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Nordic Horizontal Standard for Sampling

A structural approach to horizontal sampling standards

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Nordic Horizontal Standard for Sampling

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APPENDICES

FOREWORD

Two documents have been prepared within the Nordic Innovation Centre project "Development of Nordic generic horizontal standards for sampling (06135)":

1. A structural approach to horizontal sampling standards (present document).
2. Draft horizontal standard on selection of operational sampling standards for solids and liquids.

The first document considers giving guidance on reading and application of horizontal standards and development of the horizontal approach. The second document is an example of a standard on identification of the best available operational sampling standard related to sampling of solid granular material in stationary and dynamic situations and liquids in dynamic situations.

The project has been carried out by:

- DHI (Denmark).
- SP Technical Research Institute of Sweden (Sweden).
- Aquateam AS (Norway).
- Swedish Geotechnical Institute (Sweden).
- VTT Technical Research Centre (Finland).

The project was initiated in September 2006 and finalized in October 2008.

The project supports and refers to earlier completed Nordtest and NICe projects on sampling, laboratory quality control and field measurements. In addition several projects carried out within the last few years have been focusing on uncertainty arising from sampling and within these projects, quality control has been an important issue (Nordic Innovation Centre 2006, 6th Committee of Eurachem 2006 and Eurofins 2005):

- Handbook on wastewater and sludge sampling (Nordtest 2005).
- Uncertainty from sampling Nordtest/Eurachem (Nordtest 2007).
- Quality control manual for field measurements (NT tec 581).
- Nordtest Sampler Certification (NT ENVIR 008).
- Nordtest Sampler Certification network (ongoing work).
- Two Nordtest methods on sampling of waste (NT ENVIR 001 and NT ENVIR 004).
- A CEN/STAR workshop was held in April 2005 in Brussels.

The principal scientists and authors of this document within the project are: Bodil Mose Pedersen, Jette Bjerre Hansen, Anke Oberender (DHI), Bertil Magnusson (SP), Margareta Wahlström and Jutta Laine-Ylijoki (VTT), Ragnar Storhaug (Aquateam) and Johan Nordbäck (SGI). Christian Grøn (DHI) is gratefully acknowledged for fruitful comments and discussions.

The outputs from this NICe project on Horizontal sampling standards will be transferred to CEN so that the structural approach can form part of European Standardization work on horizontal sampling standard(s). The dissemination will take place in the end of 2008 through the committee “Danish Sampling Forum” established by Danish Standards.

The foundation of the horizontal approach and the horizontal standard is environmental sampling. However, the compilation comprises standards from a broad range of industrial sectors. Although the selection, formulation and interpretation of criteria in sampling and the selection of the best available operational standards have been achieved from an objective point of view, the work reflects the expertise represented by the people in the project group.

1 INTRODUCTION

In the environmental field as well as in the industrial sectors measurements of representative and reliable sub-samples of for example waste materiel, wastewater, intermediate streams, end products or waste streams are essential with regard to optimisation of treatment and production processes and controlling output and emissions from treatment processes. Sampling is an important activity of the measuring process providing data for all the mentioned activities and for the decisions associated with the test – and analytical results. Sampling is frequently under-evaluated compared to the subsequent testing and analytical operations, which are based on the output of the sampling operation. Sampling planning, selection of procedures and equipment therefore are vital in the process of obtaining representative sub-samples to ensure the needed measurement quality for decision making.

Currently, sampling methods and requirements are found in both national and international standards, guidelines and legal requirements, mostly developed for specific purposes and matrices. Conversely to the above-mentioned situation, sets of broad international standards are available developed for specific matrices (*e.g.:* sampling of soil). The derived major problems for international monitoring and control relying upon sampling are that:

- Uniform methods, requirements and mutual recognition cannot be obtained leading to barriers for exchange of environmental data.
- Simple, efficient, uniform and practical guidance for samplers (the person carrying out sampling) is not available, even though methods in many cases are very similar across matrices and situations.

The development of a concept and an example of a horizontal sampling standard could contribute to solve these issues and contribute in obtaining comparable environmental data.

A horizontal standard in this context is a standard that describes sampling of a broad group of targets with similar properties (*e.g.:* liquid samples) defining the steps and procedures required to attain reliable sampling. It is the first basic guidance a person involved in planning of sampling should read. A horizontal standard is more of a general handbook for samplers harmonising terminology, procedure and practice for a number of different sectors. In order to provide real and useful practical guidance for the users of horizontal standards, they shall be supported by underlying standards, which are specific with respect to sampling situation (*e.g.:* sampling of solids from a falling stream) or with respect to activity (*e.g.:* preservation of samples). These underlying standards shall still cover different sampling situations.

The horizontal approach is compliant with the current international project *Horizontal* which is supported by the European Commission and focuses on a limited number of matrices related to soil, but this NICe project refers to an even broader horizontal approach – not only solid granular material, but also other solid material as well as liquids.

The overall objective is to improve the possibilities for application of appropriate and reliable standards outside the traditional scopes given by trades, industrial and environmental sectors.

1.1 Objectives and scope

Speaking about sampling activities the final target is to deliver a representative sample from the lot/sampling target to the laboratory, where the sample is analysed. Previous to that it is essential to have standards on primary, secondary and tertiary sampling that helps you to get samples, which are representative and can (nearly) be obtained when repeating the procedure described in the operational standard.

The overall objective within this structural approach to sampling is to improve the possibilities for using sampling standards across industrial sectors, trades and the environmental sector and to ensure that operational standards are based on the same basic sampling principles. Categorization of sampling standards is made according to sampling situation (matrix, stationary or dynamic) and activities (procedure, equipment, etc.).

The aim is to ensure that horizontal standards cover broader while the operational standards become more specific concerning the technical aspects (procedures, equipment, sample handling, etc.) and more generic concerning structure, terminology and the theoretical basis for setting up criteria for the sampling.

Therefore, the scope within this structural approach is to:

- Outline the principles of the approach related to horizontal sampling standards.
- Define and outline the content of horizontal standards and operational standard primarily with respect to procedure and equipment.
- Describe the link between horizontal and operational standards.

To begin with the specific type and the composition of the material to be sampled is secondary to sampling principles. The structural approach focuses on solid and liquids in combination with the sampling situation whether it is a dynamic or a stationary sampling situation. Classification of operational standards into e.g. sampling activities is included.

In the structural approach sampling is considered as an integrated part of a measuring process.

1.2 Informative references

The following reference documents are indispensable for the application of this document. For dated references only the edition cited applies. For undated references the last edition of the referenced document applies.

- CEN/CENELEC Internal Regulation-Part 3 2003-10 Rules for the structure and drafting of CEN/CENELEC publications (ISO/IEC Directives – Part 2, modified).
- ISO/IEC 17025:2005: General requirements for the competence of testing and calibration laboratories.

- ISO 11074-2: Soil Quality – Vocabulary – Part 2: Terms and definitions relating to sampling.
- ISO 3554-1 Statistics – Vocabulary and Symbols Part 1: General statistical terms and terms used in probability.
- ISO/IEC Guide 7: 1994 Guidelines for drafting standards suitable for use for conformity assessment.

1.3 Terms and definitions

For the purpose of "Nordic horizontal standard for sampling" the following definitions apply. Definitions from compiled standards and guidelines within this project are included as well.

Bias: The difference between the average amounts from many samples and the true lot. (Smith, 2001).

Composite sample: Two or more increments/sub-samples mixed together in appropriate portions, either discretely or continuously (blended composite sample), from which the average value of a desired characteristic may be obtained.
ISO11074-2: 3.10 (1998), adopted by AMC Subcommittee.

Duplicate sample or replicate sample: One of the two (or more*) samples or sub-samples obtained separately at the same time by the same sampling procedure or sub-sampling procedure *for replicate sample.
Adapted from ISO11074-2: 2.14 (1998); ISO1998 was formally adopted from ISO3534-1 (2006); Similar definition has been adopted by AMC Subcommittee.

Fitness for purpose: The degree to which data produced by a measurement process enables a user to make technically and administratively correct decisions for a stated purpose.
Note: As defined for analytical science Thompson and Ramsey, 1995.

Fragments: The smallest inseparable physical parts of the lot. A fragment is most often a single particle for instance a grain of sand or suspended substances.
(Smith, 2001).

Homogeneity, heterogeneity: The degree to which a property or constituent is uniformly distributed throughout a quantity of material.
Note 1. A material may be homogenous with respect to one analyte or property but heterogeneous with respect to another.
Note 2. The degree of heterogeneity (the opposite of homogeneity) is the determining factor of sampling error.
IUPAC (1990)]; ISO 11074-2: 1.6 (1998)].

Non-uniformity in all the chemical and physical aspects of interest (Smith, 2001).

Increment*:* Individual physical portions that are combined to form a sample. Fragments are characterised by being extracted simultaneously by the sampling tool/equipment. (Smith, 2001).

Laboratory sample: Sample as prepared for sending to the laboratory and intended for inspection or testing.
ISO Standard 78-2 (1999), adopted by CAC.

Lot: See sampling target.

Parameter: Particular quantity subject to measurement.
Note: Definition of measurand according to Ramsey & Ellison (2007).

Precision: The closeness of agreement between independent test results obtained under stipulated conditions.
ISO3534-1: (2006).

Primary sample: The collection of one or more increments or units initially taken from a population.
IUPAC (1990), adopted by AMC Subcommittee.

Principle of correct sampling: The principle that every part of the target has equal chance of being in the sample and the integrity of the sample is preserved during and after sample (Smith 2001).

Random error of result: A component of the error which, in the course of a number of test results for the same characteristic, remains constant or varies in an unpredictable way.
Note: It is not possible to correct for random error.
ISO 3534-1: 1993 (3.9)].

Reference sampling: Characterisation of an area, using a single sampling device and a single laboratory, to a detail allowing the set-up of a distribution model in order to predict element concentrations, with known uncertainty, at any sampling point.
IUPAC (2005).

Representative sample: A sample that has the same properties of interest as the target. The bias has been reduced as much as possible. (Smith, 2001).
Sample resulting from a sampling plan that can be expected to reflect adequately to properties of interest in the parent population.
IUPAC (1990); [ISO 11074-2: 1.9 (1998)] AMC (2005).

Sample: A portion of material selected from a larger quantity of material.
IUPAC (1990); ISO11074-2 (1998), adopted by AMC Subcommittee.

Sampler: Person (or group of persons) carrying out the sampling procedures at the sampling point.
Adapted from ISO11074-2 (1998).

Sample preparation: The set of material operations (such as reduction of sizes, mixing, dividing, etc.) that may be necessary to transform an aggregated or bulk sample into a laboratory or test sample.
Adapted from ISO3534-1 (2006).

Sample pre-treatment: Collective noun for all procedures used for conditioning a sample to a defined state which allows subsequent examination or analysis or long-term storage.
Adapted from ISO11074-2: 6.1 (1998).

Sample size: Number of items or the quantity of material constituting a sample.
ISO11074-2: 4.26 (1998); ISO7002: A.40 (1986).

Sampling: Process of drawing or constituting a sample.
ISO11074-2 (1998); ISO3534-1 (2006).

Sampling bias: The part of the measurement bias attributable to the sampling.
AMC (2005).

Sampling dimension: The dimensions remaining in the target, if increments are taken across the other dimensions.
(Smith, 2001).

Sampling error: The total of all the errors generated when taking, handling and analysing a sample.
(Smith, 2001).

Sampling location: The place where sampling occurs within the sampling target. Perhaps used for location within which duplicate (or replicate) samples are taken at sampling points.

Sampling method: See sampling procedure.

Sampling plan: Predetermined procedure for the selection, withdrawal, preservation, transportation and preparation of the portions to be removed from a population as a sample.
IUPAC (1990); ISO11074-2 (1998), adopted by AMC Subcommittee.

Sampling precision: The part of the total measurement precision attributable to the sampling.
Adopted by AMC Subcommittee.

Sampling principle: See principle of correct sampling.

Sampling procedure: Operational requirements and/or instructions relating to the use of a particular sampling plan; i.e. the planned method of selection, withdrawal and preparation of sample(s) from a target to yield knowledge of the characteristic(s) of the target.
ISO3534-1 (2006); ISO11704-2 (in part), adopted by AMC Subcommittee.

Sampling situation: Defines whether the sampling target is in motion at the time of sampling.
Note: Two types of sampling situations are usually distinguished – stationary or dynamic.

Sampling strategy: Strategy includes sampling method/procedure and techniques.

Sampling target: Portion of material at a particular time, which the sample is intended to represent.
Note 1. The sampling target should be defined prior to designing the sampling plan.
Note 2. The sampling target may be defined by regulations (e.g. target size).
Note 3. If the properties and characteristics (e.g. chemical composition) of the certain area or period are of interest and must be known then it can be considered a sampling target. AMC (2005).
Adopted by AMC Subcommittee.
Sampling target is comparable to **Lot**: The entirety of the material of interest to be sampled. In process sampling the lot is for instance an elongated stockpile, a material stream (extended in time) production batch units, etc. The name lot is used within the Theory of Sampling.

