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Standard Guide for Terminology and Indices to Describe Oiling Conditions on Shorelines[1]

This standard is issued under the fixed designation F 1687; 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 standardized terminology and types of observational data and indices appropriate to describe the quantity, nature, and distribution of oil and physical oiling conditions on shorelines that have been contaminated by an oil spill.

1.2 This guide does not address the mechanisms and field procedures by which the necessary data are gathered; nor does it address terminology used to describe the cultural resource or ecological character of oiled shorelines, spill monitoring, or cleanup techniques.

1.3 This guide applies to marine shorelines (including estuaries) and may also be used in freshwater environments (rivers and lakes).

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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:*

F 1686 Guide for Surveys to Document and Assess Oiling Conditions on Shorelines[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *asphalt pavement*—a naturally formed cohesive mixture of weathered oil and sediments. Sediments in the mixture are usually in the sand/granule/pebble size range. In appearance, natural asphalt pavement may resemble the mixture artificially created to surface roads.

3.1.2 *lower-swash zone*—the area between the lowest annual water level and the mean annual water level, the lower half (approximate) of the zone of wave activity.

3.1.3 *supra-swash zone*—the area above the highest annual water level that experiences wave activity only occasionally, as during a storm event.

3.1.4 *supra-tidal zone*—the area above the mean high tide that experiences wave activity occasionally.

3.1.5 *upper-swash zone*—the area between the highest annual water level and the mean annual water level, the upper half (approximate) of the zone of wave activity.

3.1.6 *weathered oil*—the oil that has had an alteration of physical or chemical properties, or both, through natural processes such as evaporation, dissolution, oxidation, emulsification, and biodegradation.

4. Significance and Use

4.1 In order to ensure data consistency, it is important to use standardized terminology and definitions in describing oiling conditions. This guide provides a template for that purpose.

4.2 Data on oiling conditions at a shoreline are needed to provide an accurate perspective of the nature and scale of the oiling problem and to facilitate spill-response planning and decision making. Data on oiling conditions would be used in assessing the need for cleanup actions, selecting the most appropriate response technique(s), determining priorities for cleanup, and evaluating the endpoint of cleanup activities.

4.3 Mechanisms by which data are collected may vary (see Guide F 1686).[3,4] They may include aerial videotape surveys or ground-level assessment surveys. The composition and responsibility of the survey team will depend on the response organization and objectives. The magnitude and type of data sets collected may likewise vary with the nature of the spill and operational needs.[5]

4.4 Consistent data sets (observations and measurements) on shoreline oiling conditions are essential within any one spill in order to compare the data between different sites or

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[2] *Annual Book of ASTM Standards*, Vol 11.04.

[3] *Oilspill SCAT Manual for the Coastlines of British Columbia*, Prepared by Woodward-Clyde Consultants, Seattle for the Environmental Technology Branch, Environment Canada, Edmonton, Alta., 1992.

[4] *Shoreline Countermeasures Manual—Tropical Coastal Environments*, Hazardous Materials Response and Assessment Division, National Oceanic and Atmospheric Administration, Seattle, WA, 1993.

[5] Source: Owens, E. H., and Sergy, G. A., *Field Guide to the Documentation and Description of Oiled Shorelines*, ISBN 0-662-22048-X, Environment Canada, Edmonton, Alta., 1994.

observers, and to compare the data against existing benchmarks or criteria that have been developed to rate the nature or severity of the oiling. To the extent possible, consistency is also desirable between different spills, in order to benefit from previous experiences and cleanup decisions.

4.5 It is recognized that some modifications may be appropriate based on local or regional geographic conditions or upon the specific character of the stranded oil.

5. General Considerations

5.1 Shoreline conditions can be described in terms of the length, width, depth, distribution, quantity, and character of oil contamination. These six different types of data are collected by direct measurement or direct visual estimates calibrated against existing scales or indices. Standard definitions and descriptors of these data have been developed (Sections 6 and 7). Second-order applications of the basic data are further used to aid response planning (Sections 8 and 9).

