Designation: F1093 – 99 (Reapproved 2007)

Standard Test Methods for Tensile Strength Characteristics of Oil Spill Response Boom[1]

This standard is issued under the fixed designation F1093; 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 These test methods cover static laboratory tests of the strength of oil spill response boom under tensile loading.

1.2 *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.* For a specific hazard statement, see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F818 Terminology Relating to Spill Response Barriers

F962 Specification for Oil Spill Response Boom Connection: Z-Connector

3. Terminology

3.1 *Definitions*—The following definitions, quoted from Terminology F818, are used in these test methods

3.1.1 *anchor point*—a structural point on the end connector or along the length of a boom section designed for the attachment of anchor or mooring lines.

3.1.2 *ballast*—weight applied to the skirt to improve boom performance.

3.1.3 *boom section*—the length of boom between two end connectors.

3.1.4 *boom segment*—repetitive identical portion of the boom section.

3.1.5 *curtain-type boom*—a boom consisting of a flexible skirt supported by flotation. See Appendix X1.

3.1.6 *end connector*—a device permanently attached to the boom used for joining boom sections to one another or to other accessory devices.

3.1.7 *fence-type boom*—a boom consisting of self-supporting or stiffened membrane supported by floatation. See Appendix X1.

3.1.8 *float*—that separable component of a boom that provides buoyancy.

3.1.9 *freeboard*—the vertical height of the boom above the water line.

3.1.10 *hinge*—location between boom segments at which the boom can be folded back 180° upon itself.

3.1.11 *skirt*—the continuous portion of the boom below the floats.

3.1.12 *tension member*—any component which carries horizontal tension loads imposed on the boom.

4. Summary of Test Method

4.1 A specimen of spill containment boom is tested by subjecting the specimen to cyclic tests to 100 % of the manufacturer's rated tensile strength, and by applying tensile loading which progressively deforms the specimen to the point of failure. Similarly, a typical anchor point and towing device are tested in an additional tensile test. For each phase of the test, values of tensile load and deformation are observed and recorded, and modes of failure are described.

5. Significance and Use

5.1 Boom sections are frequently combined into assemblages hundreds of meters in length prior to towing through the water to a spill site. The friction of moving long boom assemblages through the water can impose high tensile stresses on boom segments near the tow vessel.

5.2 Tensile forces are also set up in a boom when it is being towed in a sweeping mode. The magnitude of this tensile force can be related to the immersed depth of the boom, the length of boom involved, the width of the bight formed by the two towing vessels, and the speed of movement.

NOTE 1—When the towing speed exceeds about 1 knot (0.5 m/s), substantial oil will be lost under the boom.

[1] These test methods are under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and are the direct responsibility of Subcommittee F20.11 on Control.

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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.

5.3 Knowledge of maximum and allowable working tensile stresses will help in the selection of boom for a given application and will permit specification of safe towing and anchoring conditions for any given boom.

6. Apparatus

6.1 *Load Application Device*—A suitable load application device, such as a hydraulic jack, shall be provided. The device must be capable of applying loads somewhat in excess of the predicted failure load on the boom.

6.2 *Tensiometer*—A tensiometer shall be selected which will encompass the range of values from no load up to the maximum boom tensile load which might reasonably be expected prior to failure of the boom.

6.3 *End Supports*—The test bed provided shall have end supports of sufficient strength and rigidity to resist significant deformation under the maximum loads expected during testing.

6.4 *Towing Devices and Connectors*—At least one of the manufacturer's standard tow bridles or towing devices shall be used at the leading end of the boom specimen (where the load is applied). A similar tow bridle or towing device shall be used at the trailing end if the test apparatus is long enough. However, if it is not, the connector at the trailing end of the specimen may be attached directly to a connector fixed to that end support of the test apparatus. Suitable shackles, cables, chains, and so forth, shall be provided to connect the towing adapters to the test equipment, as diagrammed in Figs. 1-3.