Sampling techniques: All appropriate procedures and sampling devices used to obtain and describe samples either in the field or during transportation and in the laboratory.
ISO 11074-2.

Sub-sample: A sample taken from a sample of a population.
ISO3534-1 (2006).
Note: Two or more sub-samples are combined to form a combined sample.

Sub-sampling: Process of selection one or more sub-samples from a sampler of a population.
ISO11074-2 (1998).

ToS Theory of Sampling: Provides a description of all errors involved in sampling of heterogeneous material as well as all necessary tools for their evaluation, elimination and/or minimization.
(Petersen, 2005).

Uncertainty from sampling: The part of the total measurement uncertainty attributable to sampling.
IUPAC (2005).

2 STRUCTURAL APPROACH

This document contains the basic ideas behind the horizontal approach and gives the overall workflow that has been used within this project "Nordic horizontal standard for sampling". The ideas might be used as a generic approach for development of other horizontal sampling standards.

The scope of the structural approach is to give the overall rules, contents and guidelines for reading and application of the horizontal standard.

More specific the structural approach:

- Emphasizes the connection between the measurement cycle and the basic activities in the sampling cycle, which are needed in order to get representative samples fulfilling defined quality requirements.
- Explains the overall structural approach in developing horizontal sampling standards and structuring operational standards in modules.
- Gives guidelines in structuring the overall elements included in a horizontal standard and structuring the elements included in an operational sampling standards within procedures and equipment.

2.1 The measurement cycle and the sampling cycle

The sampling cycle and the belonging activities are connected to the general measuring cycle, which describes the essential steps in the cycle of solving a client issue bound up with improvement or control of a production process (see figure 2.1). The uncertainty and the confidence of an analytical result can never be better than the uncertainties from the sampling and the sample handling taking place before the sample is delivered at the door step of the laboratory.

The measuring issue might also be related to monitoring concerning an environmental issue e.g. monitoring of water pollution sources or waste product from power stations. The client could be a work manager at an industry or for instance food or environmental authorities.

2.1.1 The measurement cycle

The measuring cycle (A) may be used as a generic framework for designing an information collecting system connected to the sampling cycle (B). The horizontal standard focuses on activities which are gray shaded in figure 2.1: sampling situation (B1), equipment (B2), quality assurance and quality control (B3), sampling procedure (B4) and sample handling (B7). Each of the activities in the sampling cycle is linked to sub-cycles which equally can be conceived as cyclic processes. A sub-cycle could be validation of the sampling procedure. Measuring activities are within this project currently kept within measurements that require a sample and subsequent analysis. For example online measurements are not included here.

Common activities belonging to the measuring cycle (A) as well as to the sampling cycle (B) is the criteria document (A4) and the production of a sample that is analysed

(A5/B9). The measuring cycle shows the different steps that have to be defined to specify the requirements needed for the next step. If quality of the information in one step is poor it will affect the quality of the resulting information. In other words: the analysis cannot rectify the imbalance arising from a non-representative sample.

The individual steps in the sample cycle need not to be carried out in a chronological sequence, but the cycle is a logical way of handling and getting around all the sampling activities. The starting point in the measuring cycle is a client issue (A1). The second step is definition of the issue and definition of requirements and information needed in relation to the decisions (A10), which will be last activity in the measuring cycle. An example of a client issue could be: Does the composition of a specified milk product – leaving a certain dairy work – fulfil the requirements set by the authorities? Or does the composition of a certain waste material that is incorporated in pavement material fulfil environmental requirements?

The measuring strategy (A3) is the long term plan of actions that is needed in order to answer the client issue and to establish the basis for decisions to be taken after one round in the circle. The criteria document (A4) is based on the strategy and includes information about who is going to be involved (laboratory technicians, co-operators, consultants), where (territory, location, industry, plant), when (measuring period, date) and what (set the target of measuring). The criteria document also comprises specification of the desired quality of the analyses and the sampling (uncertainty, accuracy, precision, etc.).

The sampling plan is a part of the criteria document and includes information about the parameter to be analysed, online measurements, etc. The input (B1) for the sampling cycle comes from the sampling plan (A4) and contains input for the analytical laboratory as well as input for persons taking care of the activities within the sampling cycle (B). The sampling plan should state why the samples are taken and when, where and how the sample should be taken. *What* includes e.g. location, facility and material. *Who* are technicians, consultants, production engineers, works managers, etc. The sampling plan includes safety precautions to be taken, safety regulation and minimisation of environmental impact on the samples. In addition to that information is needed about statistical requirements concerning individual analytical parameters, conservation, and storage temperature. Afterwards equipment, quality assurance and health & safety are described in relation to the activities in the sampling cycle (B).

Data collection from sampling and laboratory analysis (A6) is followed by data handling (A7) and data analysis (A8). The next step is reporting and recommendations (A9) related to decisions (A10) that have to be taken by the client.

2.1.2 The sampling cycle

Corresponding to the measuring cycle (A), the sampling cycle (B) shows the steps to be defined to be able to set the requirements for ending up with a report and the delivery of a representative sample taken from the target of interest (sampling target) at the laboratory's door step.

The output of the sampling cycle is a primary or secondary sample which could be a composite sample as well (automatic water sampling consisting of sub-samples). Conservation, transportation and sub-sampling are parts of the sampling cycle before report-

ing (B8). Quality control primarily takes place within the sampling cycle. The sampling cycle ends at the door step of the laboratory, where the sample is analysed (input to A7).

The first step in the sampling cycle is to look through the input from the sampling plan (A4) and the defined sampling situation (B1). Does the situation concern sampling of solid, liquid or gases and is it a dynamic or a stationary sampling situation? The input should include determination of increment size, number of increments to make up composite samples, associated increment and sample masses and sampling procedures. If necessary you must catch up more information about the accessibility at the sampling location which might influence the sampling strategy and technique, type of sample (time or flow depended sampling). Based on this information a sampling procedure can be drawn up (B4).

Starting from the defined sampling situation standards about suitable equipment (B3) can be found in a horizontal standard. The need for quality in the sample collection cycle involves correctly designed equipment and proper utilization of the equipment taking into account that every part in the sampling target must have the same probability for being sampled. In connection with handling of equipment there are other important fields like: installation of automatic samplers (power and control), training and skills, maintenance, storage, cleaning of sampling equipment, etc.

Quality assurance (B4) covers all those planned and systematic sampling actions, procedures and checks which are necessary to ensure representative samples. The actions must satisfy the requirement for quality related to a specific measurement cycle in order to be the basis for reliable analytical results. Quality control is monitoring and measuring parameters and the effectiveness of the quality assurance procedures. In general, the quality assurance of sampling methods should be done within the framework of ISO 17025 and the principles put down in the Theory of Sampling (Smith 2001). ISO 17025 (section 5.4.5 note 1) says that validation of test and analyses may include procedures for sampling, handling and preservation. It is not common practice for laboratories to carry out a validation of sampling procedures at the same technical level as done for laboratory tests or analysis. Many sampling errors could be avoided by using standards based on the sample principles included in the Theory of Sampling (Horizontal standard 2008).

Based on the input from the previous sampling activities including the sampling plan a standardised sampling procedure (B4) expected to fulfil the quality requirements set for the sampling is chosen. The procedures can for instance be chosen from the list of appropriate sampling methods identified in a horizontal standard.

Health & safety (B5) must be included in the planning of sampling in the field. The output from the field sampling is a sample and a field report with information about place, address, amount of sample, temperature, equipment, sampling person, and deviations from the sampling plan, etc. (B6). The field activities might involve sub-sampling that includes mixing of increments to form new composite samples.

From the beginning to the end of the sampling cycle and the delivery of the sample at the laboratory, the sample integrity might be influenced by biological, chemical or physical reactions. The changes depend on the composition of the sample, and to reduce or avoid these changes pre-treatment (B7) might be needed. Pre-treatment might comprise addition of preservatives.

Preservation, storage and transport of samples shall take place in such a way that the state of the sample at the time of sampling is not affected or changed to any considerable extent. Storage conditions may vary for different products but generally speaking, cooling (below 4°C) is the most often used method in preventing degradation of organic substances in samples. Chemical conservation needs more specific knowledge of the target parameters and for instance subsequent analytical methods.

The sampling report (B8) delivered to the client or the laboratory shall contain information which is necessary for the identification of the sample and for the assessment of the uncertainty belonging to the sampling. Most often there is not distinguished between uncertainty belonging to sampling and to the analytical result.

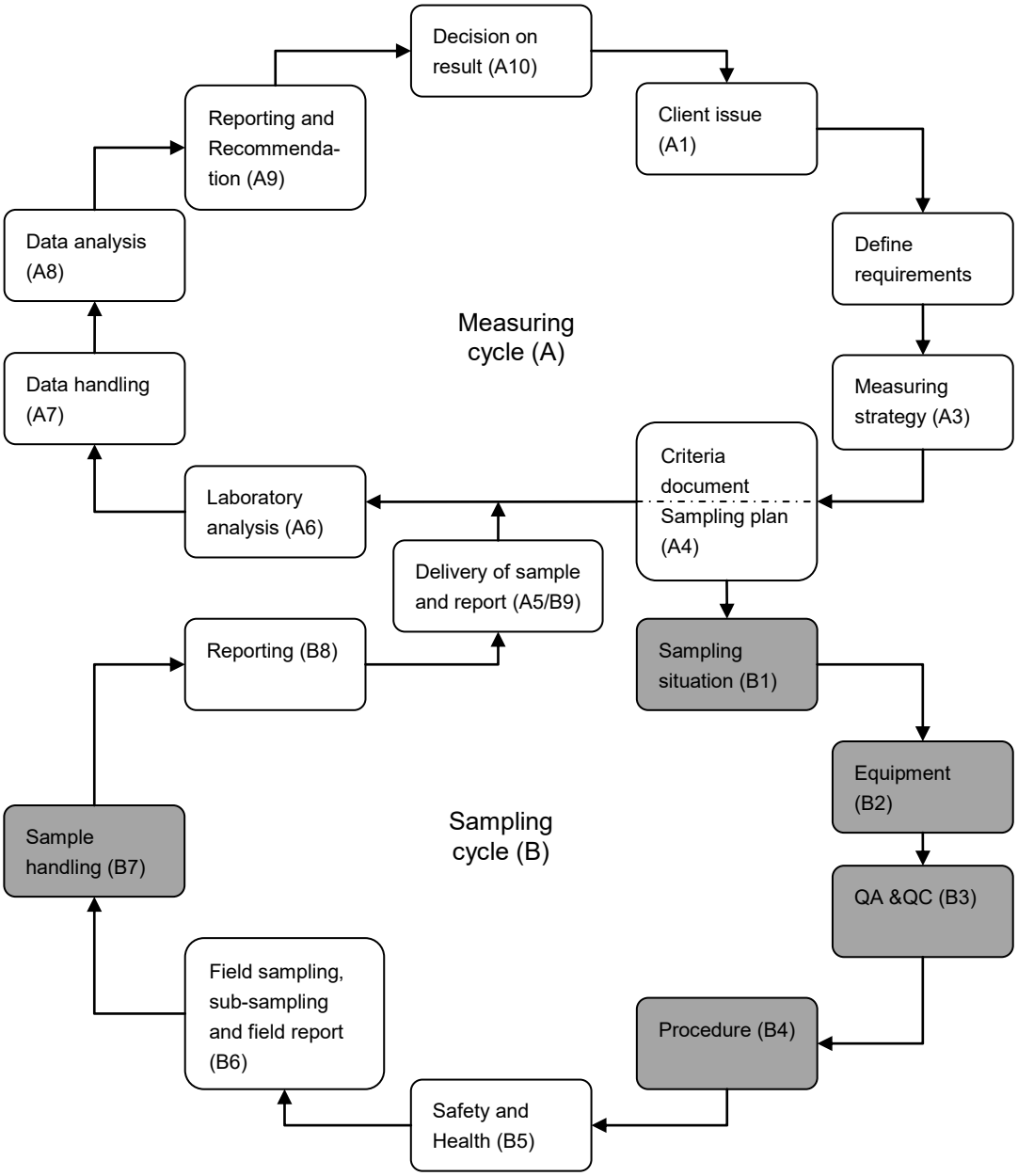

Figure 2.1 Integration between the measuring cycle and the sampling cycle. The activities within the grey shaded boxes are processed in the horizontal standard.

2.2 Developing a horizontal sampling standard – workflow

As stated in CEN/CENELEC Internal Regulations Part 3 *"Avoidance of duplication is a general principle in the methodology of standardisation"*. In the fields of sampling, methods are often applicable to more than one product, type of material or sampling target with little or no difference. Although it shall always be determined whether an

applicable sampling procedure already exists before defining a new standard, it is possible to identify sampling standards from different trades which have an overlap. Existence of horizontal sampling standards should avoid this overlap and gives an overview of the best available operational standards within equipment, quality assurance, sampling procedures and a limited number of activities within sample handling. Related to the compilation and evaluation of operational standards which take place when developing a horizontal standard it is essential to:

- Identify criteria (key factors and decision rules) that have to be taken into account when selecting the best available operational standard for a relevant sampling target.
- Identify those operational sampling standards or sections in standards, which are the best when you are focusing on individual sampling activities like procedures and equipment.

