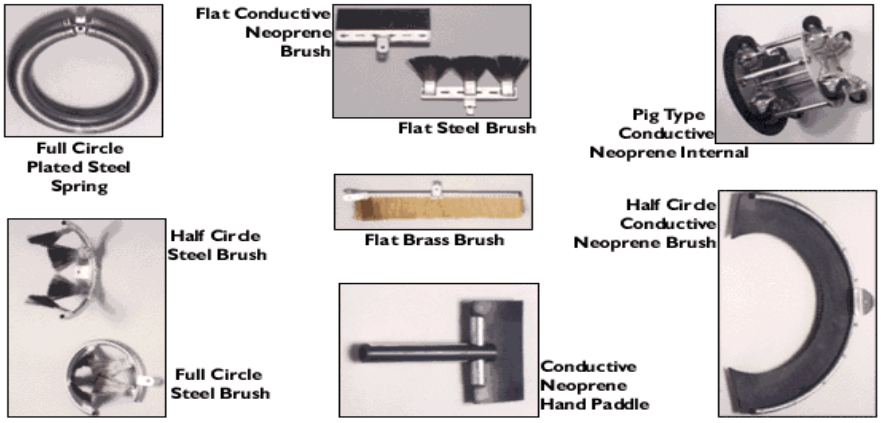
Holiday detection equipment is available from several manufacturers and distributors. For the inspection of Raven coatings it is recommended that a high voltage, DC holiday detector be used. The equipment should be capable of producing a voltage that correlates to the thickness of coating being tested according to the minimum rule of thumb of 100 volts per mil. Typically, Raven coatings are applied in a range of 40 to 250 mils. Thus a detector capable of 4,000 to 25,000 volts should be used. Most detectors operate from a battery pack which have enough capacity to test surfaces for several hours. There are also many different styles of electrodes available. The electrode to be used should be chosen according to the surface to be tested. For smooth, flat surfaces a conductive silicon or neoprene type electrode works well. For irregular or rough surfaces a brush type electrode should be used. There are also round spring electrodes for pipes.

Tinker & Rasor Model AP/W
Voltage Range: 6-16 kV
629-287-5259
www.tinkerrasor.com

Elcometer 266
Voltage Range: 0.1-30 kV
800-521-0635
www.elcometer.com

Spy Model 790
Voltage Range:
5-35 kV
713-681-5837
www.pciltd.com

Electrode Types



USING HIGH VOLTAGE TESTER

Assemble the unit as depicted in the equipment manual:

Connect the power cord to the test unit and the handle

Attach the electrode to the handle or handle extension

Connect ground cable to the unit

Set the unit to the desired test voltage:

For Tinker & Rasor AP/W the 6-16,000 V power pack the switch setting correspond as follows:

L: 6,000 V, 2: 8,000 V, 3: 10,000 V, 4: 12,500 V, 5: 15,000 V, H: 16,500 V

For Elcometer and Spy units adjust the voltage dial to the desired setting viewed on the display

Note: Initially use 100-150 volts per mil of coating thickness (ex. 100 mils = 10,000 V) and increase as necessary to detect a known holiday.

Attach the ground cable to structure or substrate. The ground cable must provide a grounding path to the substrate in order to work properly. For underground structures such as manholes the cable may be attached to the manhole frame, metal rungs, or into the soil around the manhole.

Test the continuity of the tester by turning on the unit and dragging the electrode over a known holiday or uncoated portion of the substrate. If the unit does not alarm then reposition the ground cable. Increasing the test voltage may also be necessary. Adjust the voltage or ground cable until the unit detects the known holiday. Discharges at the electrode may occur randomly, only discharges which are accompanied by the alarm of the test unit should be considered holidays.

Proceed to test coated surfaces using an even movement of the electrode across the surface. Locate and mark holidays (holidays will cause the unit to beep) using a permanent marker. Repair holidays per coating the manufacturer's recommendations.

Avoid contacting the wand handle or electrode with body parts. Also, avoid touching the electrode to conductive surfaces which may shock personnel (such as tripods, winch cables, ladders, scaffolds, etc.). NEVER use holiday detection equipment in a hazardous (flammable or combustible) atmosphere.

RECOMMENDATIONS FOR REPAIRING

Condition of holidays:

There are two main types of holidays that can be present in a coating. The first may be referred to as a void or uncoated area and is typically a result of a lack of coating applied to a surface irregularity such as inside a bughole or along an edge or joint. The other type of holiday may be referred to as a "pinhole" and is typically a result of air or water vapor escaping from the substrate. Pinholes typically occur on masonry and other porous substrates. Both types of holidays may require different repair methods.

Recommended assessment procedure:

Provide access for repair work.

Examine the holiday in the coating to assess the type and cause.

Voids and uncoated areas are identified by their appearance. The holiday will generally be along the edge of a surface or in the bottom of a "bughole". Voids may also cause holidays in hard to spray areas such as the undersides of rungs, pipes, hatchways, protrusions, etc.

Pinhole type holidays will most often look like a small hole in an otherwise well coated area. The hole may be flat or sometimes cone or bubble shaped. Pinhole holidays are caused by air or water vapor escaping from the surface leaving a "pinhole" through the coating all the way to the substrate.

An assessment must be made of the repair method to be employed. This should be based upon the type of holiday and the number of holidays to be repaired. In addition, other factors such as accessibility, available of equipment, time constraints, etc. should be taken into account.

Holidays should be marked using a method that will not contaminate the coating surface (do not use wax or oil type marking devices). Generally a Sharpie maker is suitable.

For pinhole type holidays:

The area surrounding and including the holiday should be cleaned of all contaminates.

The pinhole should be opened up to a minimum of 1/8" diameter to the substrate. This can be accomplished with a drill, die grinder, etc.

The area should then be abraded using 60-80 grit sandpaper, grinding disk or other suitable method.

The area should then be cleaned of abraded material using a clean rag (the addition of a clean sol vent such as acetone to the rag with aid in cleaning the surface).

The area should be allowed to dry and then be inspected for cleanliness.

A repair material that will resist the transmission of air or water vapor, such as Raven 405 with fortifier, may be applied to fill the pinhole to prevent reoccurrence.

A topcoat of the existing coating may then be applied over the filled pinhole and to the surrounding abraded area and allowed to properly cure prior to return to service.

For void type holidays:

The area surrounding and including the holiday should be cleaned of all contaminates.

The area should then be abraded using 60-80 grit sandpaper, grinding disk or other suitable method.

The area should then be cleaned of abraded material using a clean rag (the addition of a clean sol vent such as acetone to the rag with aid in cleaning the surface).

The area should be allowed to dry and then be inspected for cleanliness.

The repair material should then be applied to the abraded area only and allowed to properly cure prior to return to service.

All repairs should be made within the recoat window of the coating—generally 18 hours.

Recoat window is shortened by high substrate temperatures.

Repairs made outside of the recoat window require abrading and cleaning the coating surface per manufacturers recommendations.

All debris, amine blush or other contaminates need to be removed from the coating surface before any repairs are made.