5.2 Descriptions of shoreline oiling conditions are typically referenced to the lateral (seaward to landward) shoreline zonation. The location of the stranded oil within the intertidal zone affects operational access time and oil persistence.

5.2.1 Tidal zonation is described in terms of the supra-tidal, upper/mid/lower intertidal, and sub-tidal zones.

5.2.2 Non-tidal shoreline zonation is described in terms of the supra/upper/lower swash zone for lacustrine (lake) environments and the over/upper/lower/midstream bank for riverine (river) environments.

5.3 Oil persistence and the choice of cleanup options will be different for subsurface oil as opposed to surface oil. Descriptions of shoreline oiling conditions should distinguish between the oiling of surface sediments from that on the subsurface sediments (vertical zonation). On coarse sediment beaches, it can be difficult to differentiate the vertical boundaries. Fig. 1 illustrates an approach for discriminating those boundaries.

5.4 For beaches with fine sediments (that is, pebble, granule, sand, and mud), the subsurface begins at 5 cm below the surface. If a pit were to reveal oiling in sand from the surface down to 20 cm, the upper 5 cm would be classified as surface oil and the remainder as subsurface. However, the oiled

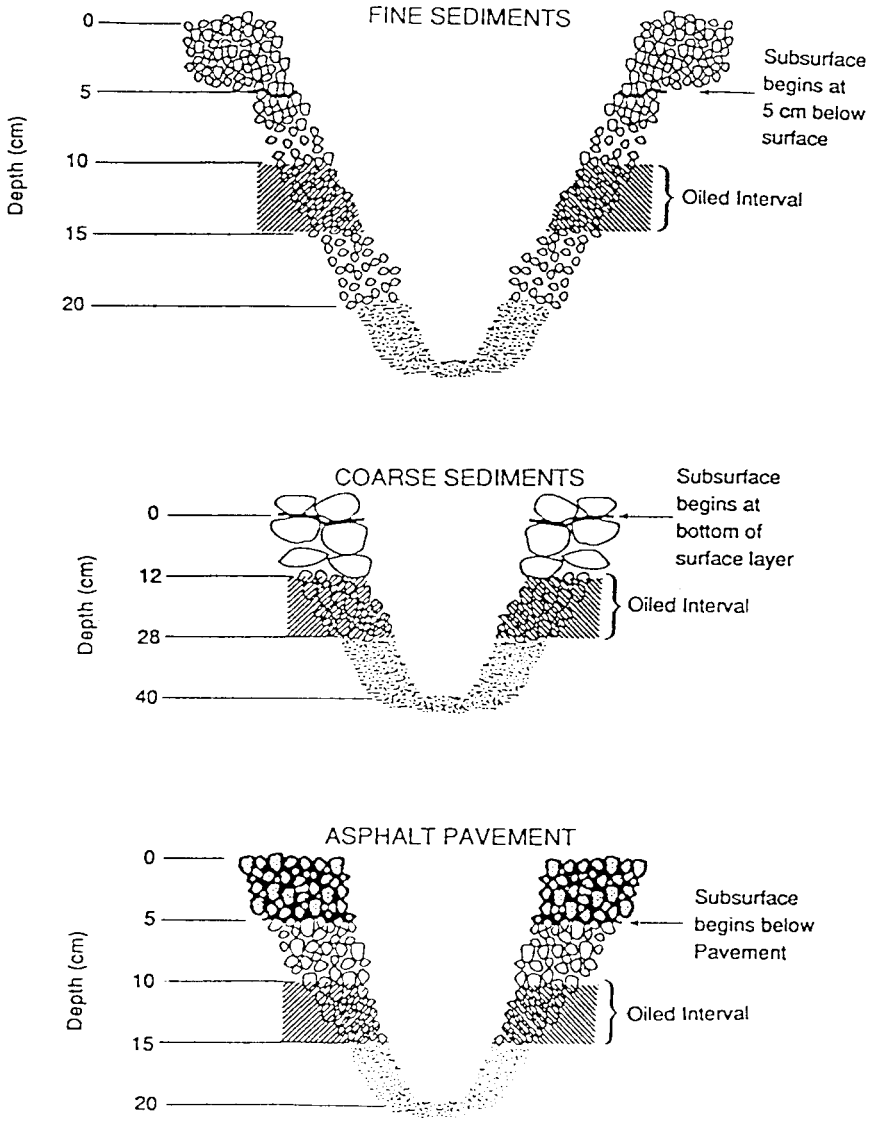

FIG. 1 Subsurface Boundaries for Various Beach Types[5]

interval would still be shown as 0 to 20 cm.

5.5 For beaches with coarse sediments (that is, cobble and boulder), the subsurface begins at the bottom of the surface material (that is, where the top layer of cobbles or boulders contact the underlying layer of sediments).

5.6 Where asphalt pavement exists on the surface, the subsurface begins at the bottom of the pavement.

5.7 Definitions of the inorganic sediments based on size are as follows:

Boulder	(>256-mm diameter)
Cobble	(64 to 256-mm diameter)
Pebble	(4 to 64-mm diameter)
Granule	(2 to 4-mm diameter)
Sand	(0.06 to 2-mm diameter)
Mud/silt/clay	(<0.06-mm diameter)

6. Description of Shoreline Surface-Oiling

6.1 *Oil Length*—This refers to the along-shore length of oiled shoreline.

6.1.1 The length should be described in numeric terms, as the actual measured or estimated value.

6.1.2 The length value must clearly indicate a reference to one of three different delineations:

