SLOVENSKI STANDARD
SIST EN 14968:2006
01-november-2006

Pomen in definicija izrazov pri izmenjavi podatkov o podtalnici

Semantics for groundwater data interchange

Semantik für den Austausch von Grundwasserdaten

Sémantique pour l'échange de données concernant les eaux souterraines

Ta slovenski standard je istoveten z: EN 14968:2006

ICS:

13.060.10
35.240.99

SIST EN 14968:2006 **en**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 14968

August 2006

ICS 13.060.10; 35.240.99

English Version

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Semantik für den Austausch von Grundwasserdaten

This European Standard was approved by CEN on 1 August 2006.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 14968:2006: E

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Foreword

This document (EN 14968:2006) has been prepared by Technical Committee CEN/TC 318 “Hydrometry”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2007, and conflicting national standards shall be withdrawn at the latest by February 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

Piezometric data, e.g groundwater level, pressure, groundwater flow, represent a valuable resource and their value is likely to increase in the context of today at the European, national and local levels.

Indeed, the environment is one of the main concerns of the European Union, and it is reflected in the new EU Directives such as the "*EU Water Framework Directive"* requesting that knowledge regarding environment be shared at the national or international levels.

Equally, groundwater quantitative data also represent a source of wealth for local actors (cities, local authorities, private companies, etc.) in undertaking their present activity. For example, a town that uses groundwater for drinking water needs groundwater data to define its drinking water policy, and run its drinking water plant. Towns can directly provide the data that they need or, if data are not available; they have to collect them from various producers that are sometimes located in different countries. In this latter case, this standard provides for a unique data exchange interface which will help towns to collect data more easily and producers to disseminate them quicker.

The aim of this standard is to describe data necessary to produce "initial" groundwater quantitative data. The description of aggregate data for groundwater lies outside the scope of this standard. For example, the depth measurement can be carried out in accordance with this standard, but not the altitude measurement. This standard is designed to meet producers' needs and not to define data that are required for exchange between national or European organizations.

This standard gives the complete semantic basis necessary to store and exchange groundwater quantitative data. To perform such exchanges, the producer may use a XML file such as recommended by European organizations but these semantics can be used with other file formats (text file, HTML).

1 Scope

This standard covers the semantics (meaning) of data exchanged between data producers, users and databanks, independently from the software device and the formats used to exchange the files.

It provides a consistent set of terms defining selected objects and their related attributes.

The standard is not applicable to:

- data describing domestic uses (drinking water, waste water) or qualitative aspects ;
- real time data or data calculated from models;
- all the various characteristics on the organizations exchanging data concerned;
- debimetric measures.

2 Terms and definitions

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

2.1
aquifer system
hydrogeological entity within which all components are in hydraulic continuity and that is bound by limits representing an obstacle for the dissemination of any perceptible effect outside the system

2.2
archive data
data stored to keep knowledge about an object for a given period of time

2.3
attribute
characteristic of an object or entity [ISO/IEC 11179-1]

2.4
calculated data
data established from calculations carried out to reach different goals: forecast, simulation, design, etc.

2.5
concept
unit of thought constituted through abstraction on the basis of characteristics common to a set of objects

2.6
data
representation of facts, concepts, or instructions in a formalized manner, suitable for communication, interpretation, or processing by humans or by automatic means

2.7
data element
unit of data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes [ISO/IEC 11179-1]

2.8
data element dictionary
information resource that lists and defines all relevant data elements

2.9
data interchange
process of sending and receiving data in such a manner that the information content or meaning assigned to the data is not altered during the transmission

2.10
data length
maximum size given in a number of characters

2.11
data producer
private or public entity in charge of data production and responsible for the validity of these data when they are published

2.12
data model
description of the organization of data in a manner that reflects an information structure

NOTE See Annex A.

2.13
data type
format used for the collection of letters, digits, and/or symbols, to depict values of a data element, determined by the operations that may be performed on the data element

2.14
definition
statement that expresses the essential nature of a data element and permits its differentiation from all other data elements

2.15
entity
any concrete or abstract thing of interest, including associations among things

2.16
information
(in information processing): knowledge concerning objects, such as facts, events, things, processes, or ideas, including concepts, that within a certain context has a particular meaning

2.17
metadata
data that defines and describes other data [ISO/IEC 11179-1]

2.18
object
any part of the conceivable or perceivable world

2.19
real time data
data generally taken from devices for the immediate knowledge of a phenomenon state

3 File structure for data interchange

The data included in the directories presented in Clauses 6 and 7 can be used with any method for data interchange. Any file format can be used to exchange data according to this standard provided that it has no impact on the data structure and the semantics described in the following clauses.

4 Piezometric concepts

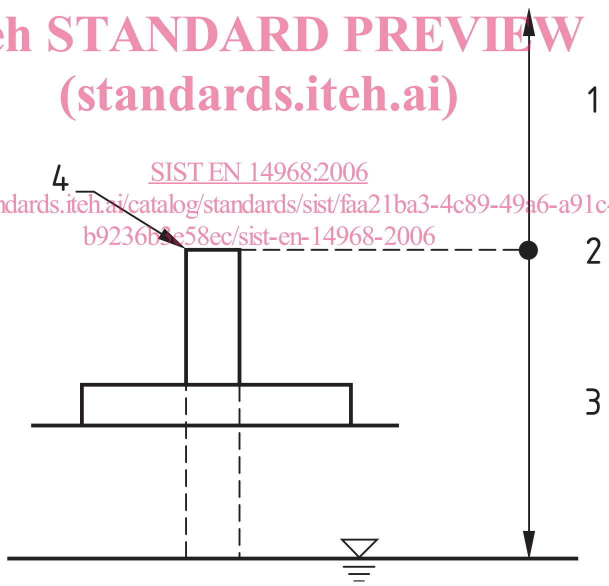
4.1 Piezometric time series

4.1.1 General

Piezometric time series are a record of the groundwater level over time. They associate a date to the groundwater level at a given moment.

