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Standard Guide for Use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems[1]

This standard is issued under the fixed designation F1737/F1737M; 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 essential~~ considerations for the maintenance, storage, and use of oil spill dispersant application systems.

1.2 This guide is applicable to spray systems employing booms and nozzles and not to other systems such as fire ~~monitors, sonic distributors,~~ monitors or ~~fan-spray guns.~~ single-point spray systems.

1.3 This guide is applicable to systems employed on ships or boats and helicopters or airplanes.

1.4 This guide is one of ~~four~~five related to dispersant application systems. Guide F1413 covers design, Practice F1460 covers calibration, Test Method F1738 ~~covers deposition, and Guide F1737 covers the use of the systems. Familiarity with all four standards is recommended.~~

~~1.5The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.~~ covers deposition, Guide F1737 covers the use of the systems, and Guide F2465 covers the design and specification for single-point spray systems. Familiarity with all five standards is recommended.

1.5 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.

1.6 *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

F1738 ~~Test Method for Determination of Deposition of Aerially Applied Oil Spill Dispersants~~ Test Method for Determination of Deposition of Aerially Applied Oil Spill Dispersants

F2465 Guide for Oil Spill Dispersant Application Equipment: Single-point Spray Systems

F2532 Guide for Determining Net Environmental Benefit of Dispersant Use

3. Significance and Use

3.1 This guide provides information, procedures, and requirements for management and operation of dispersant spray application equipment (boom and nozzle systems) in oil spill response.

3.2 This guide provides information on requirements for storage and maintenance of dispersant spray equipment and associated materials.

3.3 This guide will aid operators in ensuring that a dispersant spray operation is carried out in an effective manner.

4. ~~Equipment Types For Vessels and Aircraft~~

~~4.1A spraying system consists of one or more pumps, flowmeters, storage tanks, spray booms, and nozzles that are mounted in various configurations depending on the platform.~~

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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.

4.2Dispersant application systems on ships or boats may be portable or permanently installed. Vessels may have built-in dispersant storage tanks and on-board pumps for use with the spraying system.

4.3Dispersant application systems on helicopters are most commonly slung beneath the aircraft, with remote controls available to the pilot. Some specially configured helicopters have integral tanks and pumps. Helicopter spraying systems are available with dispersant capacity of about 500 to 2000 L (120 to 500 U.S. gal).

4.4Dispersant application systems on single-engine airplanes have a built-in tank and pump, with the booms attached to the wings. Dispersant capacity varies with the airplane design but is about 400 to 4000 L (100 to 1000 U.S. gal).

4.5Dispersant application systems can also be installed on large multiengine airplanes. These must be designed for each type of aircraft, and will include one or more pumps, flowmeters, dispersant storage tanks, and spray booms with nozzles. The airplane type and payload capability will determine the available dispersant capacity from about 4000 to 20000 L (1000 to 5000 U.S. gal).

Background to the Use of Dispersants and Spray Systems

4.1 *Primary Considerations*:

4.1.1 Use of dispersants, particularly in a specific area, may be subject to regulatory approval. Net Environmental Benefit Analysis is used for dispersant decision-making (Guide F2532). Dispersant response is for use in the early stages of a spill; so, it is strongly recommended that a rapid approval mechanism, or pre-approval, be part of response planning.

4.1.2 *Nature of Oil Slick(s) to Be Treated*:

4.1.2.1 The effectiveness of dispersants is dependent (assuming proper application) on two factors; the oil composition and the sea surface energy. The primary factor is the oil composition. Heavier oils, those that contain large amounts of components such as asphaltenes, disperse poorly, and those which have only a small amount of these disperse more easily. As oil weathers on the sea surface, its composition changes and it generally becomes less dispersable. Some oils can also form highly viscous water-in-oil emulsions, known as "chocolate mousse," particularly in areas of high energy waves. Once mousse has formed, dispersants may not be effective.

4.1.2.2 Viscosity is an indicator of the oil composition, but affects dispersion by its influence on the amount of dispersant penetrating into and mixing with the oil. Dispersant can run off the surface of highly viscous oils or will mix only slowly with them. Traditionally, oils of a viscosity between 2000 and 10 000 mPa were thought to be undispersable. However, viscosity may not be as much a limitation as is composition as noted above, especially for dispersants which are not quickly lost to the water column. Viscosity may have its largest effect on the time required for mixing with the oil.