These two elements "criteria" and "identification" are the outcomes of the horizontal standard. A structural approach as well as the horizontal standard ought to cover sampling of all types of materials and sampling situations (stationary or dynamic). However the development of the horizontal standard within the present project focuses on liquids and granular solid material.

There are three steps (see figure 2.2) in compilation of operational standards which enter into a horizontal standard.

Step 1: The first step comprises the selection of standards covering sampling of solid granular material, liquids and gases. Within this work the focus is on solid granular material and liquids. The compiled standards are listed in appendix A (solid granular material) and appendix B (liquids). The standards are correlated to document number and year, title, scope, document type (ISO, EN or national), and the content is evaluated concerning: terms and definitions, sampling objectives, material, sampling situation, type of sample, occupational health, equipment, competence, sampling procedures, sample treatment, sample handling, quality control, reporting, bibliography, examples or attachments.

Step 2: Relevant standards are picked out from the lists in the appendices A (solid) and B (liquids). The relevant standards focus on sampling activities within procedures, equipment, quality assurance and sample handling since this is covered by the draft horizontal standard.

Step 3: The last step of the identification and selection of the best available standards is carried out in two different ways: A bottom-up and a top-down method have been used for compilation.

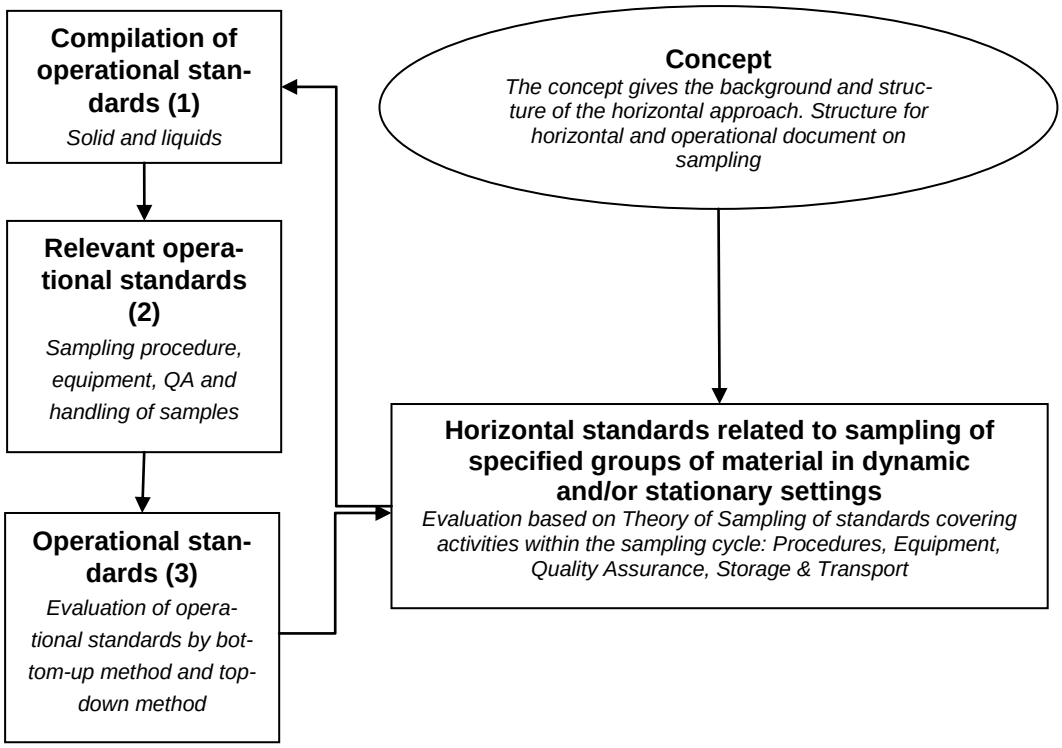

Figure 2.2 The workflow and the steps in developing a horizontal sampling standard. Bold text indicates the structural approach and the italic text describes the activities carried out within this work.

The bottom-up method is empirical founded and illustrated by the development of three documents: Appendices A, B and C in the horizontal standard demonstrate and specify decision rules/criteria and the rationales behind the selection of operational standards within equipment and sampling procedure. The selection of standards is predominantly founded on the expert knowledge in the project team about standards that are operational in the field rather than the compilation of the relevant standards. The following sampling targets are included in the appendices:

1. Sampling of solid granular material in dynamic situations.
2. Sampling of solid granular material in stationary situations.
3. Sampling of liquids in dynamic situations.

Three supporting documents have been developed in order to demonstrate how to identify and choose the best available sampling standards within solid granular material and liquids connected to stationary and dynamic situations. The identified criteria are tools for assessment of standards and identification of deficiencies or drawbacks in the standards.

The structured compilation consists of a rational for evaluation and selection of standards or sections of operational standards. The compilation includes the following steps:

A. Definition of relevant sampling targets.
B. A list of reviewed standards.
C. Rationale for evaluation and selection of standards.
D. The decision rules/key factors.

The top-down method begins with identification of criteria referring to equipment, quality assurance; sample handling and sampling procedure and the criteria are linked up to the Theory of Sampling. The criteria are used for identification of those standards that meet the criteria completely or partly. These two approaches make sure that the most often used standards (bottom-up) are included and evaluated. The top-down method is broader and includes standards outside the environmental field.

2.2.1 Definition of criteria based on Theory of Sampling

Naturally the selection of the best available operational standards depends on the set of criteria that is used for identification and selection. According to the criteria the three documents on specified sampling targets have been checked in order to ensure that there is no discrepancy between the general Theory-of-sampling based criteria and the empirical developed criteria correlated to the three well defined sampling targets.

In the "sampling field" the Theory of Sampling prepared by Dr. Pierre Gy represents a complete general theory for sampling, founded on scientific ground (Smith, 2001). Gy's work focuses mainly on solids in general (e.g. municipal sewage sludge), but the principles developed apply equally well to liquids (e.g. wastewater) and gases. The fundamental principles of correct sampling are organised into 7 parts, called the 7 sampling errors. They are called errors because sampling is an "error-generating" cycle, and these errors contribute to the non representativeness of the sample. The theory provides a structure for thinking about sampling and for attacking sampling problems. Principles laid down in the Theory of Sampling might in advantage be used for choosing and evaluating the best available operational standards.

As mentioned, you can never guarantee that you have a representative sample. But if the sampling process is performed according to certain sampling principles, then the sample will be more representative and even fulfil the appropriate quality requirements. This is opposed to the situation where the principles are not followed. Gy's theory of sampling gives the opportunity to analyze the whole sampling process. A good introduction to Gy's theory of sampling is found in Smith, (2001) and in several other references in the literature list.

The Theory of Sampling uses categorization of sampling into 0-, 1-, 2- and 3-dimensional sampling which is used as a tool of understanding different sampling situations. The geometry depends on how the sample is drawn from the target, and the dimension can be any between zero and three. The target geometry corresponds to a theoretical mathematical concept not to the direct physical dimension. In the horizontal the reference to 2- and 3- dimensional sampling is rather limited in the horizontal standard. Standards on equipment and procedures are split into stationary sampling (0-dimension) and dynamic situations (1-dimension).

Theory of Sampling is more difficult to use to define criteria for quality assurance og quality control, reporting and preservation. Concerning that kind of sampling activities expert knowledge and information of the specific sampling target are needed.

2.3 Outline of a horizontal sampling standard

A proposal on future organization of sampling standards is described in chapter 3 and illustrated in figure 3.1 and 3.2. The horizontal standard function as guidance on selection

of the best available standard when knowing the material (solid, liquid, gas), the sampling dimension (0-, 1-, 2-, or 3-) and the sampling situation (stationary or dynamic).

When setting up the structure and drafting of a document like horizontal standard, specified rules are needed. The arrangement of elements (foreword, scope, normative references, etc.) in the horizontal standard might be based on CEN/CENELEC Internal Regulation Part 3, 2003-10, which acts as a tool for writing standards, technical reports and guides.

Table 2.1 contains the necessary generic elements in a horizontal sampling standard. Comments to the arrangement of elements are given. The Nordic horizontal sampling standard follows the arrangements, and detailed descriptions are given concerning the criteria for assessment of the best available standards within sampling equipment, quality assurance, sampling procedures and sample handling regarding preservation and storage – among these cleaning of containers.

Table 2.1 Arrangements in a horizontal standard. The numbers in the parentheses in column two refer to the sampling cycle presented in figure 2.1.

Type of element	Arrangement of elements in document	Comments on the elements
Informative preliminary	Title page	
	Table of content	
	Foreword	Information related to the project group; significant sampling elements; relationship to solid, liquids and/or gases and stationary and/or dynamic; relationship to European legislation.
	Introduction	Overall commentary on technical content; reasons for prompting preparation of a horizontal document on sampling
Normative general	Scope	Laying down criteria and selecting appropriate sampling standards within selected material.
	Informative references	Indispensable documents/standards and informative standards/documents
Normative technical	Terms and definitions	Applied terms and definitions including definitions used in compiled sampling standards
Instructions	Sampling principles	Sampling principles concerning solid granular material, liquids and/or gases. Stationary and dynamic sampling situations are defined and described. Starting point is the sampling principles in the Theory of Sampling. Principles for minimizing sampling errors
	Guidance for reading the standard	Target group and workflow
Sampling Activities	Sampling dimension (B1)	Definition s of the sampling situations are included in the horizontal standard
	Equipment (B2)	Criteria for selection of sampling equipment based on Theory of Sampling. Review of equipment in standards. Applicable equipment for the selected/defined sampling situations and target. Input from bottom-up (empiric method) or top-down identification of operational standards (Theory of Sampling)
	Quality Assurance (B3)	Review of standards on quality assurance, quality control, requirements, validation and competence
	Procedure (B4)	Review of sampling procedures. Applicable strategies, techniques for the selected/defined sampling situation. Input from review of standards compiled by the bottom-up (empiric method) or top-down method (Theory of Sampling)
	Health & Safety (B5) *)	Review of standards on health & safety aspects related to the defined sampling situations with respect to dynamic, stationary, solids, liquids and/or gases
	Primary sampling and sub-sampling in the field and field report (B6) *)	Review of standards defining requirement to the field report. Sub-sampling follows the same principles as primary sampling
	Sample handling: Sub-sampling, pre-treatment, preservation, storage and transport (B7)	Review of standards related to the sample handling aspects. Parameter dependent handling activities
	Reporting and sample delivery (B8) *)	Review of standards on records/reporting. Formulas for the selected/defined sampling targets
Informative supplementary	Bibliography	Background material used for preparation of the document

*) not covered in this project.

The Nordic horizontal sampling standard follows the outlined structure but only covers equipment, sampling procedure and storage and preservations of samples.

The structure presented in table 2.1 cannot be applied to horizontal standards concerning e.g. sampling theory, statistics and other kind of data handling since a number of headlines will not be relevant in this context, mainly those covering instructions and sampling activities. Sampling plans contain all the elements presented under the headline "Sampling activities" but the content of the elements includes criteria for elements to be incorporated in an operational standard on sampling plan.

Parameter classified activities e.g. storage, preservation, transport, marking, labelling and packing might typically fit into the section about sample handling.

2.4 Outline of an operational sampling standard

The outline of an operational sampling standard is generally similar to the horizontal. However, there are differences for different categories of operational standards. The differences between the horizontal and the operational standard are mainly caused by the fact that the horizontal standard covers several sampling targets and situations and the operational standard is narrowed to one specific sampling target.

The outline of an operational standard depends on the category to which it belongs. In this section, the outline of an operational standard is presented on the assumption that it is an operational standard belonging to the category "Liquid in dynamic settings" (see Table 2.2).

Operational standards could be classified into modules containing e.g. auxiliary standards (standards independent of material and situation, see figure 2.3), standards dependent on material (solid, liquids, gases) and sub-divided into stationary situations, dynamic situations and parameter related groups of standards.

Operational standards might as well belong to the categories like "auxiliary standards" or "parameter related standards". The first group includes standards dealing with e.g. Theory of Sampling, quality assurance, sampling planning, training, education and statistics. The second group includes standards dealing with e.g. handling of samples which very often depend on the parameter to be analyzed. If phthalates are going to be analyzed then soft plastic containers are not suitable.

Table 2.2 Arrangements that should be comprised in an operational sampling standard.

