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Standard Guide for In-Situ Burning of Oil Spills on Water: Environmental and Operational Considerations[1]

This standard is issued under the fixed designation F1788; 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 the use of in-situ burning to assist in the control of oil spills on water. This guide is not applicable to in-situ burning of oil on land or the disposal of oil or oiled debris in incinerators.

1.2 The purpose of this guide is to provide information that will enable spill responders to decide if burning will be used as part of the oil spill cleanup response. Other standards address the use of ignition devices (Guide F1990), the use of fire-resistant boom (Guide F2152), the use of burning in ice conditions (Guide F2230), the application of in-situ burning in ships (Guide F2533), and the use of in-situ burning in marshes (Guide F2823).

1.3 This is a general guide only. It is assumed that conditions at the spill site have been assessed and that these conditions are suitable for the burning of oil. It is also assumed that permission to burn the oil has been obtained from appropriate regulatory authorities. Variations in the behavior of different oil types are not dealt with and may change some of the parameters noted in this guide.

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

1.4.1 *Exception*—Alternate units are included in 7.5, 7.7, and 7.8.

1.5 *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.*

1.6 *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]

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

F2152 Guide for In-Situ Burning of Spilled Oil: Fire-Resistant Boom

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

F2533 Guide for In-Situ Burning of Oil in Ships or Other Vessels

F2823 Guide for In-Situ Burning of Oil Spills in Marshes

3. Terminology

3.1 *Definitions:*

3.1.1 *burn efficiency*—burn efficiency is the percentage of the oil removed from the water by the burning.

3.1.1.1 *Discussion*—Burn efficiency is the amount (volume) of oil before burning; less the volume remaining as a residue, divided by the initial volume of the oil.

3.1.2 *burn rate*—the rate at which oil is burned in a given area.

3.1.2.1 *Discussion*—Typically, the area is a pool and burn rate is the regression rate of the burning liquid, or may be described as a volumetric rate.

3.1.3 *contact probability*—the probability that oil will be contacted by the flame during burning.

3.1.4 *controlled burning*—burning when the combustion can be started and stopped by human intervention.

3.1.5 *fire-resistant booms*—booms intended for containment of burning oil slicks (Guide F2152).

3.1.6 *in-situ burning*—use of burning directly on the water surface.

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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.

3.1.6.1 *Discussion*—In-situ burning does not include incineration techniques, whereby oil or oiled debris are placed into an incinerator.

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

4. Significance and Use

4.1 This guide is primarily intended to aid decision-makers and spill-responders in contingency planning, spill response, and training.

4.2 This guide is not specific to either site or type of oil.

5. Background

5.1 *Overview of Oil Burning:*

5.1.1 In-situ burning is one of several oil-spill countermeasures available. Other countermeasures could include mechanical recovery, use of oil-spill dispersants, and leaving the oil to natural processes.

5.1.2 In-situ burning is combustion at the spill site without removing the oil from the water. Containment techniques may be used, however, to increase the thickness of the oil (Guide F2152). The thickness of the oil slick is an important factor in the use of in-situ burning.

5.2 *Major Advantages and Disadvantages of In-situ Burning:*

5.2.1 Advantages of in-situ burning include the following:

5.2.1.1 Rapid removal of oil from the water surface,

5.2.1.2 Requirement for less equipment and labor than many other techniques,

5.2.1.3 Significant reduction in the amount of material requiring disposal,

5.2.1.4 Significant removal of volatile emission components, and

5.2.1.5 May be the only solution possible, such as in oil-in-ice situations.

5.2.2 Disadvantages of in-situ burning include the following:

5.2.2.1 Significant amounts of smoke are generated,

5.2.2.2 Residues of the burn must be dealt with,

5.2.2.3 Time in which to ignite the oil may be limited,

5.2.2.4 Oil must be a minimum thickness to burn, which may require containment, and

5.2.2.5 The fire may spread to other combustible materials.

6. Environmental Considerations for Deciding to Use In-Situ Burning

6.1 *Air Quality:*

6.1.1 Several studies have been done of the air emissions resulting from in-situ burning. It has been found that the smoke plume consists largely of carbon. The high temperatures achieved during in-situ burning result in efficient removal of most components of the oil. The thick, black smoke can be of concern to nearby human populations or ecologically sensitive areas. Since most soot precipitation occurs near the fire, this is the main area of concern. The smoke plume can also be an aesthetic concern. In-situ burning should be avoided within 1 km upwind of either an ecologically sensitive or a heavily populated area, depending on meteorological conditions. No emissions greater than one fourth of the 2020 human health exposure limits have been detected at ground level further than 1 km from an oil fire. The values of the human health exposure limits vary with jurisdiction, and, thus, the appropriate documents should be consulted. The environmental and economic trade-offs of burning the oil, as opposed to contamination of the shoreline, must be considered.

6.1.2 Burning can be safely conducted near populated areas if there is sufficient air turbulence for mixing, and in the absence of a low-level atmospheric inversion.

6.2 *Water Quality*—Measurements show that burning does not accelerate the release of oil components or combustion by-products to the water column. Highly efficient burns of heavy oils may form a dense residue that sinks.

6.3 *Wildlife Concerns*—Although no specific biological concerns related to the use of in-situ combustion have been identified to date, benthic resources may be affected by sunken oil burn residue.

7. Operational Considerations for In-situ Burning

7.1 *Safety Considerations*—The safety of the proposed operation shall be the primary consideration. Secondly, the burning operation shall not result in unintentional flashback to the source of the oil, for example, the tanker or the production platform. The third consideration is the spread of the fire to other combustible material in the area, including trees, docks, and buildings. Flashback and fire spread can often be prevented by using containment booms to tow away the oil to be burned. A fourth consideration is the safety of the ignition operation, which is often done from helicopters, and the safety of the boom tow operation must be ensured.

7.2 *Safety Monitoring and Control Requirements*—The operation must be monitored to meet safety requirements. Burning shall be monitored to ensure that fire may not spread to adjacent combustible material. Situation-specific contingency methods of extinguishing, such as boats with fire monitors, shall be available. In towed-boom operations, it has been proposed that the fire may be extinguished by increasing the tow speed so that the oil is entrained in the water. Other options for controlling the fire or the burn rate might include releasing one side of the oil containment boom or slowing down to reduce the encounter rate.

7.3 *Oil Thickness*—Most oils can be ignited on a water surface if they are a minimum of 2 to 3 mm thick (Guide F1990). Once ignited, the oils will burn down to a thickness of about 1 mm. Physical containment, such as with oil-spill containment booms, is usually necessary to achieve the desired thicknesses required. Specific information on this is provided in the appendix.

7.4 *Oil Type and Condition*—Highly weathered oils will burn, but will require high and sustained heat during ignition. Oil that is emulsified with water may not burn. Not enough data are available to determine water-content levels that limit ignition. Indications are, however, that stable emulsions which typically contain about 70 % water cannot be ignited and that oils containing less than about 25 % water will burn. Treatment