6.1.2.1 The length of oiled-shoreline, which is the length of any single continuous oiling deposit and which is keyed to a specific shoreline location;

6.1.2.2 The total length of oiled-shoreline, which is the sum of the individual continuous oilings; or

6.1.2.3 The total length of affected shoreline, which is the total length of shoreline in the spill path (the distance between the two extreme strike points) and includes non-oiled sections of shoreline as well as oiled shoreline.

6.2 *Oil Width*—This refers to the average across-shore width of the oil band or oiled area.

6.2.1 If multiple bands or areas occur across-shore, the width represents the sum of their widths.

6.2.2 The width should be described by the actual numeric (measured or estimated) value.

6.2.3 Where a descriptive expression is required or for the purpose of aggregation of the actual data, use a simplified classification scheme.

6.2.3.1 Most marine shorelines can use the following definitions:

Wide	>6 m
Medium	>3 to ≤6 m
Narrow	>0.5 to ≤3 m
Very narrow	≤0.5 m

6.2.3.2 Areas of micro-tidal (for example, Great Lakes) or macro-tidal (for example, Bay of Fundy or Cook Inlet) exposure will require an adjustment based on the width of the shoreline.

6.3 *Oil Distribution*—This refers to the percentage of the shoreline surface sediments that are covered with oil, within a fixed area.

6.3.1 In the event of multiple bands, distribution refers to the estimated percentage that best represents the collective area.

6.3.2 Distribution should be described by the percentage value that was observed.

6.3.3 Where a descriptive expression is required, or for the purpose of aggregation of the actual value, use the classification of the following:

Trace	<1 %
Sporadic	1 to 10 %
Patchy	11 to 50 %
Broken	51 to 90 %
Continuous	91 to 100 %

6.4 *Surface-Oil Quantity*—This describes the amount of oil on shoreline surface sediments. The quantity is usually expressed as thickness or concentration.

6.4.1 Direct measurement of oil thickness can be made for very thick and larger deposits of oil. Visual estimates of the thickness of oil on the shoreline surface sediments can be used in the field. The dominant oil thickness within a band or area can be described by the classification of the following:

6.4.1.1 *Pooled or Thick Oil (PO)*, generally consisting of fresh oil or mousse accumulations >1-cm thick.