Type of element	Arrangement of elements in document	Comments on the elements
Informative preliminary	Title page Table of content Foreword Introduction	 Development of operational standards in continuation of the Structural approach to horizontal sampling standard and a specific horizontal sampling standard. The material to be sampled is categorized referring to the 3 fundamental materials (solid, liquid, gas) and to a dynamic or stationary sampling situation
Normative general	Scope Objectives Normative references	Sampling target, sampling point, material, dynamic/stationary and sampling activity referring to the sampling cycle Delivery of a representative sample from a specified target at the laboratory's doorstep Standards within terminology, terms and definitions
Normative technical	Terms and definitions	Applied terms and definitions
Sampling	Procedure (general, sampling steps, validation of procedure)	Step-by-step procedure Reduction of sampling dimension Description of validation and control of the procedure - randomness Number and size of samples to be withdrawn
	Equipment	Sampling principles (Delimitation extraction, geometry, etc.) Size (of extracting tool) Shape and geometry (0-, 1-, 2-, and 3-dim.) Material (robust) Cross-contamination Operation of equipment
	Sampling handling (sub-sampling, pre-treatment, transport and storage)	Target parameter or group of parameters Representative sub-sampling Pre-treatment (filtration, preservation, mixing, homogenization communition, screening) Transport and storage (container material, cleaning, labelling)
Informative supplementary	Bibliography	Background material used for preparation of the document
	Informative annexes	Records linked to procedures and equipment. Records to be included in the field report

3 CONCLUSIONS AND RECOMMENDATIONS

The completion of the Nordic horizontal sampling project has facilitated harmonization of the sampling standards based on criteria relevant to sampling of solid granular material in stationary and dynamic situations and sampling of liquid in dynamic situations.

The aim has been reached concerning a description of a structural approach for the organisation of sampling standards and in the continuation, criteria for performing sampling in a controlled manner has been pointed out based on the Theory of sampling and empiric experience within sampling of solid granular material and liquids. Furthermore, a draft Nordic horizontal sampling standard has been prepared based on reviewing operational standards from a broad range of industrial and environmental sectors.

The intention of the work was not to cover the whole spectrum of material – from monoliths to gases – that can be sampled. Neither was it indented to address restructuring existing operational standards but instead it was to point out those operational standards across trades that could form the basis for future standards having a common foundation on criteria developed based on the Theory of sampling.

After compilation of ISO-, CEN- and Nordic sampling standards and carrying out the approach within this project, it has become clear that several issues on structuring the horizontal standard have to be developed in order to cover the whole range of sampling materials including the extremes of solid monoliths and gases. The following sections give guidance to future work.

3.1 Alternative structure for organisation of sampling standards

The International Classification of Standards (ICS) mostly categorises standards based on specified conditions found within a delimit trade, e.g. industrial or environmental sector. However, there are cross-categories like for instance Generalities (01), Services (03) Mathematics (07), Metrology and measurements (17) and Testing (19). Within the field “Environment” (13) you find standards on “Water Quality” (13.060) and below this category you find “Sewage Water” (13.060.30). In this category the standard ISO 5667-10 “Guidance on sampling of waste water” is placed.

To facilitate the harmonization of sampling standards a new approach to the classification of standards might be needed. An alternative to the existing classification could be collection of all sampling standards under the category *Metrology and measurements*. Then focus moves from a specific trade, material and locations to the sampling activities characterized by material and situation. That entrance promotes use of sampling standards across trades. For instance a standard for sampling of milk might probably be useable for sampling of drinking water for microbiological examination. Figure 3.1 gives a proposal to an appropriate structure for organization and categorisation of sampling standards. As illustrated, the proposal includes a structure for existing operational standards that is based on the overall material properties regarding solids, liquids and gases. Furthermore auxiliary standards (e.g. statistics), which are not directly linked to specific material, will cover the fourth part of the groups of operational standards. Within each group of operational standards (e.g. solids) two categories cover the standards dealing with sampling from dynamic and stationary situations respectively.

The alternative classification should take in outlines for operational standards within theoretical sampling issues, health & safety, field reporting, field report, reporting going along with the sample to the laboratory and outlines for standards linked to sampling activities that are tied to parameters.

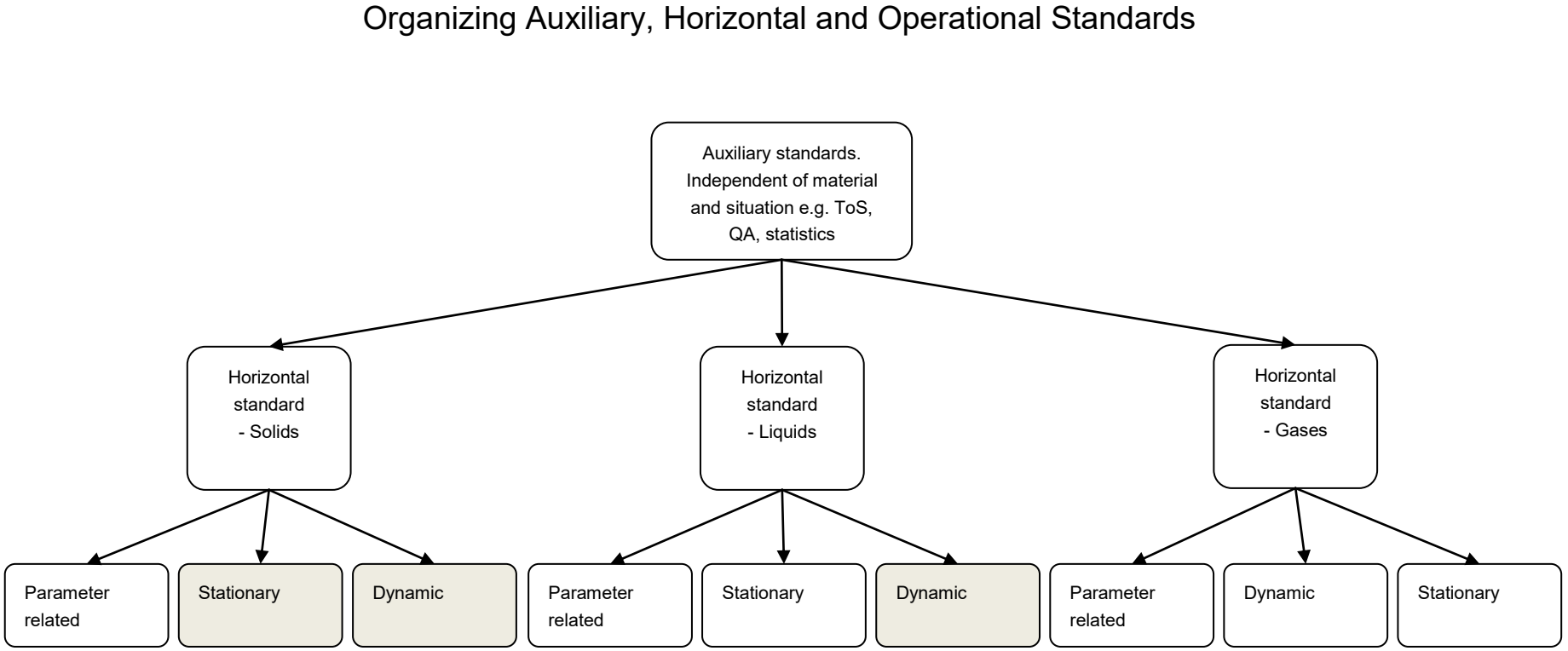

Figure 3.1 Grouping of standards, technical reports/guidance concerning auxiliary, horizontal and operational sampling activities. The developed horizontal standard contains a list of standards linked to the grey shaded boxes.

3.1.1 Horizontal standards

In order to make it clear if a certain material belongs to solid, liquid or gases, a categorisation is needed. The categorisation will improve the possibilities for identification of all relevant standards. The identification refers to the work that has to be performed when a new horizontal sampling standard is developed and to the identification taking place when you are looking in the horizontal standard to detect the best available operational standard before carrying out sampling in the field.

In CEN/TR 15310-2 Characterization of waste – sampling of waste material – Part 2 Guidance on sampling techniques, materials are categorized into:

- Liquids.
- Liquids and solids rendered mobile by heat.
- Viscous liquids.
- Sludges.
- Paste-like substances.
- Fine grained solids.
- Coarse grained solids.

This categorisation can be the basis for an enhanced extended categorization of the materials within solid and liquids. In addition to this comes a categorization of gases.

The future objective must be an extension of the draft horizontal standard. In figure 3.2 sampling situations are shown that are included in the developed standard together with sampling situations that are not included. The grey shaded sampling situations about 0- and 1-dimensional sampling of liquids together with sampling of gases should in future horizontal standards be handled regarding criteria and operational standards.

On the whole there are many other materials than those taken into account here e.g. viscous liquids, paste-like substances and sludges and gases, which similarly should refer to a horizontal standard, pointing out the criteria for an operational standard.

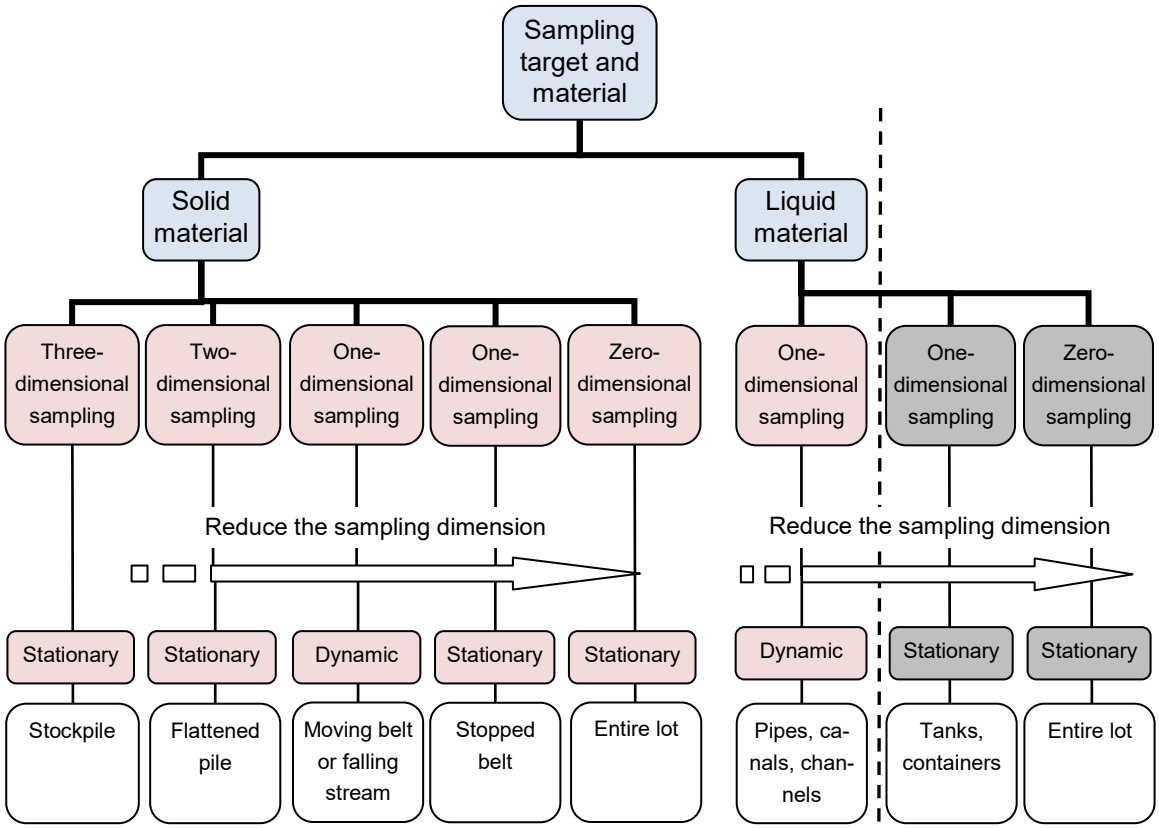

Figure 3.2 Scope and delimitation of the horizontal standard: Both sampling of solid material from dynamic and stationary situations are covered as well as sampling of liquid materials from dynamic situations. The grey shaded boxes on the right hand side of the dashed line show what is not included in the scope of this standard. The white boxes in the lower part of the figure list some examples for typical sampling situations.

3.1.2 Operational standards

There are both practical (operation of sampling equipment, handling of samples, quality control, etc.) and theoretical issues (statistic, uncertainty, etc.) to be handled when a more reliable operational sampling standard is the end. One of the purposes linked to the horizontal standard is to reflect the sampling criteria linked to material and the sampling situation. The developed criteria in the horizontal standard should be useful when developing a new operational standard within equipment and procedure. The best available standards are presented in the horizontal standard but still it has to be tested if the criteria can be used in a practical way to write a new standard or to improve one of those standards, which only partly fulfil the criteria. For instance it could be tested how to improve and rewrite ISO 5667-10 Water Quality – Sampling – Part 10 Guidance on sampling of wastewaters. In continuation of the test you should ask: Is it possible to fulfil all the criteria regarding sampling procedures for liquid material in dynamic situations?

Within the operational standards it is important to identify those sampling activities that disagree with respect to the criteria set up within the horizontal standards and how these disagreements or compromises influence the representativeness of the samples. For instance when liquids are sampled from a channel in one point then it is assumed that the mixing of the liquid is complete and therefore, a 1-dimensional sampling is appropriate. But complete mixing is only obtainable from a theoretical point of view. Then it becomes important to verify to which extent the sampling in one point influence the repre-

sentativeness of the sample (uncertainty) compared to sampling in several points in a cross section of a channel which should be the right way to sample based on the "Theory of sampling" The verification should be performed through a variographic experiment involving sampling in several points in a cross section.

