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Standard Guide for Oil Spill Dispersant Application Equipment: Single-point Spray Systems[1]

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ε1 NOTE—Units information was editorially corrected in October 2011.

1. Scope

1.1 This guide covers performance criteria, requirements, material characteristics, and essential features for oil spill dispersant application systems. This guide is not intended to be restrictive to a specific configuration.

1.2 This guide covers vessel-based spray systems employing single-point spray nozzles, including designs that have been based on or evolved from "fire-monitor" systems, and is not fully applicable to other systems such as spray boom/nozzle or aircraft systems.

1.3 This guide is one of five related to dispersant application systems. The other four guides cover the design of boom and nozzle systems, spray system calibration, spray deposition measurements, and use of the systems. Familiarity with all five guides (listed in 2.1) is recommended.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1413 Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems
F1460 Practice for Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle Systems
F1737 Guide for Use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems
F1738 Test Method for Determination of Deposition of Aerially Applied Oil Spill Dispersants

3. Equipment Description

3.1 *General*—"Single-point" oil spill dispersant spray systems include spray nozzles, some of which may be similar to those used in firefighting, that generate a spray pattern directed out from a location on the side of the vessel without the need for an outrigger boom or spray arm system to support the spray nozzle. The system includes a pumping or pressure system to deliver dispersants to the nozzle(s) or device used to spray the dispersant out onto the oil slick, and associated piping and control valves. All systems shall include flow meters and pressure gauges to monitor the dispersant discharge. All systems shall be equipped with provision for cleaning and drainage. System components shall be designed to give a uniform droplet spray and volumetric coverage as described in this guide.

NOTE 1—Nozzles used in firefighting applications are generally designed to direct a large quantity of water or firefighting foam, or both, to a small area or fire hot spot. As such, many standard firefighting nozzles are not suitable for effective application of dispersant. Some firefighting nozzles have variable spray pattern adjustment and flow control and these may be suitable for dispersant application. Some foam application nozzles have been designed to generate uniform, volumetric fallout along the length of their spray pattern and these have potential for dispersant application. Nozzles specifically designed for use in single-point dispersant application systems are also available.

3.2 *Modes of Operation*—Typical operational modes could include two nozzles, one mounted on the port deck rail and the other on the starboard deck rail, both located towards the bow of the vessel. The nozzles are supplied dispersant from either a common or separate pumps and are plumbed to permit independent operation and flow control. The nozzles spray dispersant out from the side of the vessel perpendicular to the

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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.

direction of the vessel's movement and treat oil on each side of the vessel in the zone free of the influence of the vessel's bow wave as it moves through the slick. This type of operation is only effective in light winds.

3.2.1 In moderate to high wind conditions the vessel would travel in a cross-wind direction, and dispersant would be sprayed downwind, only from the nozzle mounted on the downwind side of the vessel. If nozzles were mounted on both sides of the vessels only the downwind of the two nozzles would be used at any given time. Use of the two nozzles would alternate when the vessel reverses direction after completing a spray pass. Smaller single-point spray systems can utilize portable, "manned" nozzles to permit the operator to direct the spray from the side of the vessel onto oil slicks either while the vessel is moving or stationary. This allows the operator to target heavier patches of oil with dispersant as required.

3.3 *Neat versus Dilute Application*—Single-point spray systems may be used to apply dispersant neat or diluted, depending on the manufacturer's usage guidelines and on the slick conditions. Operators should be aware that some dispersant products are less effective when applied diluted with seawater. Manufacturer's recommended usage guidelines and independent research on dispersant effectiveness testing shall be consulted when considering dilute application.

3.4 *Operational Advantages:*

3.4.1 In operational terms, single-point spray systems may offer the following advantages over vessel-based application systems:

3.4.1.1 No specialized spray booms, spray boom attachments, or supports are required, which makes the system easy to install on vessels-of-opportunity.

3.4.1.2 Less possibility of damage to the spray equipment in rough sea conditions.

3.4.1.3 The spray swath can be considerably wider than conventional spray boom/multi-nozzle systems.

3.4.2 Single-point spray systems may offer the following advantages over conventional boom and nozzle application systems:

3.4.2.1 The single nozzles are easier to maintain than the multiple small orifices used in spray boom systems.

3.4.2.2 Higher application rates are possible which may allow one-pass spraying in thick oil conditions.

3.4.2.3 The single-point spray nozzle can be used in a "manned" operation and dispersant spray can be directed to thick oil patches in the vicinity of the vessel without the need to precisely position the spray vessel.

3.5 *Operational Disadvantages*—The single-point spray systems may have the following disadvantages as compared with conventional boom/multiple nozzle vessel and aircraft application systems.

3.5.1 The spray pattern from single-nozzle systems may be more susceptible to wind influences than conventional boom/multiple nozzle systems.

3.5.2 May be less able to apply a uniform dose rate of dispersant.

3.5.3 Application of low doses of dispersant for treatment of thin oil slicks is difficult unless the dispersant is diluted with seawater.

3.5.4 The vessel platform has slow transit and application speeds when compared with aircraft application systems (a problem common to all vessel-based application methods).

4. Minimum Equipment Performance Specifications

4.1 *Target Dosage*—Oil spill dispersant spray equipment shall provide a dispersant dosage of between 20 to 1000 L per hectare [2 to 100 U.S. gal per acre]. It is not a requirement that a single system cover the entire range. Section 7.2 of this standard lists the requirements for dosage and application data to be provided by the manufacturer.

4.2 *Dispersant Flow or Injection Rate Determination*—The dispersant flow from each single-point nozzle shall be monitored using appropriate pressure and flow meters. The dispersant flow rate (for diluted application, the dispersant flow rate is equal to the dispersant injection rate) must be sufficient to produce the required dosage on the thickness of oil being encountered

4.2.1 Dispersant flow rate (DFR) shall be verified using the following equations:

$$DFR = S \times W \times D \times 1.67 \times 10^{-3} \quad (1)$$

where:

DFR = dispersant flow rate, L/min,
S = speed of the delivery vehicle, km/h,
W = swath width, m, and
D = dosage, L/ha.

Or equivalently in U.S. units:

$$DFR = S \times W \times D \times 2.33 \times 10^{-3} \quad (2)$$

where:

DFR = dispersant flow rate, U.S. gal/min (USGPM),
S = speed of the delivery vehicle, knots,
W = swath width, ft, and
D = dosage, U.S. gal per acre (USGPA).

4.3 *Droplet Size Distribution*—The droplet size distribution of the dispersant reaching the target shall have a Volume Median Diameter (VMD) of between 300 to 800 µm. The volume median diameter is a means of expressing droplet size in terms of the volume of liquid sprayed. The median volume diameter droplet size, when measured in terms of volume, is a value where 50 % of the total volume of liquid sprayed is made up of droplets with diameters larger than the median value and 50 % smaller than the median value. Droplets having diameters lesser than approximately 300 µm have a lower probability of hitting the target because of excessive wind drift. Particles with diameters greater than 800 µm have a higher probability of penetrating through thin and non-viscous oil slicks to the water surface where their effectiveness is lost.

4.3.1 *Discussion*—There is a trade-off in effectiveness versus drop size. Larger drop sizes may be desirable from an application point-of-view as they have more momentum and can be more easily broadcast, with control, over a wide area. From an effectiveness point-of-view, larger drops may be less desirable as they can lead to herding of the slick, ineffective dispersant application, and wasted dispersant. Larger drops may also be inefficient on thin slicks, but this is not likely to be