4.1.2.3 Natural weathering affects the composition and viscosity of the oil. Much of the oil evaporated will usually consist of the most dispersable fraction. Also, loss of the lighter fractions by evaporation increases the viscosity. This combined effect may rapidly reduce the dispersability of some spilled oils. Some oils may not be effectively dispersed after only 24 h on the surface.

4.1.2.4 Surface sea energy can be an important factor in dispersant effectiveness. Higher sea energy is needed to disperse oil of less favorable composition. Very low sea energies often result in poor dispersant performance. Very high seas can be detrimental since they can promote water-in-oil emulsion formation and can cause oil slicks to become discontinuous or submerged. Spraying such slicks can result in significant dispersant loss.

4.1.3 *Environmental Conditions, Including Wind, Sea State, Visibility, and Temperature of Air and Water*— It is essential to minimize dispersant loss in aerial application due to wind drift and air turbulence. Large droplets assist in this, but, in addition, the aircraft should be flown as low as safety considerations allow. It is also best to fly into the wind while spraying, so as to limit wind drift.

5. Equipment Types For Vessels and Aircraft

5.1 A boom and nozzle spraying system consists of one or more pumps, flowmeters, storage tanks, spray booms, and nozzles that are mounted in various configurations depending on the platform.

5.2 Single-point spray systems are not covered by this standard. See Guide F2465.

5.3 Dispersant application systems on ships or boats may be portable or permanently installed. Vessels may have built-in dispersant storage tanks and on-board pumps for use with the spraying system.

5.4 Dispersant application systems on helicopters are most commonly slung beneath the aircraft, with remote controls available to the pilot. Some specially configured helicopters have integral tanks and pumps. Helicopter spraying systems are available with dispersant capacity of about 400 to 3000 L [100 to 800 U.S. gal].

5.5 Dispersant application systems on single-engine airplanes have a built-in tank and pump, with the booms attached to the wings. Dispersant capacity varies with the airplane design but is about 400 to 4000 L [100 to 1000 U.S. gal].

5.6 Dispersant application systems can also be installed on large multi-engine airplanes. These must be designed for each type of aircraft, and will include one or more pumps, flowmeters, dispersant storage tanks, and spray booms with nozzles. The airplane type and payload capability will determine the available dispersant capacity from about 4000 to 20 000 L [1000 to 5000 U.S. gal].

6. Equipment Configuration for Vessels and Aircraft

5.1

6.1 *Vessels*—Dispersant spray systems for boats have been designed for many types of craft. Most systems use water-compatible "concentrate" dispersants diluted with seawater during application. These dispersants are mixed with seawater by use of an educator or metering pump to allow for the dispersant to be used at the desired concentration (generally 5 to 10 %). Some systems spray dispersants neat (without dilution with water) and thus eliminate the need for seawater suction equipment.

56.1.1 Mounting the spray booms as far forward as possible is optimal, so that the spray is applied in front of the bow wave, because,because this wave can push oil out of reach of the spray at typical boat speeds. Nozzles and extensions should be downward-pointing and stable relative to the boom. Rig spray Spray booms with multiple nozzles should be arranged to produce flat, fan-shaped spray patterns, striking the water (oil) surface in a line perpendicular to the direction of travel of the vessel. Nozzles producing a hollow-cone shaped spray pattern should not be used. Spray pressure should not be excessive so that the spray doesdroplets do not break the oil surface. Deliver the The dispersant-water mixture should be delievered to the oil surface,surface in the desired pattern, with a minimum amount of energy. The spray should strike the oil in small droplets of 300 to 500-µm volume median diameter (VMD). The droplets should be visually larger than a fog or mist and smaller than heavy rain drops. The fan-shaped sprays from adjacent nozzles should overlap just above the oil surface.

56.1.2 Relatively small spills, such as in harbors or rivers, spills may best be treated by vessels, but theyvessels are limited on large offshore spills by their spray swath and speed. For example, a boat operating at 10 km/h (5[5 knots or 6 mph),mph], and spraying a 12-m (40-ft)[40-ft] swath, can only treat about 1.3 km^2(0.5 miles [0.5 $miles^2$)] of oil spill surface in about 12 h.