3.2 Dissemination

Nordic Innovation Centre has held a workshop on "Construction Products – environmental safety and future challenges". The workshop took place in Espoo, Finland 15-16 April 2005. Within the topic "Nordic Affairs" a presentation about "Sampling for environmental assessment – a horizontal approach" was given by Bodil Mose Pedersen, DHI. The focus was the structural approach for horizontal sampling standards. The target group was representatives from Nordic and European Protection Agencies and stakeholders e.g. consultants and testing laboratories. Abstracts and presentations" have been published on Nordic Innovation Centre's homepage: http://www.nordicinnovation.net/article.cfm?id=1-853-586 .

Danish Standards has established a committee "Danish Sampling Forum - F 205" in which DHI participates. The task for the committee is to prepare a horizontal, matrix-independent standard on representative sampling. The objective is to develop a standard that will become a CEN-standard. This is an outstanding opportunity to disseminate information about the draft Nordic horizontal standard.

The scope within "Danish Sampling Forum" is broader than the scope of the Nordic horizontal standard, which focuses on a categorisation of matrices/material into solids, liquids and gases. However, the structural approach and the draft Nordic Horizontal standard offer a very good starting point for the work of Danish Sampling Forum on a proposal for a CEN-standard. Therefore the Danish committee has on several occasions shown strong interest in the present project.

Basically the future proposal for a horizontal CEN-standard will include the sampling principles that are founded in the Theory of Sampling. In that way the Nordic horizontal standard might be a valuable part and facilitate the work of a new CEN-Standard.

The Danish committee follows sampling activities in relevant committees within CEN and ISO. Among them the following can be mentioned:

Water:	CEN TC 230, ISO TC 147 SC 6
Soil:	ISO TC 190 SC2, CEN TC 345
Waste:	CEN TC 292 WG 1
Sludge:	CEN TC 308 WG 1
Soil improvers and growing media:	CEN TC 223 WG3
Fertilizer:	CEN TC 260 WG 1
Air:	CEN TC 264, ISO TC 146
Horizontal:	CEN BT TF 151 Project Horizontal

Through the DHI-participation in the Danish Sampling Forum it is the intention to disseminate project documents from the Nordic Horizontal Project to the above-mentioned committees.

4 BIBLIOGRAPHY

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A P P E N D I C E S

A P P E N D I X A

Compilation of operational standards/guidelines Sampling of solids

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
CEN/TS 14778-1:2005	Solid biofuels - Sampling - part 1: Methods for sampling	describes methods for taking samples of solid biofuels, for example, from the place where the raw materials grow, from production plant, from deliveries, or from stock	draft standard	ok	characterisation	solid/ granular	falling streams, stationary positions, moving belt	grab samples, composite samples	none	list of equipment and specific requirements
CEN/TS 14778-2:2005	Solid biofuels - Sampling - Part 2: Methods for sampling particulate material transported in lorries	describes methods for taking samples of solid biofuels that are transported in lorries	draft standard	ok	characterisation	solid/ granular	stationary positions	grab samples, composite samples	none	list of equipment and specific requirements
prCEN/TR 15310-1:2005	Characterization of waste - sampling of waste materials - Part 1: Guidance on selection and application of criteria for sampling under various conditions	discusses the statistical principles of sampling, and provides a number of statistical tool to assist in the design of testing programmes	draft CEN/TR	ok	characterisation compliance testing on-site verification	solid/granular sludge liquid	-	probabilistic sampling (single / stratified random sampling, systematic sampling) judgemental sampling; composite samples	none	none
prCEN/TR 15310-2:2005	Characterization of waste - sampling of waste materials - Part 2: Guidance on sampling techniques	techniques for sampling liquid and granular waste material, incl. Paste-like materials and sludges	draft CEN/TR	ok	characterisation	solid/granular sludge liquid	pipes, batches, stationary position, belt, falling stream etc.	probabilistic sampling, judgemental sampling; grab samples, composite samples	none	list of equipment and general discussion
prCEN/TR 15310-3:2005	Characterization of waste - sampling of waste materials - Part 3: Guidance on procedures for sub-sampling in the field	describes procedures for reducing the overall size of waste materials in the field	draft CEN/TR	ok	-	solid/granular sludge liquid	-	-	none	list of equipment
prCEN/TR 15310-4:2005	Characterization of waste - sampling of waste materials - Part 4: Guidance on procedures for sample packaging, storage, perservation, transport and delivery	describes procedures for the packging, perservation, short-term storage and transport of both solid and liquid waste samples, including paste-like substances and sludges	draft CEN/TR	ok	-	solid/granular sludge liquid	-	-	none	list of containers and general discussion
prCEN/TR 15310-5:2005	Characterization of waste - sampling of waste materials - Part 5: Guidance on the process of defining the sampling plan	provides guidance on process of defining of a sampling plan based on the objective of the testing programme	draft CEN/TR	ok	-	solid/granular sludge liquid	-	-	none	none

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
CEN/TS 14778-1:2005	none	general description to practical explanation	short	short	none	none	yes	sampling from large stockpiles, guidelines for the number of increments to be taken	could be used as an example of an operational standard
CEN/TS 14778-2:2005	none	practical explanation	short	short	none	none	yes	no	could be used as an example of an operational standard
prCEN/TR 15310-1:2005	none	none	none	none	none	none	no	yes (statistical methods for characteriing a population, calculating the required numbers of increments and samples, minimum increment and sample size, example sampling scenarios)	general description of how to prepare a sampling plan
prCEN/TR 15310-2:2005	none	general discussion/ step-by-step	none	none	none	none	yes	yes (support on the selection of equipment and apparatus)	sampling techniques for many different sampling situations and materials are described, description is almost step-by-step/practical
prCEN/TR 15310-3:2005	none	general discussion/ step-by-step	extensive	none	none	none	yes	yes (examples of equipment for sub-sampling)	descriptions for several different materials, description of sub-sampling is more step-by-step than methods for mixing samples
prCEN/TR 15310-4:2005	none	none	none	extensive	short	none	yes	yes (packaging)	
prCEN/TR 15310-5:2005	none	none	none	none	none	none	yes	yes (examples of sampling plans for specific situations)	general description of the process of defining a sampling plan

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
prCEN/TS 15442:2006	Solid recovered fuels - Methods for sampling	describes methods for taking samples of solid recovered fuels for example from production plants, from deliveries or from stock. It includes manual and mechanical methods	draft standard	ok	characterisation	solid/ granular	material flow, static lot, vehicle	stratified random and arbitrary sampling, stratified sampling; increments	none	list of equipment and general discussion
D346-04	Standard practice for collection and preparation of coke samples for laboratory analysis	procedures for the collection and reduction of samples of coke	ASTM standard	none	characterisation	solid/granular (coke)	stopped belt, moving belt, falling stream, stationary position	composite samples	none	none
D2234/D2234M-03	Standard practice for collection of a gross sample of coal	procedures for the collection of a sample under various conditions of sampling	ASTM standard	ok	characterisation	solid/granular (coal)	stopped belt, moving belt/falling stream, stationary position	systematic and random sampling, composite samples	none	short
D5956-96 (reapproved 2001)	Standard guide for sampling strategies for heterogeneous waste	practical, nonmathematical discussion for heterogeneous waste sampling strategies	ASTM standard	ok	-	solid/granular	-	-	none	none
D6009-96 (reapproved 2006)	Standard guide for sampling waste piles	provides guidance for obtaining representative samples from waste piles	ASTM standard	ok	characterisation	solid/granular	batches/stockpiles	directed sampling, simple random sampling, stratified random sampling, systematic grid sampling	none	list of equipment and general discussion
D6232-03	Standard guide for selection of sampling equipment for waste and contaminated media data collection activities	covers criteria that should be considered when selecting sampling equipment for collecting environmental and waste samples	ASTM standard	ok	-	solid/granular sludge liquid	-	-	none	list of equipment and general discussion

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
prCEN/TS 15442:2006	none	general discussion to step-by-step practical explanation	none	short	none	ok	yes	step-by-step plan for the development of a sampling plan, guideline for a sampling plan, sampling equipment and implements, determination of minimum sample size, determination of minimum increment size for sampling from material flows, determination of minimum increment size for sampling from static lots or vehicles, implementation of sampling from material flow, implementation of sampling from a static lot or vehicle, minimum sample size required for analysis: minimum required test masses and their requirements for all analyses methods standardised for solid recovered fules	contains a very illustrative figure to show the links between the essential elements of a testing program: "box of sampling", "box of sample preparation", box of analysis"; this might be helpful to explain, what our project covers and what not
D346-04	none	general discussion/ step-by-step	extensive	none	none	none	yes	no	
D2234/D2234M-03	none	general description/ step-by-step	short	none	none	none	yes	yes (test method for estimating the overall variance for increments, monitoring cola sampling ratios using control charts)	
D5956-96 (reapproved 2001)	none	general description	none	none	none	none	yes	yes (discussion of heterogeneity and stratification of wastes and relationship of samples and populations, case study for design of a sampling approach for a highly stratified waste)	general discussion of problems and difficulties of sampling heterogeneous waste; the guide does not provide a comprehensive sampling procedure
D6009-96 (reapproved 2006)	none	none	none	short (cross-contamination)	none	none	yes	yes (waste pile - a case history)	
D6232-03	none	none	none	none	none	none	yes	yes (additional related publications)	very good list of various sampling tools, inlcuding matrix guide for equipment selection, figures of equipment, description of use and advantages/limitations of equipment

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
DS/EN 196-7:1994	Methods of testing cement - part 7: methods of taking and preparing samples of cement	describes only the equipment to be used, methods to be followed and the provisions to be complied with for taking samples of cement	DS/EN standard	ok	characterisation	solid/granular	batches, stationary situations	-	none	general discussion
DS/EN ISO 542:1995	Oilseeds - sampling		ISO standard	ok	characterisation	solid/ granular	batches, stationary situations, belt, falling stream	composite samples	none	list of equipment
DS/EN 1015-2:1999	Methods of test for mortar for masonry - part 2: bulk sampling of mortars and preparation of test mortars	specifies methods for taking a bulk sample of fresh mortar, and the preparation of a bulk test sample	DS/EN standard	ok	characterisation	solid/ sludge	batch, belt, pipes, stationary positions	composite samples	none	list of equipment
DS/EN 1482:1996 (plus corrigendum DS/EN 1482/AC)	Sampling of solid fertilizers and liming materials	describes and/or specifies sampling plans, methods of sampling, methods for the reduction and division of samples	DS/EN standard	ok	characterisation	solid/ granular	batches, stopped belt, falling stream, moving belt	composite samples	none	list of equipment
DS/EN ISO 6497:2005	Animal feeding stuffs - sampling	specifies methods of sampling animal feeding stuffs…for quality control	DS/EN ISO standard	ok	characterisation	solid/ granular, liquid	batches	grab samples, composite samples	none	list of equipment
DS/EN ISO 8130-9:1999	Coating powders - part 9: sampling	describes methods for the sampling of coating powders from consignments and for the subdivision of the sample…	DS/EN ISO standard	ok	characterisation	solid/ granular	batches	grab samples, composite samples	none	list of equipment
DS/EN 12274-1:2002	Slurry surfacing - test methods - part 1: sampling for binder extraction	specifies a method for sampling of slurry mixtures for extraction tests	DS/EN standard	none	characterisation	slurry	batches, pipes	grab samples	none	list of equipment
DS/EN 12697-27:2001	Bituminous mixtures - test methods for hot mix asphalt - part 27: sampling	describes test methods for sampling bituminous mixtures for roads and other paved areas	DS/EN standard	ok	characterisation	solid	stationary positions, batches, stock piles	-	none	list of equipment
DS/EN ISO 15528:2000	Paints, varnishes and raw materials for paints and varnishes - sampling	describes manual methods of sampling paints, varnishes and raw materials for paints and varnishes.	DS/EN ISO standard	ok	characterisation	solid/ liquid	batches, stationary positions, conveyor belts	grab samples	none	list of equipment and general discussion

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
DS/EN 196-7:1994	none	general discussion	short	short	none	ok	yes	typical examples of sampling equipment normally used	
DS/EN ISO 542:1995	none	general discussion to step-by-step practical explanation	short	short	none	short	yes	examples of apparatus for sampling and division	
DS/EN 1015-2:1999	none	general discussion to step-by-step practical explanation	size reduction	short	none	none	yes	no	could be used as an example of an operational standard
DS/EN 1482:1996 (plus corrigendum DS/EN 1482/AC)	none	general description to practical explanation	reduction	short	none	ok	yes	alternative methods of sample reduction, examples of rotating sample dividers, typical sampling report	
DS/EN ISO 6497:2005	short	general discussion to step-by-step practical explanation	short	short	none	ok	yes	feeding stuffs containing undesirable substances which are likely to be non-uniformly distributed, inluding mycotoxins, castor-oil seed husks and poisonous seeds	
DS/EN ISO 8130-9:1999	none	practical explanation	none	short	none	none	no	no	could be used as an example of an operational standard
DS/EN 12274-1:2002	none	practical explanation	none	none	none	ok	yes	no	could be used as an example of an operational standard
DS/EN 12697-27:2001	none	practical explanation	none	none	none	ok	yes	no	could be used as an example of an operational standard
DS/EN ISO 15528:2000	none	general description to practical explanation	short	short	none	ok	yes	no	

