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Standard Guide for Collecting Skimmer Performance Data in Controlled Environments[1]

This standard is issued under the fixed designation F631; 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 standard provides a guide for determining performance parameters of full-scale oil spill removal devices in recovering floating oil when tested in controlled environments.

1.2 This guide involves the use of specific test oils that may be considered hazardous materials after testing is completed. It is the responsibility of the user of this guide to procure and abide by the necessary permits for disposal of the used test oil.

1.3 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D97 Test Method for Pour Point of Petroleum Products

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

D971 Test Method for Interfacial Tension of Oil Against Water by the Ring Method

D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

D2983 Test Method for Low-Temperature Viscosity of Lubricants Measured by Brookfield Viscometer

D4007 Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure)

~~F625~~F625/F625M Practice for Classifying Water Bodies for Spill Control Systems

F808 Guide for Collecting Skimmer Performance Data in Uncontrolled Environments (Withdrawn 1997)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *data collection period, n*—the period of time during a test run when the performance data are recorded.

3.1.2 *emulsification factor, n*—the increase in total fluids in storage as a result of emulsification by the skimming mechanism, the skimmer pump, or other component of the skimmer.

$$EF = (WC_F - WC_0)/(100 - WC_F) + 1 \quad (1)$$

where:

WC_F = the final water content %, and
WC_0 = the initial water content %.

3.1.3 *fluid recovery rate, n*—the volume of fluid recovered by the device per unit of time m^3/h.

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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] The last approved version of this historical standard is referenced on www.astm.org.

3.1.4 *nameplate recovery rate, n*—the maximum skimming capacity of a device as stated by the manufacturer.

3.1.5 *oil encounter rate, n*—the volume of oil per unit time actively directed to the removal mechanism (m^3/h).

3.1.6 *oil recovery efficiency, n*—the ratio, expressed as a percentage, of the volume of oil recovered to the volume of total fluids recovered.

3.1.7 *oil recovery rate, n*—the volume of oil recovered by the device per unit of time (m^3/h).

3.1.8 *oil slick, n*—the oily fluid encountered by the skimmer.

3.1.8.1 *Discussion*—

Most real oil slicks actually are composed of various proportions of pure oil, water-in-oil (W/O) emulsions, and oil-in-water (O/W) emulsions; therefore, efficiencies and other performance criteria must be differentiated between those based on the oil slick itself, and those based on only the water-free oil contained within the oil slick.

3.1.9 *oil slick encounter rate, n*—the volume of oil slick per unit time actively encountered by the skimmer, and therefore, available for recovery (m^3/h).

3.1.10 *oil slick recovery efficiency, n*—the ratio, expressed as a percentage, of the volume of oil slick recovered to the volume of total fluids recovered.

3.1.11 *oil slick recovery rate, n*—the volume of oil slick removed from the water surface by the skimmer per unit of time.

3.1.12 *oil slick thickness, n*—the average thickness of the oil slick encountered by the test device (mm).

3.1.13 *test fluid, n*—the oil or oil/water mixture distributed on the water of the test facility and presented to the spill removal device for recovery.

3.1.14 *throughput efficiency, n*—the ratio, expressed as a percentage, of the volume of oil recovered to the volume of oil encountered.

4. Significance and Use

4.1 This guide provides quantitative data in the form of oil recovery rates, throughput efficiencies, and oil recovery efficiencies under controlled test conditions. The data can be used for evaluating design characteristics of a particular spill removal device or as a means of comparing two or more devices. Caution must be exercised whenever test data are used to predict performance in actual spill situations as the uncontrolled environmental conditions that affect performance in the field are rarely identical to conditions in the test tank. Other variables such as mechanical reliability, presence of debris, ease of repair, ease of deployment, required operator training, operator fatigue, seaworthiness, and transportability also affect performance in an actual spill but are not measured by this guide. These variables should be considered along with the test data when making comparisons or evaluations of spill removal devices.

5. Summary of Guide

5.1 The spill removal device may be tested in a wave/tow tank or other facility that is suitable for controlling the appropriate test parameters. Significant testing results can be obtained using simple test tanks or ponds, particularly when calm water and low velocity advancing tests are desired as an economical means to screen and compare devices. Controlled test variables include relative velocity, oil properties and slick thickness, wave conditions, and pertinent device variables. It is essential that the device be operated in a steady-state condition during the sampling period when oil encounter rate, recovery rate, recovery efficiency, and device parameters are monitored, measured, and recorded.

