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

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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, or fan-spray guns.

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 related to dispersant application systems. Guide F 1413 covers design, Practice F 1460 covers calibration, Test Method F 1738 covers deposition, and Guide F 1737 covers the use of the systems. Familiarity with all four standards is recommended.

1.5 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

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]

F 1413 Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems

F 1460 Practice for Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle Systems

F 1738 Practice for the Determination of Deposition of Aerially Applied Oil Spill Dispersants

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

4.1 A 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.

4.2 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.

4.3 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 500 to 2000 L (120 to 500 U.S. gal).

4.4 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).

4.5 Dispersant 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

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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.

available dispersant capacity from about 4000 to 20 000 L (1000 to 5000 U.S. gal).

5. Equipment Configuration for Vessels and Aircraft

5.1 *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 %).

5.1.1 Mount the spray booms as far forward as possible so that the spray is applied in front of the bow wave, 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 booms with multiple nozzles 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 does not break the oil surface. Deliver the dispersant-water mixture to the oil 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.

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

5.2 *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. 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).

5.2.1 Helicopters are limited in the volume of dispersant they can carry, typically under 2000 L (500 U.S. 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.

5.3 *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 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, that affects droplet size, may be a problem for lower viscosity dispersants of less than 60 mpa (cSt), at aircraft velocities exceeding about 200 km/h (100 knots or 120 mph). The spray-boom altitude during application should not be over 9 m (30 ft).

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

5.4 *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.

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

5.4.2 The largest dispersant liquid capacity for such aircraft is 20 000 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

6.1 Whichever 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.

6.2 Personnel 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.