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
DS/EN ISO 15605:2004	Adhesives - sampling	specifies methods for sampling adhesives and related products	DS/EN ISO standard	ok	characterisation	solid/ liquid	batches	-	short	list of equipment
DS/EN 23954: 1993	Powders for powder metallurgical purposes - sampling	specifies procedures for the sampling of powders for powder metallurgical purposes. It also covers the splitting of the sample	ISO standard	ok	characterisation	solid/granular	batches, belt, stream	composite samples	none	list of equipment
EN 932-1 (2000)	Test for general properties of aggregates - Part 1: Methods for sampling	specifies methods for obtaining samples of aggregates from deliveries, preparation and processing plants including stocks	EN standard	ok	characterisation	solid/granular (aggregates)	stopped belt, moving belt, falling stream, batches, stationary position	grab samples	short	list of equipment
EN 12350-1:1999	Testing fresh concrete - Part 1: Sampling	speficies two procedures for sampling fresh concrete, by composite sampling and by spot sampling	EN standard	ok	characterisation	sludge/solid	batch, falling stream, stationary positions	grab samples, composite samples	none	list of equipment
EN 14899 (2006)	Characterisation of waste - sampling of waste materials - framework for the preparation and application of a sampling plan	specifies the procedural steps to be taken in the preparation and application of a sampling plan	EN standard	ok	-	solid/granular liquid	moving stream (e.g. conveyor) or static; moving stream (e.g. pipe) or contained	probabilistic sampling judgemental sampling	short	none
prEN ISO 13690: 2006	Cereals, pulses and milled products - sampling of static batches (ISO 13690:1999)	specifies general conditions relating to sampling for the assessment of the quality of cereals, pulses and milled products	draft standard	ok	characterisation	solid/ granular	batches, stationary positions	grab samples, composite samples	short	list of equipment
prEN ISO 21568 (2003)	Foodstuffs - Methods of analysis for the detection of genetically modified organisms and derived products - sampling (ISO/DIS 21568:2003)	gives guidance for setting up a valid sampling strategy for foodstuffs that are to be analysed for the presence of genetically modified organisms and derived products	draft EN standard	ok	characterisation	solid/granular	moving belt, faling stream, stationary / batches	-	short	none

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
DS/EN ISO 15605:2004	none	practical explanation	none	short	none	ok	yes	no	
DS/EN 23954: 1993	none	general description to practical explanation	short	none	none	none	yes	no	
EN 932-1 (2000)	none	general discussion/ step-by-step	extensive	short	none	extensive	yes	yes (examples of equipment for sampling and sample reduction, measurement of sampling variation, examples of methods for sampling conical stockpiles, the use of random numbers for random selection)	
EN 12350-1:1999	none	practical explanation	none	short	none	ok	no		
EN 14899 (2006)	none	none	none	none	none	ok (document sampling plan, sampling record)	yes	yes (sampling plan, sampling record, chain of custody, analysis request form)	general description of how to prepare a sampling plan, including involved parties, objectives of testing programme, health and safety, sampling approach
prEN ISO 13690: 2006	none	general description to practical explanation	none	short (packaging and labelling)	none	ok	yes	sampling scheme for consignments of more than 100 bags, examples of sampling instruments, guide to appropriate instruments for the sampling of cereals and other commodities covered in this International Standard	
prEN ISO 21568 (2003)	none	general discussion	none	short	none	short (sampling report)	yes	yes (sampling scheme for consignments of more than 100 bags according to ISO 13690:1999, laboratory samples sizes of different cereals and oilseeds, laboratory sample size of derived products from corn and soybeans, probability to accept lot using sample size 10000 particles applying different threshold levels, estimation of the number of particles in 100 mg test portions after centrifugal milling)	

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
ISO 1124: 1988	Rubber compounding ingredients - carbon black shipment sampling procedures	specifies procedures for the sampling of carbon black for use in the rubber industry, delivered in bulk, semi-bulk or packages	ISO standard	ok	characterisation	solid/ granular	batches	grab samples, composite samples/ individual samples	none	specific requirement
ISO 1839:1980	Tea - sampling		ISO standard	ok	characterisation	solid/ granular	batches	composite samples	none	list of equipment
ISO 1988: 1975	Hard coal - sampling	specifies methods of sampling hard coal, for both routine and special purposes	ISO standard	none	characterisation	solid/ granular	moving stream, stationary positions, stopped belt	continuous og intermittent sampling	none	list of equipment and general discussion
ISO 2067:1998	Granulated cork - sampling	specifies a methods for the sampling of granulated cork	ISO standard	none	characterisation	solid/ granular	batches	composite samples	none	none
ISO 3082 (2000)	Iron ores - Sampling and sample preparation procedures	gives underlying theory, basic principles for sampling and preparation of samples, basic requirements for the design, installation and operation of sampling systems	ISO standard	ok	characterisation	solid/ granular	moving stream, stationary situation, stopped-belt	mass basis, time basis, stratified random sampling; composite sample	short	general discussion
ISO 3085 (2002)	Iron ores - experimental methods for checking the precision of sampling, sample preparation and measurement	specifies experimental methods for checking the precision of sampling, sample preparation and measurement of iron ores	ISO standard	none	quality control	solid/granular (iron ores)	stationary, moving/stopped belt	periodic systematic sampling stratified sampling	none	none
ISO 3165: 1976	Sampling of chemical products for industrial use - safety in sampling	gives recommendations relating to safety in the sampling of chemical products for industrial use	ISO standard	none	-	solid / liquid	-	-	extensive	-
ISO 3963: 1977	Fertilizers - sampling from a conveyor by stopping the belt	specifies a reference method for sampling all solid fertilizers transported on a conveyor belt…	ISO standard	none	characterisation	solid/ granular	stopped belt	-	short	specific requirement

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
ISO 1124: 1988	none	practical explanation	short	short	none	ok	no	no	
ISO 1839:1980	none	practical explanation	short	short	none	ok	no	no	could be used as an example of an operational standard
ISO 1988: 1975	none	general description to practical explanation	short	none	replicate sampling	none	no	sampling equipment, examples of instructions to sampling operators, methods of checking precision by means of replicate sampling, methods of checking sample preparation errors, method of testing for bias, theory of calculation of number of increments from experimental data, theory of replicate sampling, theory of checking sample preparation errors	standard ISO 2309:1980 "Coke - sampling" is very similar to this standard
ISO 2067:1998	none	practical explanation	short	short	none	ok	yes	no	could be used as an example of an operational standard
ISO 3082 (2000)	none	general discussion to step-by-step practical explanation	short to extensive sample preparation (division)	short	none	none	yes	checklist for mechanical sampling systems, equation for number of increments, alternative methods of taking the reference sample, procedure for determining the minimum mass of divided gross samples for size determination, dimensions of riffel dividers	
ISO 3085 (2002)	none	general discussion	short	none	none	ok	yes	yes (example of experiment on periodic systematic sampling by method 1, example of recording particulars of experiment, example of data sheet for checking precision, example of control charts, alternative method for analysis of experimental data	general discussion/description of calculations for number of increments/ gross samples etc. and methods for analysis of experimental data
ISO 3165: 1976	-	-	-	-	-	-	no	no	
ISO 3963: 1977	none	practical explanation	none	none	none	ok	yes		could be used as an example of an operational standard

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
ISO 4296/2:1983	Manganese ores - sampling - part2: preparation of samples	specifies methods of preparing samples of manganese ores for determining the chemical composition	ISO standard	ok	characterisation	solid/granular	-	-	none	none
ISO 5667-12:1995	Water quality - sampling - part 12: Guidance on sampling of bottom sediments	provides guidance on the sampling of sedimentary materials from rivers and streams, lakes and similar standing bodies, estuarine and harbour areas	ISO-standard	ok	mapping, monitoring, characterisation	solid	batches, canal	composite samples	short	general discussion
ISO 6644:2002	Flowing cereals and milled cereal products - automatic sampling by mechanical means	specifies requirements for the automatic sampling, by mechanical means, of cereals	ISO standard	ok	characterisation	solid/ granular	belt, stream	continuous and intermittent sampling	none	list of equipment and general discussion
ISO 7742:1988	Solid fertilizers - reduction of samples	specifies a method suitable for the reduction of a sample of a solid fertilizer to a smaller quantity	ISO standard	none	-	solid/ granular	-	-	none	general discussion and specific requirements
ISO 8213: 1986	Chemical products for industrial use - sampling techniques - solid chemical products in the form of particles varying from powders to coarse lumps	describes the general techniques of taking and preparing samples with a view to the assessment of a solid chemical product lot	ISO standard	none	charaterisation	solid/ granular	batches	grab sample, composite sample	short	list of equipment
ISO 8633:1992	Solid fertilizers - simple sampling method for small lots	defines a sampling plan for the control of quantities of solid fertilizer not more than 250 t and outlines the methods to be used	ISO standard	ok	characterisation	solid/granular	batches	composite samples	none	general discussion
ISO 8868 (1989)	Fluospar - Sampling and sample preparation	specifies sampling methods for a lot of fluospar and methods for the preparation of samples taken from the lot..., it covers underlying theory, basic principles, basic requirements for the sampling device	ISO standard	ok	characterisation	solid/ granular	belt, stationary situations (wagons, containers, ships, stockpiles, bagges material)	mass basis, time basis sampling; composite sample	none	general discussion
ISO 9138: 1993	Abrasive grains - sampling and splitting		ISO standard	none	characterisation	solid/granular	batches, stationary positions	grab sample	none	specific requirement

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
ISO 4296/2:1983	none	none	short to extensive (sample preparation and division)	short	none	none	yes	details of riffle divider	
ISO 5667-12:1995	none	general discussion	none	short (storage, transport and preservation)	none	ok	yes	description of the scissor-grab system, piston drill system, corer system, beeker sampler systemsealed core sampler system, falling bomb system, jenkins mud sampler system, craib corer system, piston corer, peat borers	
ISO 6644:2002	none	general description to practical explanation	none	short (packaging and labelling)	none	ok	yes	examples of automatic samplers	
ISO 7742:1988	none	none	extensive	none	none	none	yes	alternative methods, examples of apparatus	
ISO 8213: 1986	none	general description to practical explanation	short	none	none	ok	yes	table of random numbers - method of use for sampling, figures and examples of apparatus fr sampling	
ISO 8633:1992	none	practical explanation	short	none	none	ok	yes	no	
ISO 8868 (1989)	none	general discussion to step-by-step practical explanation	short to extensive (sample division, mixing)	short	none	none	yes	different sizes of riffle divider	this standard covers more or less the same headlines as: ISO 4552-2, ISO 4296-1, ISO 6153, ISO 3713, ISO 10836, ISO 8685)
ISO 9138: 1993	none	practical explanation	short (sub-sampling)	none	none	none	yes	no	could be used as an example of an operational standard

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
ISO 9411-1:1994	Solid mineral fuels - Mechanical sampling from moving streams - Part 1: Coal	provides recommended practices for the mechanical sampling of solid mineral fuels from moving streams	ISO standard	ok	characterisation	solid/ granular	falling stream	time-basis sampling; mass-basis sampling, stratified random sampling; composite samples		general discussion and specific requirements
ISO 10381-2:2003	Soil quality - sampling - Part 2: Guidance on sampling techniques	guidance on techniques for taking and storing soil samples	ISO standard	ok	characterisation	solid/granular	in situ	disturbed / undisturbed samples	extensive (but general)	list of equipment, cross-contamination
ISO 10381-3:2002	Soil quality - sampling - Part 3: Guidance on safety	guidance on the hazards that may exist during a site investigation and when collecting samples	ISO standard	none	characterisation, hazard assessment	solid/granular	in situ, batches, stationary	-	extensive (exposure to hazards, potential on-site hazards, safety precautions, incl. Procedures and equipment)	list of safety equipment
ISO 10381-4:2003	Soil quality - sampling - Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites	describes the sampling of soils	ISO standard	none	characterisation	solid/granular	in situ	disturbed / undisturbed samples	none	list of equipment
ISO 10381-5:2005	Soil quality - sampling - Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination	gives guidance on the procedure for the investigation of urban and industrial sites	ISO standard	none	characterisation, hazard assessment	solid/granular	in situ	judgemental sampling, regular sam	none	none

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	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
ISO 9411-1:1994	none	general discussion to step-by-step practical explanation	extensive (sample division, mixing, reduction)	short	reserve sample	none	yes	technical guidance notes on the operation of mechanical samplers, methods for determining primary increment variance and of checking precision by means of replicate sampling, methods of checking sample preparation and testing errors, methods of testing for bias, specimen statistical calculations, variogram method of determining sampling variance	this standard is almost identical with ISO 9411-2: 1993 (Solid mineral fuels - Mechanical sampling from moving streams - Part 2: Coke)
ISO 10381-2:2003	none	general description	none	extensive (containers, labelling, storage)	none	short	yes	yes (description of manually and power-operated sampling tools)	good tables: applicability of ground excavation, drilling and sampling techniques; suitability of sample containers
ISO 10381-3:2002	none	-	-	-	-	-	yes	no	
ISO 10381-4:2003	experienced personnel	general description	none	short	short	ok (sampling report)	yes	yes (example of soil sampling in a trial pit)	
ISO 10381-5:2005	none	general discussion	none	none	none	ok (preliminary investigation and the conceptual model, exploratory investigation, main site investigation)	yes	yes (objectives of soil sampling)	

