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Standard Guide for Collecting Performance Data on Temporary Storage Devices¹

This standard is issued under the fixed designation F1599; 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 guide covers a guideline for measuring the performance parameters of full-scale temporary storage devices that would be used to store oil and oil-water mixtures.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in 6.2.

1.4 *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

F625 Practice for Classifying Water Bodies for Spill Control Systems

F631 Guide for Collecting Skimmer Performance Data in Controlled Environments

F715 Test Methods for Coated Fabrics Used for Oil Spill Control and Storage

3. Terminology

3.1 *Definitions:*

3.1.1 *Design Terminology—Terms Associated With Temporary Storage Device Design:*

3.1.2 *accessories*—optional mechanical devices used on or in conjunction with a temporary storage device system but not included with the basic storage device and hose connectors, that is, lights, paravanes, buoys, anchor systems, storage bags, repair kits, etc.

3.1.3 *ancillary equipment*—mechanical devices necessary to the operation of a given temporary storage device system, for example, air pumps, hydraulic power supplies, control manifolds, etc.

3.1.4 *ballast*—the weight applied to the device to improve performance.

3.1.5 *container body*—the continuous portion of the device that serves to provide structural strength and shape to the device to contain the stored material.

3.1.6 *device weight*—the dry weight of a fully assembled temporary storage device.

3.1.7 *draft*—the maximum vertical dimension of the device below the water line.

3.1.8 *flotation*—that portion of the device that provides buoyancy.

3.1.9 *freeboard*—the minimum vertical height of the device above the water line; for open devices, this is the minimum height at which water can enter it.

3.1.10 *handhold*—any strap, handle, depression, or other provision for grasping the device by hand.

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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.

- 3.1.11 *lifting point*—the structural point(s) on the device designed for the attachment of a lifting device, such as a crane.
- 3.1.12 *liner*—accessory or ancillary equipment that provides containment within the container body.
- 3.1.13 *mooring point*—the structural point(s) along the length of the device designed for the attachment of anchor or mooring lines.
- 3.1.14 *overall height*—the maximum vertical dimension of the device.
- 3.1.15 *sail*—the maximum vertical height of the device above the water-line.
- 3.1.16 *shipping weight*—the weight of the device when packaged for transportation.
- 3.1.17 *shipping volume*—the volume of the device when packaged for transportation.
- 3.1.18 *stiffener*—a component that provides support to the device.
- 3.1.19 *temporary storage device*—a collapsible device used to store fluids temporarily.
- 3.1.20 *tension member*—any component that carries tension loads imposed on the device.
- 3.1.21 *tow point*—structural point(s) on the device designed for the attachment of towing lines.
- 3.1.22 *Engineering Terminology— Terms Associated With Temporary Storage Device Engineering:*
- 3.1.23 *drag force*—the resisting force on a device that results from it being towed.
- 3.1.24 *gross buoyancy*—the weight of fresh water displaced by the device at the point of submergence.
- 3.1.25 *gross buoyancy to weight ratio*—the gross buoyancy divided by device weight.
- 3.1.26 *heave response*—the ability of the device to react to the vertical motion of the water surface.
- 3.1.27 *maximum capacity*—the maximum volumetric capacity of the device as calculated from physical dimensions.
- 3.1.28 *maximum dynamic load*—the sum of all instantaneous dynamic loads, including those due to acceleration, wave forces, etc.
- 3.1.29 *operational capacity*—the maximum volumetric capacity of the device per application.
- 3.1.30 *pitch response*—the tendency of the device to oscillate about its lateral axis.
- 3.1.31 *rated pressure*—the maximum continuous operating pressure of the device, as specified by the manufacturer.
- 3.1.32 *reserve buoyancy*—the gross buoyancy minus device weight.
- 3.1.33 *reserve buoyancy to weight ratio*—the reserve buoyancy divided by device weight.
- 3.1.34 *roll response*—the tendency of the device to rotate about its longitudinal axis due to wave, wind, or current forces.
- 3.1.35 *yaw response*—the tendency of the device to oscillate about its vertical axis.
- 3.1.36 *Classification Terminology:*
- 3.1.37 *pillow tank*—a closed, generally rectangular or round coated fabric tank.
- 3.1.38 *open pool*—an open, generally rectangular or round coated fabric tank, similar in structure to a “wading pool.”
- 3.1.39 *towable pillow tank*—similar to a pillow tank used on land or on deck, but generally made of heavier material and having special rigging for towing.
- 3.1.40 *towable flexible tank*—a storage device that is generally long and cylindrical in shape and, when full, is largely submerged, characterized by flexibility along the length of the device.
- 3.1.41 *towable open tank*—an open, inflatable, barge-type vessel that resembles a large inflatable boat, characterized by a portion of the top surface being open to atmosphere.

