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Standard Test Method for Determining a Measured Nameplate Recovery Rate of Stationary Oil Skimmer Systems[1]

This standard is issued under the fixed designation F2709; 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 test method defines a method and measurement criteria to quantify the performance of a stationary skimmer in ideal conditions in support of a device's nameplate recovery rate (capacity). If a determination of a skimmer's capabilities in realistic conditions (that is, advancing or waves) is required, testing should be performed according to Guide F631 or equivalent.

1.2 This test method includes the option of testing to determine recovery efficiency.

1.3 This test method and parameters are intended to provide ideal recovery conditions allowing the skimmer system to operate and collect oil at its maximum possible recovery rate. Given ideal conditions, inherent mechanical and physical attributes of the system become the limiting factors.

1.4 This test method is intended to identify limitations of the skimmer system, such as performance of the skimming mechanism, the flow of oil within the skimmer and sump, the pump characteristics, and typical discharge head conditions.

1.5 It is accepted that the measured nameplate recovery rate as determined by this test method will not likely be achievable under actual conditions of a spill. The measured nameplate recovery rate should be used in conjunction with a de-rating factor to account for such issues as changing encounter rate, changes in other recovery conditions, changes in oil properties and slick thickness, number of daylight hours, operator downtime, less than ideal control of skimmer settings, and inclement weather.

1.6 This test method involves the use of specific test oils that may be considered hazardous materials. It is the responsibility of the user of this test method to procure and abide by necessary permits and regulations for the use and disposal of test oil.

1.7 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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 Automatic Transmission Fluids, Hydraulic Fluids, and Lubricants using a Rotational Viscometer

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

F631 Guide for Collecting Skimmer Performance Data in Controlled Environments

[1] This test method is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and is the direct responsibility of Subcommittee F20.12 on Removal.

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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. Terminology

3.1 *Definitions:*

3.1.1 *deadheading*—within a pump system, this occurs when the discharge line is blocked.

3.1.1.1 *Discussion*—

For example, when a valve on the discharge side is closed with no other flow path available.

3.1.2 *fluid recovery rate*—the volume of fluid recovered by the device per unit of time (m^3/h).

3.1.3 *ideal conditions*—operating conditions that result in the maximum nameplate recovery rate of a skimming system within the limitations of the test method.

3.1.4 *measured nameplate recovery rate*—the maximum rate at which the skimmer system can recover and process oil under ideal conditions.

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

3.1.6 *oleophilic*—oil skimmers that use collection surfaces for recovery, for example, disc, brush, drum, belt, mop, and so forth.

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

3.1.8 *preload volume*—the total volume of oil within the defined test area. When pertaining to this test method, typically comprised of the volume necessary to create a 75 mm thick oil slick in the defined test area plus any additional oil for use during startup.

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

3.1.10 *skimmer system*—a skimmer and ancillary equipment, including power supply, hydraulic lines, discharge pump, suction/discharge hoses, and control apparatus.

4. Significance and Use

4.1 It has been industry practice to claim the capacity of a skimmer based on the rate of the discharge pump (which are typically rated using water as a test fluid) or other arbitrary methods.

4.2 End users need a test methodology that evaluates optimum performance data for planning and selection of equipment.

4.3 This test method will assist producers and other stakeholders to verify and accurately report skimmer system performance.

4.4 This test method is specifically designed to quantify two key skimmer performance values, to reduce testing costs, and to encourage industry wide performance standardization.

4.5 This test method establishes test conditions that will result in a measured nameplate recovery rate and an indication of the combination of test parameters (oil type, viscosity, operating speed) that result in the highest average performance for the tested skimmer system.

4.6 This test method will validate the performance of the discharge pump in the skimmer system, under conditions that are typical of a recovery operation. Specifically, this will include a modest imposed head pressure composed of static head and dynamic friction losses due to a specified length of discharge hose.

4.7 This test method encourages performance testing using two or more oils for comparison purposes.

4.8 Tests shall be conducted under well-documented conditions and generate repeatable results. More detailed testing and collection of skimmer performance is covered under existing standards (for example, Guide F631).

4.9 Testing (SL Ross 2007)[3] has shown that, when water is present, recovery performance in slick thicknesses ranging from 50 mm to 75 mm results in values comparable to significantly thicker slicks. This may not be the case with high-rate skimmers in viscous oil, where the rate of oil recovery exceeds the rate at which the slick will flow to the skimmer mechanism.

4.10 For skimming systems that include various options for the discharge pump, the test described in this test method may be used to measure the performance of the skimming component of the system. Performance of the pumping component can be measured independently using the same viscosity of oil and the discharge head conditions noted in this test method. The measured nameplate recovery rate of any specified skimming component and pump combination would be the lesser of the skimming component and the pump.