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
ISO/DIS 10381-8 (2003)	Soil quality - sampling - Part 8: Guidance on sampling of stockpiles	defines methods that shoud be applied when sampling from stockpiles	draft ISO standard	ok	characterisation compliance testing on-site verification	solid/granular	stockpiles	probabilistic sampling (informatinve, non-informative) judgemental sampling simple / stratefied random sampling systematic sampling	short	list of equipment and general discussion
ISO 13909-1:2001	Hard coal and coke - mechanical sampling - Part 1: General introduction	defines the basic terms used in the sampling of solid mineral fuels, describes the general principles of sampling and details the information to be provided in the documentation and the sampling report	ISO standard	ok	-	solid/ granular	falling stream, moving belt, stationary lots	-	none	none
ISO 13909-2:2001	Hard coal and coke - Mechanical Sampling - Part 2: Coal - sampling from moving streams	specifies procedures and requirements for the design and establishment of mechanical samplers for the sampling of coal from moving streams and describes the methods of sampling used	ISO standard	none	characterisation	solid/ granular	moving streams	continuous and intermittent sampling; mass-basis sampling, time-basis sampling, stratified random sampling	short	general discussion and specific requirements
ISO 13909-3:2001	Hard coal and coke - Mechanical sampling - Part 3: Coal - sampling from stationary lots	specifies procedures for the mechanical sampling of coal from stationary lots	ISO standard	none	characterisation	solid/ granular	stationary positions (wagons, barges, ships, stockpiles)	continuous and intermittent sampling	none	general discussion and specific requirements
ISO 13909-6:2001	Hard coal and coke - Mechanical Sampling - Part 6: Coke - Preparation of test samples	describes the preparation of samples of coke from the combination of primary increments to the preparation of samples for specific tests	ISO standard	none	-	solid/ granular	-	time-basis sampling, mass-basis sampling	none	equipment for sample division
ISO 15176 (2003)	Soil quality - characterisation of excavated soil and other soil materials intended for re-use	guidance on the range of tets that may be necessary to characterise soil	ISO standard	ok	characterisation	solid/granular	in situ, batches, stockpiles	-	none	none

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
ISO/DIS 10381-8 (2003)	none	none	extensive	extensive	none	none	yes	yes (example of sampling plan, of a chain of custody form, estimation of minimum increment and sample size, scale of sampling, statistical principle and statistical methods for characterising a population, calculating the required number of samples, examples of types of sampling suitable for the goal, sampling techniques,	general description of how to prepare a sampling plan (including sampling design, record of information, health and safety) of sampling strategy (incl. Statistical principles, purpose of sampling, types of sampling, sampling locations), equipment and techniques
ISO 13909-1:2001	none	general description	none	short	none	ok	yes		this standard is some kind of umbrella standard to the ISO 13909, which consists of 8 standards - some related to coal and some to coke only
ISO 13909-2:2001	none	general discussion	none	short	none	none	yes	examples of calculations of the number of sub-lots and number of increments per sub-lot (sampling from moving streams), evaluation of sampling equipment for mass-basis sampling, guidance on the operation of mechanical samplers	this standard is almost identical with ISO 13909-5:2001 " Hard coal and coke - Mechanical sampling - Part 5: Sampling from moving streams"
ISO 13909-3:2001	none	general description to practical explanation	none	short	none	none	yes	examples of calculations of the number of sub-lots and number of increments per sub-lot (sampling from stationary lots)	
ISO 13909-6:2001	none	none	extensive	none	none	none	yes	no	this standard is almost identical with ISO 13909-4:2001 "Hard coal and coke - mechanical sampling - part 4: coal - preparation of test samples
ISO 15176 (2003)	none	none	none	none	none	none	yes	yes (data quality, handling and evaluation good practice in the re-use of soil materials, guidance on the determination of the scope of investigation needed before excavation of soil materials, example of classification and evaluation of soils and other soil materials, examples of element and compounds belonging to different contaminant groups)	

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
ISO/FDIS 18283:2006	Hard coal and coke - Manual Sampling	defines the basic terms used in manual sampling of hard coal and coke and describes the general principles of sampling. It specifies procedures and requirements for establishing a manual sampling scheme, methods of manual sampling, sampling equipment, handling and storage of samples, sample preparation and a sampling report	draft standard	ok	characterisation	solid/ granular	stopped belt, falling stream, moving belt, stockpiles, loading/unloading, stationary positions	continuous og intermittent sampling; mass-based and time-based sampling	none	list of equipment and specific requirements
ISO/FDIS 20904:2006	Hard coal - Sampling of slurries	sets out the basic methods for sampling fine coal, coal rejects or tailings of nominal top size < 4 mm that is mixed with water to form a slurry	draft standard	none	characterisation	slurry	moving streams in pipes, canals etc.	time-basis sampling; stratified random sampling	none	list of equipment and general discussion
NT ENVIR 001:1995	Solid waste, municipal: sampling and characterisation	to obtain information about the amount and composition of solid waste	Nordtest method	ok	characterisation	solid/granular		random sampling composite samples	short (safety equipment)	none
NT ENVIR 004 (1996)	Solid waste, particulate materials: sampling	recommendations are applicable for sampling of silod residues	Nordtest method	ok	charcterisation, compliance testing on-site verification	solid/granular	stopped conveyor belt falling stream moving conveyor belt stationary position (container, vehicle, stockpile)	systematic random sampling (mass basis sampling, time basis sampling) stratified random sampling	none	manual automatic
SOP 2006 (08/11/94)	Sampling equipment decontamination	to provide a descriptio of the methods used for preventing, minimizing, or limiting xcross-contamination of samples…	U.S. EPA Env. Response team, Standard Operating procedures	none	-	-	-	-	short	list of equipment
SOP 2009 (11/16/94)	Drum sampling	to provide technical guidance (…) at hazardous waste sites containing drums with unknown contents	U.S. EPA Env. Response team, Standard Operating procedures	none	characerisation, hazard assessment	solid/granular sludge liquid	batches	grab sample	short	list of equipment and general discussion

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
ISO/FDIS 18283:2006	short	general description to practical explanation	extensive	short	none	ok	yes	example of calculation of precision, mass of increments, number of sub-lots and number of increments per sub-lot, methods for sampling large fuels and fuels from stationary lots	this standard only seems to lack quality control and occupational health; all other points are covered rather well
ISO/FDIS 20904:2006	none	general description to practical explanation	short	short	none	none	yes	examples of correct slurry devices, examples of incorrect slurry sampling devices, manual sampling implements	
NT ENVIR 001:1995	none	general description	short	none	QAWP	ok	yes	yes (statistical calculations)	
NT ENVIR 004 (1996)	none	general description	none	short	none	ok (sampling record)	no	yes (sampling plan, equipment, statistical tables and calculations)	different techniques / equipment for different situations; calculations regarding number of samples; basic statistical evaluation of analysis results; Fundamental statistics for sampling;
SOP 2006 (08/11/94)	none	step-by-step, practical	none	-	short (rinsate blanks)	none	yes	yes (contaminants and recommended solvent rinse, decontamination layout)	Different procedures and methods for decontamination
SOP 2009 (11/16/94)	none	step-by-step, practical	none	extensive (handling procedure)	short	none	yes	yes (data sheets, figures of sampling equipment)	procedures for different equipment

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
SOP 2010 (11/16/94)	Tank sampling	to provide technical guidance for the implementation of sampling protocols for tanks and other confined spaces from outside the vessel	U.S. EPA Env. Response team, Standard Operating procedures	none	characterisation	solid/granular sludge liquid	batches	grab sample	short	list of equipment and general discussion
SOP 2012 (02/18/00)	Soil sampling	to describe the procedures for the collection of representative soil samples	U.S. EPA Env. Response team, Standard Operating procedures	none	hazard assessment	solid/granular (soil)	in situ	-	short	list of equipment and general discussion
SOP 2016 (11/17/94)	Sediment sampling	collection of representative sediment samples	U.S. EPA Env. Response team, Standard Operating procedures	none	characterisation	solid/granular	in situ	-	short	list of equipment
SOP 2017 (11/17/94)	Waste pile sampling	to outline the equipment ad methods used in collecting representative samples from waste piles, sludges or other solid or liquid waste mixed with soil	U.S. EPA Env. Response team, Standard Operating procedures	none	characerisation	solid/granular (waste, waste / sludge / other solids mixed with soil)	batches	random sampling stratified random sampling; grab sample	none	list of equipment
TC 151 WI 151 (2004)	D2.1 (part 1) Sampling of sewage sludge, treated biowastes and soils in the landscape - Framework for the preparation and application of a sampling plan; Introductory element - sampling of sewage sludge, treated biowastes and soils in the landscape - framework for the preparation and application of a sampling plan	specifies the procedural steps to be taken in the preparation and application of a sampling plan	draft	ok	-	solid/ granular sludge	-	probabilistic sampling judgemental sampling	short	none

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
SOP 2010 (11/16/94)	none	step-by-step, practical	none	extensive (handling procedure)	short	none	yes	yes (volume calculations, figures of sampling equipment)	procedures for different equipment
SOP 2012 (02/18/00)	none	step-by-step, practical	short	short	short	none	yes	yes (figures of sampling equipment)	surface soil, sampling at depth, procedures for different equipment
SOP 2016 (11/17/94)	none	step-by-step, practical	none	short	short	none	yes	yes (figures of sampling equipment)	procedures for different equipment
SOP 2017 (11/17/94)	none	step-by-step, practical	short	short	short	none	yes	yes (figures of sampling equipment)	procedures for different equipment
TC 151 WI 151 (2004)	none	general description	short	short	none	ok (sampling record)	yes	yes (example of a sampling plan, example of a sampling record, an example chain of custody form, an example sample analysis request form)	general description of how to prepare a sampling plan

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular sludge liquid	pipes, canal, batches, in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	e.g. judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
TC 151 WI 151 (2004)	D2.2 (part A) Sampling of sewage sludge, treated biowastes - Technical report on sampling - Guidance on selection and application of criteria for sampling under various conditions	discusses the statistical principles of sampling, and provides a number of statistical tool to assist in the design of testing programmes	draft	ok	characterisation compliance testing on-site verification	liquid solid/ granular sludge	-	probabilistic and judgemental sampling	none	none
TC 151 WI 151 (2004)	D2.2 (part B) Sampling of sewage sludge and treated biowastes - Technical Report on Sampling - Guidance on sub-sampling in the field	describes procedures suitable for use in the field for reducing the size of field samples, with or without combining increments	draft	ok	-	liquid solid/ granular sludge	-	-	none	none
TC 151 WI 151 (2004)	D2.2 (part C) Sampling of sewage sludge and treated biowastes - Technical report on sampling - Guidance on procedures for sample packaging, storage, preservation, transport and delivery	describes procedures for the packging, preservation, short-term storage and transport of samples of sewage sludge and treated biowastes	draft	ok	-	liquid solid/ granular sludge	-	-	none	none

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
TC 151 WI 151 (2004)	none	none	none	none	none	none	yes	yes (sampling scale, statistical methods for characterising a population, calculating the required number of increments and samples, minimum increment and sample size mass (mass/volume), example sample scenarios)	
TC 151 WI 151 (2004)	none	none	extensive (sub-sampling)	none	none	none	yes	yes	describes principles of sub-sampling for granular materials, liquid sludges, paste-like sludges, gelatinous sludges, and describes different sub-sampling methods; descriptions are general to practical
TC 151 WI 151 (2004)	none	none	short	extensive	none	none	yes	yes (packaging: table with information on samples containers, preservation and storage conditions for different parameters measured in sediments and sludges and liquids)	