4. Significance and Use

4.1 This guide covers the collection of quantitative data in the form of storage capacity, strength of materials, filling and offloading rates, and towability under controlled test conditions. The data can be used for evaluating the design characteristics of a particular temporary storage device or as a means of comparing two or more devices. Caution must be exercised whenever the test data are used to predict performance in actual spill situations since the uncontrolled environmental conditions that affect performance in the field are rarely identical to conditions in the test facility. Other variables such as mechanical reliability, the presence of debris, ease of repair, required operator training, operator fatigue, and transportability also affect performance in an actual spill but are not included in this guide. These variables should be considered along with the test data when making comparisons or evaluations of temporary storage devices.

4.2 Although this guide provides data on the performance of temporary storage devices, all of the combinations of actual conditions of use are not simulated in this series of tests. In particular, the resistance of the device to grounding, abrasion resistance of the container body, venting of the device during loading, and other operational issues not covered by this guide should be considered along with the test data when making comparisons or evaluations of temporary storage devices.



5. Overall Observations

5.1 For each of the tests that follow, the total manpower required to conduct the procedure and the required ancillary equipment will be noted in the test record. In addition, the total elapsed time for each portion of the tests will be noted.

5.2 Observations of the buoyancy and stability of the deployed device will be made for the marine testing of towable devices.

5.3 Any observations relative to safety will be entered as part of the test record. These should include any hazardous conditions noted and limitations due to weather conditions, as well as any safety precautions that were observed or should be observed. If the manufacturer's specified operating procedures are found to be deficient relative to safety observations, this should be noted.

5.4 The test series should be videotaped to document the tests and procedures.

6. Initial (Static) Loading Tests

6.1 The storage device, and any enclosed ancillary equipment (for example, flotation collars), should be subjected to the following tests using air or dyed water, as appropriate, in order to confirm the structural integrity and evaluate (qualitatively) any leakage. The following is presented as a guideline in the absence of manufacturer-supplied guidelines for performing initial loading tests.

6.2 Overpressure tests can be extremely dangerous, and precautions should be taken against the possibility of sudden and complete failure of the device. The following tests use large volumes of water or pressurized air, or both, that could cause injury to personnel and serious damage to property if released suddenly.

6.3 *Closed Devices and Enclosed Ancillaries:*

6.3.1 *Leak Test*—The storage device should be inflated with air to a test pressure, calculated as follows:

$$P = \frac{\sigma}{15r}$$

where:

P = test pressure (Pa),

σ = minimum ultimate tensile strength of material (N/m), and

r = radius of largest section (m).

6.3.2 Allow the storage device to stand for 30 min at the test pressure $\pm 10\%$. Maintaining the test pressure within $\pm 10\%$, apply a soapy water solution liberally to the seam areas, fitting joints, valves, and all fabric areas. Record and mark air seepage.

NOTE 1—The inspector must determine what is an acceptable leak since some small air leaks may not necessarily mean that a liquid would leak through the same hole. Also, some air bubbles may be caused by air forced out between the fabric layers and would not cause a liquid leak.

6.3.2.1 Mark and record the location and extent of any surface or seam irregularities, blisters, or cracks. Recheck these areas carefully for leaks. The inspector must determine the acceptable level of such surface irregularities.

6.3.3 The storage device may be re-tested if leaks can be stopped by tightening the fittings or by minor permanent repairs.

6.3.4 *Overpressure*—Pressurize the device to 150 % of the rated pressure (defined in 4.2). Hold for 30 min, and then reduce the pressure to a safe level and inspect for leaks.

6.3.5 If the device exhibits leaks that are not structural failures, rework it and repeat the leak test of 6.3.1. If the device exhibits leaks that are from structural failure (that is, loose seams, fabric failure, etc.), rework it as necessary and repeat the overpressure test of 6.3.4.

6.3.6 Closed devices may also be tested using the procedures of 6.4 to determine whether minor air bubble leaks permit water to leak through the fabric.

6.4 *Open Devices:*

6.4.1 *Leak Test*—The following leak test for open devices can be performed only with the device out of water. If the device cannot be suspended to allow observation of its bottom when full, a sheet of white water sorbent cloth should be placed under it to indicate leaks.

6.4.2 Fill the device with water to its full operating level. Color the water with a water marker dye that provides a good color contrast with the storage device and sorbent cloth. Allow the device to stand for 2 h.

6.4.3 Observe and mark obvious leaks. Wipe the seam and leaking areas with a white water sorbent cloth, and determine whether colored water has leaked through. Mark and record the leaks. No splits or blisters in the coating or seams shall be acceptable.

6.4.4 The storage device may be re-tested if the leaks can be stopped by tightening the fittings or by minor permanent repairs.

7. Deployment, Loading, and Towing Tests

7.1 *General*—A visual examination of the device will be conducted once the temporary storage device has been made ready for deployment. The material specifications and operational limitations of the hose coupling mechanisms and any other fittings, such as towing bridle, drogue attachments, or securing devices, should be recorded.