6.4.1.2 *Cover (CV)*, 0.1 cm and ≤1-cm thick.

6.4.1.3 *Coat (CT)*, >0.01 cm and ≤0.1-cm thick coating. This can be scratched off on coarse sediments or bedrock.

6.4.1.4 *Stain (ST)*, ≤0.01-cm thick. An oil residue discoloration on the sediment surface. It cannot be scratched off easily on coarse sediments or bedrock.

6.4.1.5 *Film (FL)*, transparent or translucent thin layer or sheen.

6.4.2 The oil concentration can be determined by chemical analytical methods and is expressed as the weight of oil to weight of surface sediment.

6.5 *Oil Character*—This refers to the properties or form of the oil residue on the shoreline.

6.5.1 Qualitative descriptors of oil character may be developed to suit the circumstances of the spill. Typical descriptors are as follows:

6.5.1.1 *Freshlike (FR)*, having a black, shiny, fluid, non-oxidized appearance.

6.5.1.2 *Tarry (TC)*, having a tacky, tar-like, often weathered, semi-solid consistency.

6.5.1.3 *Surface Oil Residue (SR)*, consisting of non-cohesive oiled, surface sediments, either as continuous patches or in coarse-sediment interstices.

6.5.1.4 *Mousse (MS)*, emulsified oil (oil and water mixture) existing as patches or accumulations, or within interstitial spaces.

6.5.1.5 *Tar Balls or Mousse Patties (TB)*, discrete balls or patties on a beach or adhered to rock or coarse-sediment shoreline. Tar ball diameters are generally <0.1 m, and patties are ≥0.1 to ≤1 m.

6.5.1.6 *Asphalt Pavement (AP)*, cohesive mixture of weathered oil and sediments.

6.5.1.7 *Sheen (SH)*, a very thin transparent or translucent oil layer ranging in color from silver to rainbow to light brown, of approximate thickness of 0.0001 to 0.001 mm.

6.5.2 Physical and chemical analytical characterization of the oil residues can be used on selected samples to determine oil properties.

7. Description of Shoreline Subsurface-Oiling

7.1 *Depth*—This refers to the depth of penetration or burial of the oil into the shoreline subsurface sediments, or both. It is

the distance measured from the ground surface to the bottom of the oiled zone, or to the bottom of a discrete lens of oil that exists beneath the surface. In the latter case, the thickness of the oil lens is also measured, that is, top and bottom boundaries.

7.2 *Subsurface-Oil Quantity*—This refers to the amount of oil in the shoreline subsurface sediments (see 5.3 for guidance on vertical zonation). The quantity can be expressed in descriptive terms or by measurements of concentration.

7.2.1 Qualitative descriptions facilitate rapid field estimates of oil volume and may also reflect actual spill conditions. Typical descriptors may include the following:

7.2.1.1 *Oil-Filled Pores (OP)*—Pore spaces in the sediment matrix completely filled with oil. They are often characterized by oil flowing out of the sediments when disturbed.

7.2.1.2 *Partially Filled Pores (PP)*—Pore spaces filled with oil, but it generally does not flow out when exposed or disturbed.

7.2.1.3 *Cover or Coat or Stain or Film* (see 6.4.1)—Oil residue on larger grained-sized sediments.

7.2.1.4 *Trace (TR)*—A discontinuous film or spots of oil on sediments, or an odor or tackiness with no visible evidence of oil.

7.2.1.5 *Asphalt Pavement (AP)*—Cohesive mixture of weathered oil and sediments situated completely below a surface sediment layer (note thickness).

7.2.2 Chemical analytical methods can be used on selected samples to determine the oil quantity as a concentration (expressed as the weight of oil to weight of sediment at a specified subsurface location).

