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Soil quality — Inhibition of reproduction of Collembola (*Folsomia candida*) by soil contaminants

*Qualité du sol — Inhibition de la reproduction de Collembola (*Folsomia candida*) par des contaminants du sol*

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 190, *Soil quality,* Subcommittee SC 4, *Biological characterization*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 444, *Environmental characterization of solid matrices,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 11267:2014), which has been technically revised.

The main change is as follows:

— addition of an annex to provide specific information when using alternative Collembola species for reproduction test.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Ecotoxicological test systems are applied to obtain information about the effects of contaminants in soil and are proposed to complement conventional chemical analysis (see References [2] and [4]). Reference [2] includes a list and short characterization of recommended and standardized test systems and Reference [4] gives guidance on the choice and evaluation of the bioassays. Aquatic test systems with soil eluate are applied to obtain information about the fraction of contaminants potentially reaching the groundwater by the water path (retention function of soils), whereas terrestrial test systems are used to assess the habitat function of soils.

Soil-dwelling Collembola are ecologically relevant species for ecotoxicological testing. Springtails are prey animals for a variety of endogeic and epigeic invertebrates and they contribute to decomposition processes in soils. In acidic soils they are probably the most important soil invertebrates besides enchytraeids with respect to that function, since earthworms are typically absent.[19] Additionally, Collembola represent arthropod species with a different route and a different rate of exposure compared to earthworms[1] and enchytraeids.[3] Various species were used in bioassays of which four species were used most commonly, *Folsomia candida* Willem, *Folsomia fimetaria* L., *Onychiurus armatus*, and *Orchesella cincta*.[20] Numerous soil toxicity tests supported by Environment Canada (EC) resulted in the development and standardization of a biological test method for determining the lethal and sublethal toxicity of samples of contaminated soil to Collembola.[10] The method prepared by EC includes four species, *Orthonychiurus folsomi*, *Proisotoma minuta*, *F. candida*, and *F. fimetaria*. As standardized test systems using Collembola as indicator organisms for the habitat function of soil, another two methods exist. One is designed for assessing the effects of substances on the reproductive output of the Collembola, *F. fimetaria* and *F. candida* in soil[19],[21], and the other method described here, focuses on testing contaminated soil. Optionally the method can be used for testing substances added to standard soils (e.g. artificial soil) for their sublethal hazard potential to Collembola.

This document describes a method that is based on the determination of sublethal effects of contaminated soils to adult Collembola of the species *Folsomia candida* Willem. The species is distributed worldwide. It plays a similar ecological role to *F. fimetari*[10],[19]. *F. candida* reproduces parthenogenetically and is an easily accessible species as it is commercially available and easy to culture. *F. candida* is considered to be a representative of soil arthropods and Collembola in particular. Background information on the ecology of springtails and their use in ecotoxicological testing is available in Reference [22].

Distinct Collembolan species inhabit various ecological niches at different soil depths and in different soil types across the globe. Although considered a surrogate species and therefore frequently used in ecotoxicological reproduction tests, *F. candida* is not common in most natural soils.[28] Furthermore, species specific morphological adaptations can influence exposure and toxic effects of chemicals on organisms.[102] Thus, the use of a variety of Collembolan species representing different morphological adaptations can be advantageous to obtain a broad spectrum of sensitivities for this group. Therefore, other species like *F. fimetaria* (euedaphic, distributed worldwide and found in agricultural soils[28]), *Onychirus yodai* (an euedaphic Asian species,[31] *Proisotoma minuta* (hemiedaphic, distributed worldwide and inhabiting agricultural soils [31],[36]), *Protaphorura fimata* (euedaphic, occuring through mild temperate to cold zones [31],[37]), and *Sinella curviseta* (epedaphic, distributed from North America to Europe, Southeast Asia and Japan [42]) were added as potential alternative test species (Annex E). These species have been used as ecotoxicological test species before, but available testing experience is limited.

Effects of substances are assessed using a standard soil, preferably a defined artificial soil substrate. For contaminated soils, the effects are determined in the soil to be tested and in a control soil. According to the objective of the study, the control and dilution substrate (dilution series of contaminated soil) are either an uncontaminated soil comparable to the soil to be tested (reference soil) or a standard soil (e.g. artificial soil).

NOTE The stability of the test substance cannot be ensured over the test period. No provision is made in the test method for monitoring the persistence of the substance under test.

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Soil quality — Inhibition of reproduction of Collembola (*Folsomia candida*) by soil contaminants

1 Scope

This document specifies one of the methods for evaluating the habitat function of soils and determining effects of soil contaminants and substances on the reproduction of *Folsomia candida* Willem by dermal and alimentary uptake. This document also provides information on how to use this method for testing substances under temperate conditions.

The chronic test described is applicable to soils and soil materials of unknown quality, e.g. from contaminated sites, amended soils, soils after remediation, industrial, agricultural or other sites of concern and waste materials.

The method is not applicable to volatile substances, i.e. substances for which H (Henry's constant) or the air/water partition coefficient is greater than 1, or for which the vapour pressure exceeds 300 Pa at 25 °C.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10390, *Soil, treated biowaste and sludge – Determination of pH*

ISO 10694, *Soil quality — Determination of organic and total carbon after dry combustion (elementary analysis)*

ISO 11260, *Soil quality — Determination of effective cation exchange capacity and base saturation level using barium chloride solution*

ISO 11277, *Soil quality — Determination of particle size distribution in mineral soil material — Method by sieving and sedimentation*

ISO 11465, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

ISO 18400-206, *Soil quality — Sampling — Part 206: Collection, handling and storage of soil under aerobic conditions for the assessment of microbiological processes, biomass and diversity in the laboratory*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
contaminant
substance or agent present in the soil as a result of human activity

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