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Standard Guide for Environmental Site Characterization in Cold Regions[1]

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INTRODUCTION

Understanding environmental processes that occur in soil and rock systems in cold regions of the world depends on adequate characterization of not only the physical, chemical, and biological properties of soil and rock but also the climatic factors under which they exist. Processes of interest may include, but are not limited to, surface and subsurface hydrology, contaminant mobilization, distribution, fate and transport, chemical and biological degradation of wastes, geomorphological, and ecological processes in general.

1. Scope

1.1 Use this guide in conjunction with Guide D5730.

1.2 This guide describes special problems to be considered when planning field investigations in cold regions. The primary focus of this guide is presenting the special problems and concerns of site characterization in the cold regions of the world.

1.3 Laboratory testing of soil, rock, and ground-water samples is specified by other ASTM standards that are not specifically discussed in this guide. Laboratory methods for measurement of physical properties relevant to environmental investigations are included in Guide D5730.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 This guide emphasizes the care that must be taken by all field personnel during operations in tundra and permafrost areas of the world.

1.6 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.7 *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]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)

D5254 Practice for Minimum Set of Data Elements to Identify a Ground-Water Site

D5408 Guide for Set of Data Elements to Describe a Ground-Water Site; Part One—Additional Identification Descriptors

D5409 Guide for Set of Data Elements to Describe a Ground-Water Site; Part Two—Physical Descriptors

D5410 Guide for Set of Data Elements to Describe a Ground-Water Site;Part Three—Usage Descriptors

D5730 Guide for Site Characterization for Environmental Purposes With Emphasis on Soil, Rock, the Vadose Zone and Ground Water

D5781 Guide for Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D5783 Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

[1] This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.01 on Surface and Subsurface Characterization.

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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.

D6001 Guide for Direct-Push Ground Water Sampling for Environmental Site Characterization

3. Terminology

3.1 *Definitions*—Definitions of terms used in this guide are in accordance with Terminology D653.

3.1.1 Guide D5730 identifies major references from a range of disciplines that can be used as additional sources for definitions of terms that are related to environmental site characterization.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *active layer*, *n*—the top layer of ground above the permafrost table that thaws each summer and refreezes each fall.

3.2.2 *alpine permafrost*, *n*—permafrost developed in temperate climate mountainous areas of the world.

3.2.3 *continuous permafrost*, *n*—permafrost occurring everywhere beneath the exposed land surface throughout a geographic regional zone, with the exception of widely scattered sites, such as newly deposited unconsolidated sediments, where the climate has just begun to impose its influence on the ground thermal regime that will cause the formation of continuous permafrost.

3.2.4 *discontinuous permafrost*, *n*—permafrost occurring in some areas beneath the ground surface throughout a geographic regional zone where other areas are free of permafrost.

3.2.5 *icing*, *n*—a sheet-like mass of layered ice, either on the ground surface or on the surface of river ice. Aufeis (German), Naled (Russian).

3.2.6 *permafrost*, *n*—the thermal condition in earth materials where temperatures below 0°C persist over at least two consecutive winters and the intervening summer; moisture in the form of water and ground ice may or may not be present. Earth materials in this thermal condition may be described as perennially frozen, irrespective of their water and ice content.

4. Significance and Use

4.1 This guide, when used in conjunction with Guide D5730, provides direction to the selection of the various ASTM standards that are available for the investigation of soil, rock, the vadose zone, ground-water, and other media where the investigations have an environmental purpose and are conducted in cold regions of the world. It is intended to improve consistency of practice and to encourage rational planning of a site characterization program by providing information to assist in the design of an environmental reconnaissance or investigation plans. This guide is intended to provide information that will help minimize the effect of site characterization operations on areas of frozen ground or permafrost and increase the safety of environmental operations in cold regions.

4.2 This guide presents information and references for site characterization for environmental purposes in cold regions of the world.

5. Special Problems of Cold Regions

5.1 *Safety*—When working in very cold temperatures safety is of utmost importance. Weather is volatile and unpredictable. The difficulty of working under arctic conditions tends to cause frustration and increases the chance of injury. Freezing of exposed flesh and hypothermia can occur very quickly under winter conditions. Specific training in arctic survival techniques in accordance with the Department of the Army or comparable training is recommended for anyone expected to work in these conditions.

5.2 *Tundra*—All operations in areas of tundra must be undertaken with special care. What causes a minor impact in a temperate region from a small environmental site characterization study will have a greater impact on tundra or areas underlain by permafrost. Special care and attention during the planning process must be given to field operations to prevent damage to the tundra surface and vegetation. Winter field operations when tundra is protected by snow and ice are less damaging than summer operations but increase difficulties created by very cold temperatures (see 5.3).

5.2.1 Give special attention to all operations using any form of vehicle in tundra areas. Because of the fragile nature of tundra only a single vehicle pass or aircraft landing may be all that is required to cause uncontrolled degradation of the vegetation and underlying permafrost.

5.2.2 Give special attention to any operation using a motorized or heat producing unit (for example, drilling equipment). These items must be insulated in order to protect permafrost or frozen surface layers against heat transfer, which can result in irreversible degradation of the vegetation and underlying permafrost.

5.3 *Very Cold Temperatures*—Field operations during seasons of very cold temperatures require special planning and concern. Work elements that would require only an hour or so to perform in temperate climates may require several days to perform under the winter temperatures of cold regions. Site investigation planning should take into consideration and allow sufficient time to perform all steps of the investigation. Some procedures, such as tactile methods for visual-manual classification of soils, may not be feasible during cold weather.

5.4 *Permafrost*—The cold winters and short summers of the polar regions produce a layer of frozen ground or permafrost that remains frozen through the summer. Permafrost is a phenomenon of the polar and subpolar regions of the world. About 20 % of the world's land is underlain by permafrost. Permafrost and permafrost hazards uniquely affect most activities in the cold regions, and permafrost and associated hazards must be considered in the planning of all environmental site characterization operations.

5.4.1 Many permafrost areas of the world are not in equilibrium with the existing climate. Any small disturbance of the thermal regime of the permafrost, such as a tire track or drill hole, may result in a drastic change in the underlying permafrost. Therefore, extreme care must be given to prevent damage to the environment when conducting characterization operations in areas underlain by permafrost.

5.4.2 Permafrost acts as a natural barrier in some areas, containing aquifers not usually exposed to surface conditions. Penetration of the permafrost layer into underlying ground water during installation of monitoring wells or collection of deep core samples can increase and exacerbate the fate and