7.3 *Subsurface-Oil Length or Width*—This refers to the along-shore length or across-shore width of oiled subsurface sediment at a specific location (see 6.1 and 6.2).

8. Other Calculations

8.1 *Total Oiled Area = Length × Width Data* (6.1 and 6.2)—This refers to the total surface area of shoreline within which there is oil (of varying distribution). This value can be used in planning cleanup operations and in monitoring changes through time.

8.2 *Surface Oil Cover = (Length × Width) × Distribution Data* (6.1, 6.2, and 6.3)—This is a measure of the actual surface area that is covered by oil, that is, the total oiled area × % coverage (also known as equivalent area oiled). This value is useful when trying to quantify the degree of oiling or to monitor changes and oil removal rates.

8.3 *Oiled Sediment Volume = Depth × Area*—This refers to the total volume of shoreline sediments that contain oil (of varying concentrations and distribution). This is the volume of sediment that might have to be handled in a cleanup operation.

8.4 *Oil Volume*—This refers to the quantity of oil in or on the shoreline sediments. These calculations require oil concentration data in combination with knowledge of oiled sediment volume or equivalent area oiled, or oil loading data, together with sediment porosity/retention estimates.

9. Rating the Degree of Oiling

9.1 Collected field data can be combined to create indices that rate the degree or relative severity of oiling. This process reduces large volumes of observational data and allows a single-value, site-to-site, relative comparison. Such indices become very valuable for setting priorities and making decisions with respect to shoreline cleanup on medium to large spills where large areas are oiled. They provide a perspective for describing, summarizing, or comparing multiple areas or long sections of oiled coast in an easily understandable manner.

9.2 Rating indices must be adjusted to local conditions, particularly where the shoreline width data do not conform to the classification described in 6.2.

9.3 A tiered approach to rating is used to allow for different levels of detail of collected data. This enables data from different surveys with different levels of detail to be compatible with each other, as well as to refine the rating with increasing levels of data detail input. An example three-tier index is contained in Table 1, Table 2, and Table 3.

9.3.1 *Surface Oil Cover Category*—This combines width × distribution data (6.2 and 6.3).

9.3.2 *Surface Oiling Category*—This combines width × distribution × thickness (see 6.4.1).

9.3.3 *Subsurface Oiling Category*—This combines depth × relative concentration (7.1 and 7.2).

9.4 Descriptors of the degree of oiling are very light, light, moderate, and heavy. The indices are used to produce a rating of a described location. Typically, the rating category is combined with alongshore length; for example, Segment AB-1 has 20 m of heavy surface oiling.

TABLE 1 Oil Cover Category Matrix[5]

	Width of Oiled Areas			
	Wide, >6 cm	Medium, 3 to 6 m	Narrow, 0.5 to 3 m	Very Narrow, <0.5 m
Continuous, 91 to 100 %	heavy	heavy	moderate	light
Broken, 51 to 90 %	heavy	heavy	moderate	light
Patchy, 11 to 50 %	moderate	moderate	light	very light
Sporadic, 1 to 10 %	light	light	very light	very light
Trace, <1 %	very light	very light	very light	very light

TABLE 2 Surface Oiling Category Matrix[5]

	Initial Oil Cover Category			
	Heavy	Moderate	Light	Very Light
Pooled/thick, >1 cm	heavy	heavy	moderate	light
Cover, 0.1 to 1.0 cm	heavy	heavy	moderate	light
Coat, 0.01 to 0.1 cm	moderate	moderate	light	very light
Stain/film, <0.01 cm	light	light	very light	very light

TABLE 3 Subsurface Oiling Category Matrix[5]

	Penetration Depth or Thickness of Oil Lens			
	>30 cm	21 to 30 cm	11 to 20 cm	≤10 cm
Oil-filled pores	heavy	heavy	moderate	moderate
Part-filled pores	heavy	moderate	moderate	light
Cover/coat stain residue	moderate	moderate	light	light
Trace	light	very light	very light	very light