



### Aquastore 1100V Holiday Testing Process

This Technical Bulletin provides a detailed background and description of Engineered Storage Product Company's (ESPC) 1100 volt DC Dry Holiday Testing (Discontinuity Detection) for glass-fused-to-steel panels. These panels are used in Aquastore® liquid storage tanks in the municipal and industrial market segments. Although Section 12.9 of ANSI/AWWA D103-09 by reference to ASTM D1562-01 Test Method A permits the use of 67.5 volt wet bulb testing for coatings with thickness less than 20 mil, Aquastore tanks are tested to the even more stringent 1100V test per Test Method B of ASTM D1562-01. This higher testing is done to greater verify the quality of the glass fusing process and to better detect near voids (thin spots), entrapped contaminants and insufficient bubble structure. Failure to detect these imperfections through the use of only a 67.5V wet sponge test may lead to premature failure of the coating and thus appreciably degrade the tank's critical, front-line barrier to corrosion.

#### Background

Because of the superior results of conducting 1100V Holiday testing on tank coatings, the use of EN 15282:2007 and ISO 28765:2008 standards for 1100V testing are growing globally. Therefore, Aquastore tank panels are tested to these 1100V testing criteria ensuring a 100% holiday free glass-fused-to-steel panel and that there is no damage to the glass coating as a result of the testing process. Incorporation of this testing standard further contributes to Aquastore's already high standards for quality and superior tank coating performance. Meeting current and emerging global standards for tank performance is what not only helps make Aquastore tanks a national leader, but a global benchmark. No wonder why everyone compares their non-glass coating to glass coating performance.

Since 2000, significant improvements have been made in the factory testing equipment for glass coatings. Prior to these improvements there were significant and valid concerns regarding testing results and potential damage being done to the glass layer during the actual testing process. Currently there are several pieces of commercially available equipment that can routinely test glass coatings for Holidays with dependable and repeatable results without damaging the glass coating.

#### Holiday Testing Criteria

ASTM D 5162-01 divides testing into two methods – Method A for low voltage wet sponge testing and Method B for high voltage spark testing. This standard indicates that the low voltage wet sponge test is generally used for determining the existence of continuities in coatings having a total thickness of 20 mils (0.5mm) or less because certain coatings may be damaged if tested with high voltage equipment. This damage may occur if the dielectric properties of the coating are not sufficient to allow the high voltage testing to be used. The fusing process of glass to steel in Aquastore panels creates these superior dielectric properties which are not created in other surface coating processes. So the use of the test itself is a qualitative check of the coating properties in addition to having a sufficient coating thickness and the coating being Holiday free. Engineered Storage Products certifies that the dielectric properties of the Aquastore glass-fused-to-steel coating is sufficient to allow the use of this higher testing voltage.

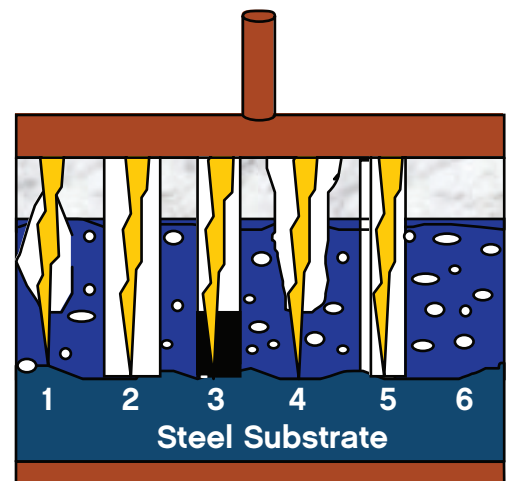


Figure 1 - Voltage Test Sheet Results

- 1 - Current passes through defect below surface (Near Void)
- 2 - Current passes through pin hole
- 3 - Current passes through grease
- 4 - Current passes through thin spot (Near Void)
- 5 - Current passes through small pin hole
- 6 - No Defects. Current DOES NOT pass through a uniform, continuous, quality coating layer.**

## Holiday Testing Process

The purpose of Holiday testing is to detect for the presence and location of discontinuities, voids, and/or near voids (thin spots) in an otherwise non-conductive surface. Holiday testing is performed by generating a DC voltage potential or difference between the glass surface and the steel (or other conductive) substrate, and then detecting any current flow that occurs between the two surfaces.

**Figure 1** illustrates some of the many different types of defects that may be detected.

If testing Vitrium®, Aquastore's three-coat one-fire (3c1f) system, a detector wand is applied to the dry, glass surface while monitoring for any return signal that may be detected on the steel substrate. This circuit is recreated for each and every sheet tested. If a Holiday is detected on any pass of the test wand for any reason the whole panel is rejected, and the entire panel reblasted and recoated. Spot touch-up of a panel is never allowed.

## Benefits and Restrictions of Low Voltage vs. High Voltage Testing

As with any type of testing there are economic, technical and operational tradeoffs. As such, a summary of the benefits and restrictions of both the low voltage wet sponge test and high voltage dry testing processes are provided below.

### Low Voltage Wet Testing

#### The primary advantages:

- A low-cost wet sponge model costs approximately \$250.
- It is fairly easy to use so extensive training is not required
- It is a non-destructive test for most coating thicknesses

#### The primary disadvantages:

- It cannot locate a thickness defect that is masked by the coating or unclean surface
- The coating must be dried after locating a holiday to prevent current from traveling along a wet path and erroneously indicating a holiday where none exists (telegraphing).

### High Voltage, Dry Spark Detector

#### The primary advantages:

- It will detect metallic inclusions
- It will detect low coating thickness or bubbles hidden below the coating surface
- Detected holidays are highly visible and easily isolated

#### The primary disadvantages:

- The high voltage, spark detector cost can cost approximately \$3,000
- It requires a trained operator for use
- It could be a health hazard if inappropriately used

## Non-destructive Testing Voltages

There is a ceiling for the maximum voltage that can be used before the test voltage itself is destructive. By destructive, it is meant that the test voltage creates electrical paths that otherwise would have been satisfactorily coated.

**Figures 2A and 2B** are examples of the maximum voltage that should be used for Holiday testing depending on the coating thickness. Accordingly, EN 14430:2004, 1100V testing can be used below 7.9 mil coating thickness if the properties of the coating are certified by the tank manufacturer.

**Figures 2a and 2b — Standards for Maximum Testing Voltage.** Examples of maximum Holiday testing voltages before destruction of coating may occur in glass layer.

Suggested Voltages for High Voltage Spark Testing		
Thickness		Suggested Inspection Voltage
mils	mm	Volts
8-12	0.20-0.31	1500
13-18	0.32-0.46	2000
19-30	0.47-0.77	2500

Source - ASTM D 5162-01

Test Voltages		
Coating Thickness		Maximum Test Voltage
µm	mils	Volts
200	7.9	1600
210	8.3	1660
220	8.7	1690
230	9.1	1750
240	9.4	1800
250	9.8	1850
260	10.2	1900
270	10.6	1940
280	11.0	1990
290	11.4	2030
300	11.8	2070
400	15.7	2520
500	20.0	2900

Source - EN 14430:2004