6. Interferences

6.1 The table of results (see 13.1) shall address the possibility of test facility effects. For example, wall effects may interfere hydrodynamically with the device's performance.

6.2 Care should be taken that any containment means that is not inherent in the skimming device does not affect the oil distribution to the device.

7. Test Facilities

7.1 Several types of test facilities can be used to conduct the test outlined in this guide.

7.1.1 *Wave/Tow Tank*—A wave/tow tank has a movable bridge or other mechanism for towing the test device through water for the length of the facility. A wave generator may be installed on one end, or on the side of the facility, or both.

7.1.2 *Current Tank*—A current tank is a water-filled tank equipped with a pump or other propulsion system for moving the water through a test section where the test device is mounted. A wave generator may be installed on this type of test facility.

7.1.3 Other facilities, such as private ponds or flumes, may also be used, provided the test parameters can be suitably controlled.

7.2 Ancillary systems for facilities include, but are not limited to, a distribution system for accurately delivering oils to the water surface, skimming systems to assist in cleaning the facility between tests, and adequate tankage for storing the test oils.

8. Test Oils

8.1 Test oils for use with this guide should be selected to fall within the parameters specified in Appendix X1. These oils may be crude, refined, or simulated.

8.2 If test oils vary significantly from the recommended ranges, the test report shall discuss the implications of such deviations on the performance of the device.

8.3 The viscosity of oil varies greatly with temperature. Frequently test oils must be distributed in the test facility at temperatures different from the water temperature. When this occurs, the oil generally will approach the surface water temperature.

8.4 If oils that originally meet the conditions stated in Appendix X1 are reused, their properties may change and should be evaluated prior to reuse.

9. Safety Precautions

9.1 Test operations shall conform to established safety (and regulatory) requirements for both test facility operations and oil handling. Particular caution must be exercised when handling flammable or toxic test oils.

10. Test Device

10.1 The test device shall be deployed in accordance with facility operating characteristics. The device must be operated in accordance with the manufacturer's specified operating instructions with respect to mechanical operations and established maintenance routines. Modifications to the device, in any modification from commercial design, shall be recorded with the test results.

10.2 The make and model of the device, its nameplate recovery rate, and any other identifying specifications shall be recorded with the test results.

11. Test Variables

11.1 At the outset of the test, the independent or control test parameters are selected. The test evaluator should include a discussion of the procedures that were used to establish calibration and standardization. Data should be expressed with an indication of variability. Typical test variables include:

Test oils	as stated in Appendix X1
Test speed	upper and lower limits and speed increments selected as appropriate within ± 0.1 m/s
Oil slick thickness	1, 5, and 25 mm and other thicknesses as appropriate
Wave conditions	wave characteristics of significant height, average length, and average significant period and pattern may be varied as appropriate to the design of the skimmer
Wave height	0 mm, 150 mm, and 450 mm
Debris	Use various materials to simulate various forms of natural debris that may hinder skimmer operation. Recommended materials include: polypropylene rope, ½ in. diameter, cut into lengths ranging from 4 in. to 2 ft; softwood lumber, nominal dimensions 2 by 2 in., lengths ranging from 4 in. to 2 ft; foam sponges, nominal size 4 to 12 in; broken ice, nominal size 1 to 4 in. diameter; seaweed, lengths up to 5 ft; plastic or aluminum disposable containers (such as soda cans); sorbent pads, booms, or sheets; or other suitable materials. Use adequate number of pieces to produce concentrations at the skimmer inlet area corresponding to 50 % surface coverage.

12. Procedure

12.1 Prior to the test, select the operating parameters, such as tow speed (as applicable), wave conditions, test fluid, and oil distribution rate. Then prepare the facility and spill removal device for the test run. Occasionally, it may be necessary to preload the device with test fluid to achieve steady-state operation within a reasonable period of time. Any preload must be carefully measured and discharged into the device. Measure or note immediately prior to each test the following parameters describing ambient conditions:

12.1.1 Air temperature (°C),

12.1.2 Water temperature near the surface (°C),