A P P E N D I X B

Compilation of operational standards/guidelines Sampling of liquids

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
			standard draft standard	none ok	(different types of:) characterisation compliance testing on-site verification quality control process control hazard assessment documentation of clean-up goal	solid/granular (inkl. Specific name) sludge liquid (incl. Specific name)	pipes canal batches in situ stationary position (container, vehicle, stockpiles) moving belt stopped belt falling stream loading and unloading of material	judgemental / probabilistic sampling disturbed / undisturbed sample systematic / non-systematic sampling grab sampling composite samples sampling frequency: mass basis / time-basis sampling time-dependend flow-dependend	none short extensive safety equipment health and safety measures	none manual mechanical automatic cross-contamination/ cleaning of equipment list of equipment general discussion specific requirements
DS/EN 58:2004	Bitumen and bituminous binders - Sampling bituminous binders	describes methods of sampling bituminous binders	standard	ok	characterisation/ quality control	liquid/ solid	pipe, containers, cans	grab sampling, composite sampling	short	general discussion
DS/EN ISO 707:1997	Milk and milk products - guidance on sampling	gives guidance on methods of sampling milk and milk products for microbiological, chemical, physical and sensory analysis	standard	ok	characterisation	liquid/ solid	batches, stationary positions	grab samples	none	list of equipment and general description
DS 2214:1990	Water analysis - Sampling of natural water for analysis of trace metals	the standards deals with sampling of lake water, sea water and running water with a low content of trace metals	standard	ok	characterisation	liquid	batches and canals (natural waters)	grab sampling	none	general discussion
DS 2250: 1983	Sampling, transportation and storage of samples for microbiological analysis	gives rules for sampling, transport and storage of all types of water, sludge and sediment	standard	none	characterisation	liquid, sludge, solid	batches, pipes	grab sampling	short	general discussion
DS 2398:1998	Ship's and marine technology - Sampling from lubricating oil and hydraulic systems - Guidance for sampling of represantative samples for determination of degree of cleanliness and for solid particle contamination	describes a method for dynamic and static sampling from lubricating and hydraulic systems	standard	none	characterisation	liquid	pipes, batches	-	none	specific requirement
DS/EN ISO 3170: 2004	Petroleum liquids - Manual Sampling	specifies the manual methods to be used for obtaining samples of liquid or semiliquid hydrocarbons, tank residues and deposits from fixed tanks etc.	standard	ok	characterisation	liquid	pipes, batches, stationary positions	static sampling, dynamic sampling; spot and zone samples, composite samples	short	list of equipment and general discussion

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
	none short extensive experienced personnel special education certificates	none general description step-by-step, practical explanation	none short extensive on-site pretreatment (filtration, preservation…) sub-sampling (riffle, coning/quartering, secondary sample…) sample mixing (several samples into one)	none short extensive sample container cleaning of sample container sample preservation labelling transport and storage requirements for disposal of surplus test material	none short extensive type of quality control: blanks/blinds control sample chain of custody report field report quality assurance work plan (QAWP)	none ok extensive	yes no	yes no	
DS/EN 58:2004	none	general discussion to practical explanation	short	short	none	ok	no	example of a form for reporting on the sampling of bituminous binders	describes shortly the fundamentals of sampling and focuses on arrangements, equipment and methods of sampling, i.e. different equipment (pipes, valves etc.)
DS/EN ISO 707:1997	short	general description to practical explanation	none	extensive (cleaning of sampling equipment, containers, preservation, storage and transport	short (replicates)	ok	yes	sampling equipment and shapes of samples, thermally insulated container for the transport of cooled, frozen and quick-frozen food samples, additional information for the use of insulated transport containers	
DS 2214:1990	none	general description	short to extensive, on-site pretreatment	short to extensive, sample container, cleaning of sample containers, preservation and storage	none	none	yes	no	standard is in danish
DS 2250: 1983	none	general discussion to practical explanation	none	short	none	ok	no		
DS 2398:1998	none	practical explanation	none	short	none	none	yes	no	
DS/EN ISO 3170: 2004	short	general discussion to practical explanation	short to extensive (homogenization)	short	none	none	yes	guidance on safety precautions	

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
DS/EN ISO 3171:1999	Petroleum liquids - Automatic pipeline sampling	recommends procedures to be used for obtaining, by automatic means, representative samples ...	standard	ok	characterisation	liquid	pipes	intermittent fixed-grab-volume samplers, intermittent variable-grab-volume samplers	short	general discussion
DS/EN 25667-1:1994	Water quality - Sampling - Part 1: Guidance on the design of sampling programmes	the standards sets out the general principles to be applied in the design of sampling programmes for the purposes of quality control, quality characterisation, and identification of sources of pollution of water, including bottom deposits and sludges	standard	none	characterisation quality control hazard assessment	liquid solid sludge	batches (natural waters) and canals pipes	-	short to extensive	none
DS/EN 25667-2:1994	Water quality - Sampling - Part 2: Guidance on sampling techniques	provides guidance on sampling techniques used to obtain the data necessary to make analyses for the purpose of quality control, quality characterisation and identification of sources of pollution	standard	ok	characterisation quality control hazard assessment	liquid	-	spot samples, priodic samples, continuous samples, series sampling, composite sampling, large volume samples	none	general discussion
ISO 5555:2001	Animal and vegetable fats and oils - Sampling	describes methods of sampling crude or processed animal and vegetable fats and oils, whatever the origin and whether liquid or solid	standard	ok	characterisation	liquid/ solid	pipes, batches, stationary positions	grab sampling, composite sampling	none	list of equipment
ISO/WD 5667-3	Water quality - Sampling - Part 3: Guidance on the preservation and handling of samples	gives general guidelines on the precautions to be taken to preserve and transport water samples	draft	none	-	liquid	-	-	none	none
ISO 5667-4:1987	Water quality - Sampling - Part 4: Guidance on sampling from lakes, natural and man-made	presents detailed principles to be applied to the design of sampling programmes, to sampling techniques and the handling and preservation of samples of water from natural and man-made lakes	standard	ok	characterisation	liquid	batch	spot and composite samples	short	list of equipment and general discussion
ISO 5667-5:1991	Water quality - Sampling - Part 5: Guidance on sampling of drinking water and water used for food and beverage processing	establishes detailed principles to be applied to the design of sampling programmes, to sampling techniques and to the handling and preservation of samples	standard	none	characterisation quality control	liquid	pipes canals batches	sampling frequency and timing	short	none

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
DS/EN ISO 3171:1999	none	general discussion to practical explanation	short (homogenization)	short	none	none	yes	estimating water-in-oil dispersion, example of water concentration profile tests at a crude oil terminal, guide for initial screening of potential sampling locations	describes apart from automatic sampling also methods for estimation of overall sampling system uncertainty, selection of sampling points, general sampling principles, profile testing, test to prove the sampling system
DS/EN 25667-1:1994	none	general description	none	none	none	none	yes	yes (normative references)	different sampling objectives and sampling situations are described in general, including sampling in industry, from trade effluents, sewage, storm water etc.; time and frequency of sampling and statistical considerations are included, as well as justifications for flow measurement and methods for it
DS/EN 25667-2:1994	none	none	none	types of sample containers	none	ok	yes	yes (desirable features of automatic sampling equipment)	different types of samples are described: spot samples, continuous samples, periodic samples, series sampling, composite samples, large volume samples; different types of equipment are described in general
ISO 5555:2001	none	practical explanation	short	short	none	ok	yes	temperature limits, examples of sampling instruments and ancillary apparatus	
ISO/WD 5667-3	none	none	short (on-site pretreatment)	extensive (labelling, transport, containers, preservation)	none	none	yes	no	the draft includes an extensive table with techniques generally suitable for the preservation of samples for physico-chemical, chemical and biological analysis, as well as a table for allocation of parameters to the types of preservation
ISO 5667-4:1987	none	general descpription	none	short	none	ok	yes	report - sampling from lakes, natural and man-made	
ISO 5667-5:1991	short	general description to step-by-step, practical explanation	short	short (sampling containers, labelling, preservation, transport and storage)	short	ok	yes	yes (report - Sampling of drinking water and water used for food and beverage processing)	

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
ISO 5667-6:1990	Water quality - Sampling - Part 6: Guidance on sampling of rivers and streams	sets out the principles to be applied to the design of sampling programmes, sampling techniques and the handling of water samples from rivers and streams for physical, chemical and microbiological assessments	standard	ok	characterisation	liquid	pipes/ canals	grab samples, continuous sample	short	list of equipment and general discussion
ISO 5667-7:1993	Water quality - Sampling - Part 7: Guidance on sampling of water and steam in boiler plants	recommends procedures and equipment for sampling water and steam in boiler plants …	standard	ok	characterisation	liquid	pipes, batches	-	none	list of equipment and general discussion
ISO 5667-9:1992	Water quality - Sampling - Part 9: Guidance on sampling from marine waters	provides guidance on the principles to be applied to the design of sampling programmes, sampling techniques and the handling and preservation of samples of sea water from tidal waters	standard	ok	characterisation/ quality control	liquid	canal, batches	grab samples, composite samples	short	list of equipment and general discussion
DS/ISO 5667-10:2004	Water quality - Sampling - Part 10: Guidance on sampling of waste waters	contains details on the sampling of domestic and industrial waste water	standard	ok	characterisation quality control compliance testing	liquid	pipes canals batches	sampling frequency and timing; grab sampling, composite samples	short to extensive (health and safety measures)	general discussion (manual and automatic equipment)
ISO 5667-11:1993	Water quality - Sampling - Part 11: Guidance on sampling of groundwaters	provides guidance on the design of sampling programmes, sampling techniques and the handling of water samples taken from groundwater	standard	ok	characterisation	liquid	in situ (groundwater)	grab samplers, pumps, sampling point selection and sampling frequency and timing	short (health and safety measures)	general discussion
DS/EN ISO 5667-13:1998	Water quality - Sampling - Part 13: Guidance on sampling of sludges from sewage and water treatment works	gives guidance on the sampling of sludges from wasterwater treatment works, water treatment works and industrial processes	standard	ok	characterisation compliance testing	sludge	pipes, canal, batches/stationary position (tanks and road tankers, stockpiles, long piles), belts	composite sampling grab and spot sampling	short to extensive (health and safety measures)	general discussion
ISO 5667-14:1998	Water quality - Sampling - Part 14: Guidance on quality assurance of environmental water sampling and handling	provides guidance on the selection and use of various quality assurance techniques relating to the manual sampling of surface, potable, waste, marine and groundwaters	standard	ok	-	liquid	-	-	-	-

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
ISO 5667-6:1990	none	general description	none	short	short	ok	yes	no	
ISO 5667-7:1993	none	general description	none	short	none	ok	yes	sampling points in boiler plants, coolers, report - sampling of water and steam in boiler plants	
ISO 5667-9:1992	none	general description	none	short	none	ok	yes	example of a sampling report form for marine waters	
DS/ISO 5667-10:2004	none	general description	none	short (sampling containers, labelling, preservation, transport and storage)	none	ok	yes	yes (report - Sampling of domestic and industrial waste water)	the standard includes a description of choice of sampling method, calculations for the sampling frequency
ISO 5667-11:1993	none	general description	on-site pretreatment, general description	short	none	ok	yes	yes (report - Sampling from groundwaters)	rather general description of sampling equipment and apparatus, sampling procedures and choice of sampling methods
DS/EN ISO 5667-13:1998	none	general description	short (quartering, multiple subsamples)	short (containers, preservation, storage)	none	ok	yes	yes (vacuum sampling devices, apparatus for sampling from pipes under pressure)	
ISO 5667-14:1998	none	none	none	short (transport, stabilisation and storage)	extensive (replicates, field blanks, rinsing of equipment, filtration recovery, spiked samples)	ok	yes	yes (control charts)	extensive description of sampling quanlity control techniques in general and particular, including analysis and interpretation of quality control data

Document number and year	Title	Scope	Document type	Terms and definitions	Sampling objective	Materials	Sampling situation	Principles (approach / technique, patterns)	Occupational health	Equipment
ISO 5667-17:2000	Water quality - Sampling - Part 17: Guidance on sampling of suspended sediments	applicable to the sampling of suspended solids for the purpose of monitoring and investigation of freshwater qualuty	standard	ok	characterisation	liquid	canal, batches	-	short	list of equipment and general discussion
ISO 5667-18:2001	Water quality - Sampling - Part 18: Guidance on sampling of groundwater at contaminated sites	provides guidance on the sampling of groundwater at potentially contaminated sites	standard	ok	characterisation hazard assessment	liquid	in situ (groundwater)	pumps	short	list of equipment and general discussion
ISO/WD 5667-20:2005	Water quality - Sampling - Part 20: Guidance on the use of sample data for decision making - compliance with limit values and classification	establishes important principles for dealing with the use of sample data for decision-making	draft	none	-	liquid	-	-	-	-
ISO/IEC 17025:1999	General requirements for the competence of testing and calibration laboratories	specifies the general requirements for the competence to carry out tests and or calibrations, including sampling	standard	none	-	-	-	-	-	-

Document number and year	Competence	Sampling procedures	Sample treatment (on site)	Sample handling	Quality control	Reporting	Bibliography/ References	Examples / Attachments	Comments
ISO 5667-17:2000	none	general description	none	none	short (blanks)	none	yes	information on suspended solids and their sampling	rather general description; due to lack of standard protocols in this field no definitive guidance is given
ISO 5667-18:2001	none	general description	none	short	short	ok	yes	yes (calculation of sampling frequency using a nomogram)	the standard includes sampling strategy and programme design, types of monitoring installations; it includes types of sampling equipment (advantages and disadvantages) and a guide to the suitability of sampling methods for different groundwater parameters
ISO/WD 5667-20:2005	-	-	-	-	-	-	yes	yes (calculation of confidence limits and calculations for the binomial distribution)	describes types of error and variation, estimation of summary statistics, water quality standards, classification of pollutants etc.
ISO/IEC 17025:1999	extensive	-	-	-	-	-	yes		the standard contains among others the following headlines: management requirements (organisation, quality systems, document control, corrective action…) and technical requirements (personnel, test and calibration methods etc.)