6.5 *Gage Points*—Gage points shall be affixed to each end of the test specimen to facilitate measurement of elongation during the course of the test.

6.6 *Elongation Measurement Scale*—A suitable measuring device shall be provided so that elongation measurements may be made periodically throughout the test. The device shall have a precision equal or better than $\frac{1}{1000}$ th the distance between gage points (that is, 3 mm precision for 3 m gage point separation).

6.7 *Boom Specimens to be Tested*—Equipment shall be arranged to apply tensile loading to a specimen consisting of at least two complete boom segments of standard length as supplied by the manufacturer. Boom segments of less than standard length may be used for this test provided that the tension member length is proportional, the hinge area between them, the connector assemblies at each end, and the anchor point are fabricated identically to the manufacturer's full size standard boom section provided the total specimen is at least 10 ft (3 m) in length.

6.8 *Alternative Apparatus*—Because production lengths of boom are normally longer than 15 ft and because undue stress due to gravity forces may be placed on such boom if tested with the apparatus described above, the following described apparatus may be substituted. Test apparatus which lays the boom in a horizontal and continuously supported manner or one which provides support similar to that provided by the water (that is, a split table supporting the boom in an upright manner) will be satisfactory.

7. Hazards

7.1 Failure of a loaded containment boom can release a substantial amount of energy. During testing, personnel and equipment shall be positioned and protected so that sudden failure of the test specimen is unlikely to cause injury or damage.

8. Procedure

8.1 *Determination of Boom Tensile Strength*:

8.1.1 *Test Bed Preparation*—Prepare a test bed with two end supports separated with sufficient clearance for the boom specimen, two towing devices, and testing equipment as shown in Fig. 1. Mount the specimen with one towing device attached directly to one of the end supports. Alternately, the connector at the trailing end of the test specimen may be attached to a Specification F962 connector fixed to the end support of the test apparatus as shown in Fig. 2. The tensiometer is used to link the towing device at the other end of the boom specimen to the load application device and hence to the second end support. Suitable shackles, chains, cable, and so forth, can ordinarily be used for making connections. However, in some cases it may be necessary to design and fabricate special connecting devices to distribute loads satisfactorily.

8.1.2 *Cyclic Loading to 100 % of Manufacturers Rated Strength*—Load the boom specimen to 100 % of the manufacturer's rated tensile strength. Then reduce the load to 10 % of the manufacturer's rated strength. Note the positions of gage points on the specimen while under full tensile load, and at 10 % of full tensile load. Then repeat this loading cycle until the specimen has been subjected to a total of ten complete cycles.

8.1.3 *Test to Ultimate Failure or Permanent Deformation*—If the specimen has not failed during the cyclic loading phase, it is then subjected to increasing loading until failure occurs. "Failure" is defined here as the inability to function or the rupture of the tension member, skirt material, or connector.

8.2 *Determination of Anchor Point Strength*:

8.2.1 *Test Bed Preparation*—Mount a second specimen, consisting of one or more standard boom segments, in the test

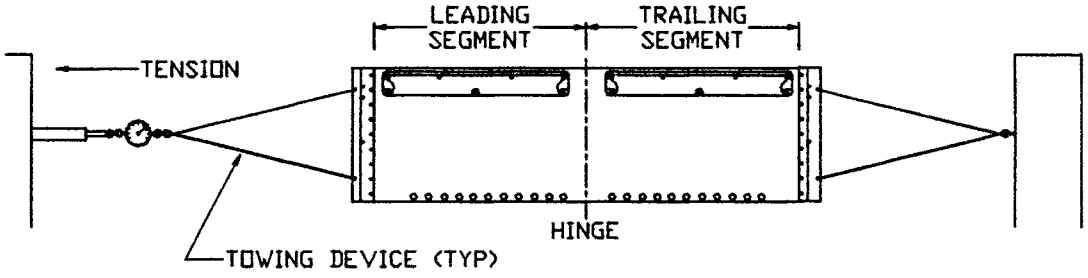

FIG. 1 Test Bed