5.26.2 *Helicopters*—Spraying systems on helicopters are either integral (attached to the airframe) or external units that have a combined tank, pump, and spray boom assembly suspended below the aircraft from a cargo hook, as specified by the manufacturer of the bucket. Sufficient room must be allowed between the helicopter and the spray unit to allow for safe connection and disconnection.release. Spraying is controlled from the cockpit with an electrical remote control unit, attached by cable to the spray system. Nozzles should be oriented parallel to the direction of travel and pointed aft on the spray boom. Only concentrate dispersants applied without dilution are suitable for aerial spraying. The spray-boom altitude, when spraying, should not be over 9 m (30 ft). 10m [30 ft].

56.2.1 Helicopters are limited in the volume of dispersant they can carry, typically under 2000 L (500[500 U.S. gal).gal]. They have greater speed than vessels, however, and if working near the source of dispersant supply, helicopters provide very efficient dispersant application on small areas. Helicopters are best close to shore and should not work further than 20 km (15 miles)[15 miles] from shore, unless there are available offshore platforms on which to land, refuel, and load dispersants.

5.36.3 *Small Airplanes*—Small single-engine airplanes typically will have a wind-driven pump that draws dispersant from a tank to feed the spray booms, that are usually fitted close to the trailing edge of the wing. The dispersant is discharged through nozzles (spaced at intervals along the boom) that are designed to generate droplets within the required size range. The dispersant pump should be capable of spraying at a rate that is required for a surface coverage of 20 to 100 L/hectare (2[2 to 10 U.S. gal/acre)]. The pump rate should be variable in flight, and regulated and monitored with a pre-calibrated flowmeter or pressure gage. Air shear, thatwhich affects droplet size, may be a problem for lower viscosity dispersants of less than 60 mpa (cSt),mPa [cSt], at aircraft velocities exceeding about 200 km/h (100[100 knots or 120 mph).mph]. The spray-boom altitude during application should not be over 9 10 to 30 m (30 ft). [30 to 100 ft].

56.3.1 Small airplanes generally have limited load capacity, about 400 to 3000 L (100[100 to 800 U.S. gal).gal]. This size of aircraft may provide rapid response to small spills, and has longer range and greater speeds than a helicopter system.

5.46.4 *Large Airplanes*— Large multiengine, propeller-driven, airplanes offer increased payload, range, and speed for the treatment of large spills. Most of these aircraft require the installation of wing-mounted booms and other integral parts. Some large cargo airplanes have a rear cargo or personnel door that can be opened in flight, can accommodate portable tank systems, and have extendable booms that can be deployed in flight. Such a system can be permanently fitted to a dedicated airplane, or installed as needed in an airplane of opportunity. These systems may require specific certification by aviation authorities for use on a particular type of aircraft.

5.4.1These larger aircraft will generally fly at altitudes of 15 to 30 m (50 to 100 ft) when applying dispersant to the oil.

5.4.2The largest dispersant liquid capacity for such aircraft is 20000 L (5000 U.S. gal). Aircraft range and payload characteristics can limit the dispersant volume. Application rates from 20 to 100 L/hectare (2 to 10 U.S. gal/acre) can be achieved. Typical coverage for these systems is 30 hectares/min (75 acres/min) at 130 to 150 knots.

6.Control of Spraying Operations

6.1Whichever method is employed to apply dispersants, an objective assessment is required to ensure that a vessel or aircraft spraying operation is conducted properly and effectively. Direction of the operation and observation of its effectiveness can best be conducted from another controller (spotter) aircraft overhead. This can be a light airplane or helicopter, but it must have a high endurance and good radio communications with the spray aircraft or vessel. An airborne observer can not function adequately in the spraying aircraft. To ensure safety in such a case, all the aircraft must have planned for, and maintained, continuous communications.

6.2Personnel in the controller (spotter) aircraft can identify the heavier concentrations of oil (or those slicks posing the greatest threat), direct spray aircraft or boats to the target, request spraying to be started and stopped, and judge the accuracy of the application. These aerial functions are important for spraying operations since oil visibility from a vessel or a spray plane is limited. Air support is essential when large multiengine aircraft are used for spraying. Even when using helicopters and small airplanes for spraying, it is not reasonable to rely on pilot observation, since all of the sprayed area is behind the aircraft. Consequently, the area of coverage and the effect of the dispersant is better seen by an observer in a control plane at a higher altitude, who also can better direct the spray plane on the next pass, in the same or a different treatment area. —Large multi-engine airplanes offer increased