Designation: D 6990 – 03

Standard Practice for Evaluating Biofouling Resistance and Physical Performance of Marine Coating Systems[1]

This standard is issued under the fixed designation D 6990; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This method establishes a practice for evaluating degree of biofouling settlement on and physical performance of marine coating systems when panels coated with such coating systems are subjected to immersion conditions in a marine environment. Guidance for preparation or exposure and handling of test specimens can be found in related ASTM standards as noted below (see Section 2).

1.2 This practice and related exposure methodologies are designed as tools for the relative assessment of coating performance, and in no way are to be used as an absolute indicator of long-term performance under all conditions and in all environments. There can be high variability among and within exposure sites with respect to water quality and population or species of fouling organisms, and coating performance may vary with these and other properties.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* A specific hazard statement is given in Section 6.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

Recommended ASTM Methods and Practices for evaluation of antifouling coatings via panel exposure under a variety of exposure conditions:

D 3623 Test Method for Testing Antifouling Panels in Shallow Submergence

D 4938 Test Method for Erosion Testing of Antifouling Paints Using High Velocity Water

D 4939 Test Method for Subjecting Marine Antifouling Coatings to Biofouling and Fluid Shear Forces in Natural Seawater

D 5479 Practice for Testing Biofouling Resistance of Marine Coatings Partially Immersed

D 5618 Test Methods for Measurement of Barnacle Adhesion Strength in Shear

2.2 *ASTM Standards for Reference Only:*[2]

The following ASTM standards may provide the reader with useful information on evaluating physical performance of marine coating systems. The method references are provided only for the convenience of the reader. The reader is not required to specifically apply these methods to the ratings and reporting assigned under this method, but is encouraged to utilize the descriptions, definitions, and pictures provided in the methods to assist in understanding coating physical performance.

D 16 Terminology for Paint, Related Coatings, Materials, and Applications

D 660 Test Method for Evaluating Degree of Checking of Exterior Paints

D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints

D 662 Test Method for Evaluating Degree of Erosion of Exterior Paints

D 714 Test Method for Evaluating Degree of Blistering of Paints

D 772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints

D 4538 Terminology Relating to Protective Coating and Lining Work for Power Generation Facilities

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *biofilm*, *n*—matrix-enclosed populations of microorganisms adherent to each other or to surfaces, or both, or interfaces.

3.1.2 *biofouling adhesion*, *n*—qualitative force required for the successful and complete removal of marine fouling attached to the antifouling coating surface (for example, reference Test Methods D 5618).

[1] This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.45 on Marine Coatings.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.3 *corrosion eruptions*, *n*—build up of oxides, exiting through protective paint film.

3.1.4 *damage*, *n*—limited destruction of portions of paint film due to impact with a foreign article.

3.1.5 *digging*, *n*—a term used to describe hard fouling macroorganisms that are growing “into” the coating. That is, where its calcareous shell penetrates/breaks through the coating surface causing physical damage to the coating.

3.1.6 *macroorganism*, *n*—organisms large enough to be seen with the naked eye. In this context, these organisms would be noted when growing on submerged surfaces.

3.1.7 *microorganism*, *n*—organisms too small to be seen with the naked eye. These generally include bacteria, protozoa, fungi and microalgae. Sometimes also called “slime.”

3.1.8 *peeling*, *n*—the phenomenon manifested in paint films where a portion of a film, when pulled, can be removed in strips or relatively large intact pieces, or both.

3.1.9 *silt*, *n*—sedimentary material consisting especially of mineral particles intermediate in size between those of sand and clay.

3.1.10 *softness*, *adj*—the phenomenon manifested by paints in transferring some of its pigmentation to a foreign item or substance, upon encountering friction on its surface.

3.1.11 *wearing*, *n*—gradual loss of the paint film caused by use or exposure to the environment.

4. Summary of Practice

4.1 Test specimens or panels are coated with marine coating systems and exposed to marine immersion conditions for a specified amount of time and under specific sets of conditions as agreed upon by the producer and user. See 2.1 for published ASTM standard methods and practices that provide guidance for exposure of coating systems.

4.2 Coating systems are evaluated in terms of fouling rating which describes percent of coverage of the coating system by biofouling organisms, and physical deterioration rating which describes the percentage area of the coating system affected by physical coating failure(s). These data are useful in assessing and comparing effectiveness of antifouling coating systems.

5. Significance and Use

5.1 This practice is designed to provide guidance to a panel inspector for quantitative and consistent evaluation of coating performance from test panels coated with marine antifouling coating systems. The practice assesses performance of coating systems based on both antifouling and physical properties.

5.2 The user is cautioned that the results are representative for the specific region and time of year in which the specimens are immersed. It shall be noted that interpretation of results will depend on the geographical location where the test is conducted, whether the coated specimens are exposed either totally or partially immersed, under static or dynamic conditions, and/or in either vertical or horizontal orientation.

5.3 Simultaneous testing of a proven standard antifouling coating system (known to minimize fouling accumulation, for example, containing biocide or active agent(s) to prevent fouling settlement/growth) in the specific marine environment shall be included as a reference to assist in interpretation of results. In addition, a negative control (inert surface susceptible to heavy fouling) shall be included on a regular basis. For the exposure to be valid, the surface of the negative control should show heavy fouling relative to the standard system(s).

5.4 Marine coating systems that produce positive results relevant to the standard system(s) show potential for use in protecting underwater marine structures.

5.5 The format can be utilized independent of exposure protocol and coating type, and provides the end user with a consistent practice and format for reporting of performance rating.

6. Safety Precautions

6.1 **Warning**—Certain marine coating systems contain toxic materials (biocides) that may cause skin and eye irritation on contact as well as adverse physiological effects if ingested or inhaled. In the preparation, application, and general handling of panels coated with various types of marine paints, the use of appropriate protective clothing and equipment is required consistent with local, state, federal government regulations and recognized industrial and technical standards.

7. Procedure—Evaluation of Fouling Present on Test Surface

7.1 Controls should be exposed and assessed at the same time as the test materials. More information about the use of control materials in weathering tests can be found in Guide G 141. (See also 5.3 above.)

7.2 Retrieve test panels and any negative controls and reference coatings from immersion site. Note and record the visual percentage coverage by biofilm or silt, or both, or lack thereof in accordance with the guidelines provided below.

7.3 Prior to inspection, it is recommended that panels be rinsed in order to remove silt (may interfere with observation of attached forms) and unattached forms. Alternatives such as either gentle agitation of the panels or not rinsing the panels may be done but must be specified in the final reports. (Then, check reporting section to make sure this information is required.) Whichever preparation is chosen, it must be documented and performed on all panels equally. If rinsed, the test panel surface is to be wetted using low-pressure water (for example, household pressures from ⅜ to ½ in. garden hose are sufficient) in the form of a gentle shower spray or non-forceful flow to allow for a reliable inspection of what is attached to the coating/panel. Nozzles that cause water to be forcefully applied to the panel shall not be used. **Warning**—Risk in rinsing panels is that subsequent biofouling attachment may be affected. Alternatively, panels may be gently agitated in water to remove loose/unattached bacterial biofilm or silt deposits, or both. **Warning**—Risk in not rinsing panels is that silt or slime, or both, may interfere with assessment of biofouling attachment on complete panel surface.

7.3.1 Water used to rinse panels shall be taken from the immersion site or be of similar salinity to that of the immersion site.

7.4 Test panels shall not be allowed to dry during the entire inspection period. A holding tank is useful for accomplishing this.

7.4.1 Rise water or holding tank water, or both, shall be taken from the immersion site or be of similar salinity.