



Standard Practice for Cone Penetrometer Technology Characterization of Petroleum Contaminated Sites with Nitrogen Laser-Induced Fluorescence¹

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1. Scope

1.1 This practice covers the method for delineating the subsurface presence of petroleum hydrocarbons and other hydrocarbons using a fiber optic based nitrogen laser-induced fluorescence sensor system.

1.2 The petroleum hydrocarbon sensing scheme utilizes a fluorescence technique in which a nitrogen laser emits pulsed ultraviolet light. The laser, mounted on the cone penetrometer platform, is linked via fiber optic cables to a window mounted on the side of a penetrometer probe. Laser energy emitted through the window causes fluorescence in adjacent contaminated media. The fluorescent radiation is transmitted to the surface via optical cables for real-time spectral data acquisition and spectral analysis on the platform.

1.3 This sensor responds to any material that fluoresces when excited with ultraviolet wavelengths of light, largely the polycyclic aromatic, aromatic, and substituted hydrocarbons, along with a few heterocyclic hydrocarbons. The excitation energy will cause all encountered fluorophores to fluoresce, including some minerals and some non-petroleum organic matter. However, because the sensor collects full spectral information, discrimination among the fluorophores may be distinguished using the spectral features associated with the data. Soil samples should be taken to verify recurring spectral signatures to discriminate between fluorescing petroleum hydrocarbons and naturally occurring fluorophores.

1.4 This practice is used in conjunction with a cone penetrometer of the electronic type, described in Test Method D 5778.

1.4.1 The direct push LIF described in this practice can provide accurate information on the characteristics of the soils and contaminants encountered in the vadose zone and the saturated zone, although it does not make a distinction between dissolved and sorbed contamination in the saturated zone.

1.5 This practice describes rapid, continuous, in-situ, real-time characterization of subsurface soil.

1.6 Direct push LIF is limited to soils that can be penetrated with the available equipment. The ability to penetrate strata is based on carrying vehicle weight, density of soil, and consistency of soil. Penetration may be limited; or, damage to sensors can occur in certain ground conditions.

1.7 This practice does not address the installation of any temporary or permanent soil, ground water, soil vapor monitoring, or remediation devices; although, the devices described may be left in-situ for the purpose of on-going monitoring.

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

1.9 Direct push LIF environmental site characterization will often involve safety planning, administration, and documentation. This practice does not purport to address the issues of operational or site safety.

1.10 *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

- D 653 Terminology Relating to Soil, Rock, and Contained Fluids
- D 1129 Terminology Relating to Water
- D 3650 Test Method for Comparison of Waterborne Petroleum Oils by Fluorescence Analysis
- D 4657 Test Method for Polynuclear Aromatic Hydrocarbons in Water
- D 5088 Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites
- D 5730 Guide to Site Characterization for Environmental Purposes With Emphasis on Soil, Rock, the Vadose Zone, and Ground Water
- D 5778 Test Method for Performing Electronic Friction

¹ This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

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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.