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Standard Guide for In-Situ Burning of Spilled Oil: Fire-Resistant Boom¹

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1. Scope

1.1 This guide covers a set of criteria to evaluate the performance, material characteristics, and essential features of fire-resistant oil spill containment boom.

1.2 This guide covers two types of fire-resistant oil containment boom: those that are intrinsically fire-resistant through the use of fire-resistant materials, and those that provide fire-resistance through the use of coolants. This guide may not be fully applicable to other types of fire-resistant boom.

1.3 This guide is one of four related to in-situ burning of oil spills. Guide F1788 addresses environmental and operational considerations, Guide F1990 addresses ignition devices, and Guide F2230 addresses burning in ice conditions.

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

1.5 *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

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

F818 Terminology Relating to Spill Response Booms and Barriers

¹ This guide is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and is the direct responsibility of Subcommittee F20.15 on In-Situ Burning.

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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.

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

F1093 Test Methods for Tensile Strength Characteristics of Oil Spill Response Boom

F1523 Guide for Selection of Booms in Accordance With Water Body Classifications

F1788 Guide for In-Situ Burning of Oil Spills on Water: Environmental and Operational Considerations

F1990 Guide for In-Situ Burning of Spilled Oil: Ignition Devices

F2084 Guide for Collecting Containment Boom Performance Data in Controlled Environments

F2230 Guide for In-situ Burning of Oil Spills on Water: Ice Conditions

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *actively-cooled fire-resistant boom*—type of fire-resistant boom that uses ancillary equipment to supply coolant to the boom to increase its fire resistance.

3.1.2 *ancillary equipment*—mechanical devices essential to the operation of a given boom system; for example, water pumps, power supplies, control manifolds, and so forth.

3.1.3 *fire resistance*—the ability of a barrier to maintain structural integrity and oil containment ability while being subjected to the thermal stress of a petroleum fire.

3.1.4 *fire-resistant boom*—barrier intended for containment of burning oil floating on water.

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

3.1.6 *heat flux*—the thermal intensity indicated by the amount of energy per unit area. (kW/m^2).

3.1.7 *in-situ burning*—burning of oil directly on the water surface.

3.1.8 *residue*—the material, excluding airborne emissions, remaining after the oil stops burning.

3.1.8.1 *Discussion*—Residue includes only material derived from the oil that is burned, and it shall not include material related to the boom or its components.

3.1.9 *salvageable components*—components of the boom that may be reused in a repair or reconstruction of the boom to its original state.

3.2 For other definitions relating to boom properties and dimensions, refer to Terminology **F818**.

4. Equipment Description

4.1 To be effective, the fire-resistant boom shall contain oil floating on water before, during, and after exposure to in-situ burning of oil.

4.2 Some fire-resistant booms use coolant to increase their fire resistance. With some booms, this is actively supplied by ancillary equipment; others rely on wicking of the water in which the boom is floating. Additional requirements and testing stipulations for such booms are noted in **5.5** and **6.5**.

4.3 If a boom is defined as reusable, a procedure for cleaning, decontaminating, salvage, and restoration shall be provided to the user by the manufacturer.

4.4 Fire-resistant booms may be used in conjunction with conventional booms or “transition” booms. If a boom is to be used in this fashion, a suitable means of connection between the fire boom and transition boom must be made, such as a connector in accordance with Specification **F962**.

5. Minimum Equipment Performance Characteristics

5.1 Overview:

5.1.1 Minimum performance characteristics are grouped under three headings: Operability, Oil Containment; and Fire-Resistance. All minimum performance characteristics listed here shall be achieved before a boom is considered to meet the requirements of this guide.

5.1.2 The fire-resistant boom shall withstand oil fires and contain oil in various conditions that include both calm water and waves with a significant wave height of up to 1 m and a period of 3 to 4 s.

5.1.3 For booms intended for use in salt water or brackish water, the boom shall be tested in water that has a salinity of 15 o/oo (parts per thousand) or greater. For booms that rely on wicking, the salinity shall be 33 o/oo or greater. For actively-cooled booms, the water in which the boom is tested may be 15 o/oo if the water supplied to the boom (from a separate supply) has a salinity of 33 o/oo or greater.

5.2 Operability Characteristics:

5.2.1 The fire-resistant boom shall meet the minimum physical dimensions and strength parameters as for conventional oil containment booms, except for the buoyancy-to-weight ratio. These parameters are listed in Guide **F1523** and summarized in **Table 1**.

5.2.2 *Total Tensile Strength*—Prior to exposure to an in-situ burn, the fire-resistant boom shall meet the minimum total strength for the various water body classifications listed in **Table 1**.

5.2.3 Total tensile strength for fire-resistant booms may decrease after each burn exposure. In any case, the boom shall retain sufficient strength following a burn to retain burn residue and any unburned oil and to allow the salvage or disposal of the boom.

5.2.4 *Corrosion Resistance*—Fire-resistant oil spill containment booms (and ancillary systems, if applicable) shall be manufactured of components that do not degrade significantly

TABLE 1 Minimum Design Values for Fire-Resistant Boom

Boom Property	Calm Water ^A	Calm Water – Current ^A	Protected Water ^A	Open Water ^A
Freeboard prior to burn, mm	120	130	260	530
Freeboard following burn, mm	60	70	130	270
Draft, mm	150	160	330	660
Gross buoyancy-to-weight ratio prior to burn	3:1	3:1	3:1	3:1
Gross buoyancy-to-weight ratio following burn	1.5:1	1.5:1	1.5:1	1.5:1
Tensile strength, N per mm of boom draft ^B	57	140	64	72
Tear strength, N	450	450	450	450

^A Water body types defined in Practice **F625**.

^B Tensile strength measured by Test Methods **F1093**.

and that maintain fire resistance characteristics while exposed to typical marine environmental conditions.

5.2.5 *Extreme Temperature Properties*—The fire-resistant boom and any ancillary equipment shall not be adversely affected by use or storage at temperatures within the range of -40 to 40 °C.

5.2.6 *Fabric Tests*—Fabrics and components shall meet the applicable test methods for fabrics used in spill control barriers and temporary storage devices in accordance with Test Methods **F715**.

5.2.7 *Hazardous Waste*—If the boom’s materials of manufacture include any hazardous materials, the appropriate Material Safety Data Sheet and exposure limits shall be provided by the manufacturer. The fire-resistant boom system shall not create or add to the hazardous waste pollution, nor shall it have any special disposal requirements beyond that typically required of oil spill booms.

5.2.8 *End Connectors*—The fire-resistant boom section interconnections shall meet boom fire tolerance requirements.

5.2.9 *Documentation*—Documentation shall be provided by the manufacturer addressing storage, handling, maintenance, health and safety, test results, and recommended repair procedures.

5.3 Oil Containment Characteristics:

5.3.1 Prior to exposure to an oil fire, the fire-resistant boom shall display similar oil containment characteristics expected of conventional oil spill containment booms.

5.4 Fire-Resistance Characteristics:

5.4.1 The fire-resistant boom shall contain oil and survive in heat fluxes equivalent to an in-situ burn of diesel with a minimum diameter of 4.5 m, for a total of three 1 h burn cycles, with a minimum 1 h cool down between cycles.

5.5 Additional Requirements for Actively-Cooled Booms:

5.5.1 Additional fire-resistance testing for actively-cooled booms is specified in **6.5.2** to confirm the adequacy of backup systems for coolant supply. To fulfill the additional test requirement, it is recommended that actively-cooled booms have the following features:

5.5.1.1 Backup coolant supply system,

5.5.1.2 Flowmeter or indicator on each coolant supply to monitor the flow, and