[3] S. L. Ross Environmental Research Ltd., *Skimmer Tests at the Ohmsett Facility to Validate a Standard Test Protocol for Nameplate Recovery Rate*, Minerals Management Service, Herndon, VA, 2007 .

5. Test Facilities

5.1 The minimum lateral dimensions of the test tank shall be three times the length and width of the skimmer device, that is, if the skimmer has a dimension of 1 by 1.5 m, the test area shall be 3 by 4.5 m. If the test is conducted without the presence of water, the tank may be smaller; however, the skimmer must float freely and be clear of the tank walls throughout the test period. The tank depth shall accommodate the skimmer without grounding during the test.

5.2 Test oils shall be identified by industry-accepted name and are recommended to fall within the five categories defined in Guide F631.

5.3 It is recommended the skimmer system be tested in two or more oil types for comparison purposes.

5.4 The oils used for testing will be characterized from samples taken at the start of a test period or when oil is replenished from a new source. A test oil log shall be generated and will indicate test oil type, sample number, temperature, and test date.

5.5 The following tests are to be conducted on oils: viscosity (Test Method D2983), bottom solids and water (Test Method D4007), specific gravity (Test Method D1298), surface, and interfacial tension (Test Method D971). Viscosity may also be established using a published temperature/viscosity chart for the test oil. Viscosity shall be reported for the temperature at which the test is performed.

5.6 Manual temperature measurements of the test oil (and water, if applicable) will be taken in or near the skimmer sump with an accuracy of ±1°C. Note that if testing outdoors, solar effects may significantly increase surface oil temperature. If steam or heat is introduced into the skimmer system as part of its design, additional measurements are to be taken before such heating to gauge the properties of the oil accurately.

5.7 Ambient air test temperature shall be recorded.

5.8 Record water salinity if applicable.

5.9 The skimmer shall be tethered but must float freely for the duration of the test.

5.10 Multiple tanks are required for recovered product for subsequent volume measurements (minimum of two). One tank is necessary to receive fluid during startup/purge and a second for the steady state recovery period. Additionally, a means of directing flow from the startup/purge tank to a collection tank is necessary while operating. A suggested method is to use a manifold equipped with diversion valves (caution should be taken not to deadhead the discharge flow).

5.11 The collection tanks shall be elevated above the test oil surface to accommodate a required static head on the skimmer system equal to 3.5 m of fluid. Alternatively, a restriction may be imposed within the discharge hose to mimic the desired static and dynamic head at the pump discharge at expected flow rates.

5.12 For skimmers that do not include a discharge pump, the recovery rate shall be measured as oil accumulates in the skimmer's sump.

5.13 When applicable, hydraulic pressure and flow measurements shall be made during the tests. Pressure and flow values shall not exceed manufacturer recommendations.

6. Skimmer System Set-up

6.1 *General:*

6.1.1 The skimmer components shall be fully documented. This shall include: dimensions, draft and freeboard, weight, specifications of skimmer, hydraulic power unit, discharge pump and hoses, and so forth. Components other than those provided by the manufacturer and necessary to assemble a functional skimmer system shall be reported.

6.1.2 The skimmer shall be deployed in the center of the test area and tethered, but allowed to float freely.

6.1.3 If a discharge pump is offered by the manufacturer as part of the system, the normal commercially offered pump shall be used in this test. It may be installed in the skimmer head or remotely but shall be configured as designed.

6.1.4 The manufacturer supplied power supply, hydraulic lines, control apparatus, and accessories shall be used to operate the skimmer.

6.1.5 Control lines, hydraulic lines, and discharge hoses should not interfere with the normal operation of the skimmer. Route hydraulic and discharge hoses to minimize effect on skimmer freeboard.

6.1.6 The pump and power supply shall be operated within its normal operating range or duty point for the system.

6.1.7 When applicable, the operational speed of the recovery device shall be recorded, that is, rotational speed of drum or disc, or lineal speed of mop or brush. Various means may be employed, for example, mechanical or manual counters, measuring hydraulic flow correlated to rotational speed and so forth, but must be validated as part of each test series.

6.1.8 Test oil is transferred from supply to the test area for establishing the initial preload volume slick thickness when water is present.

6.1.9 The skimming system will be equipped with a discharge hose 15 m long and of the manufacturer intended diameter. The discharge hose shall be routed to a collection tank. The end of the discharge hose opening shall be elevated 3.5 m above the test oil surface unless the head is simulated as described in 5.10.