Depending on the variability of the groundwater level, measurements will be more or less frequent over a period of time.

The groundwater level measurements shall be positive or negative according to the measurement point (see Figure 1). Measurements are negative when the groundwater level rises above the measurement point (as with an artesian well), and positive in all the other cases.



Key

1 height (-)

2 level zero

3 depth to groundwater level (+)

4 measurement point

Figure 1 — Qualification of the groundwater level measurements

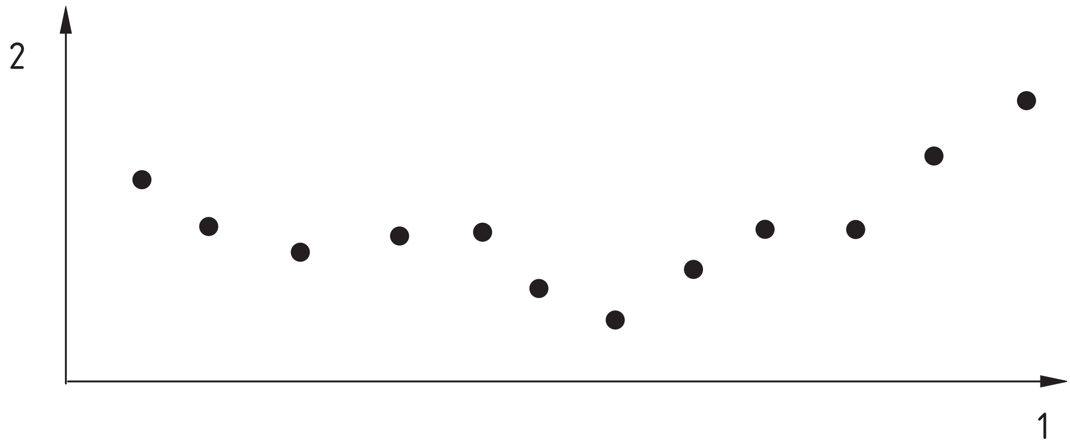
4.1.2 Type of time series

4.1.2.1 General

The groundwater level is measured with discontinuous or continuous time series.

4.1.2.2 Discontinuous time series

Discontinuous time series are sets of level measures observed with or without any specific frequency (see Figure 2).



Key

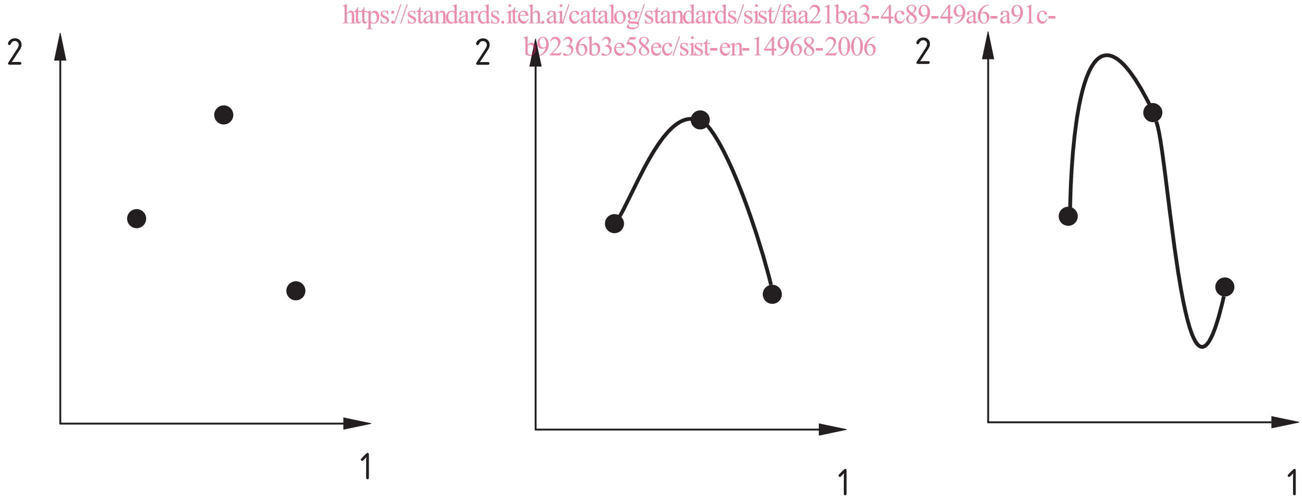
1 time

2 depth to groundwater level

Figure 2 — Discontinuous time series

With this kind of time series, the evolution of the groundwater level between two measures is unknown.

Figure 3 shows that measures (example A) conceal two radically different evolutions (examples B and C) of the groundwater level.



Example A Example B Example C

Key

1 time

2 depth to groundwater level

Figure 3 — Elevation of the groundwater level between measurements

Piezometric measurements shall be made with a sensor. If the sensor does not operate for a shorttime, e.g. sensor breakdown, or if the result has no meaning, at least one piezometric measurement will be missing. In such a case, the missing data shall be identified because there is no continuous series for the measure preceding this missing data and the measure coming after.

4.1.2.3 Continuous time series

The groundwater level is known at any moment during the period covered by the continuous time series. Indeed, continuous time series are curves resulting from a permanent measurement of the groundwater level.

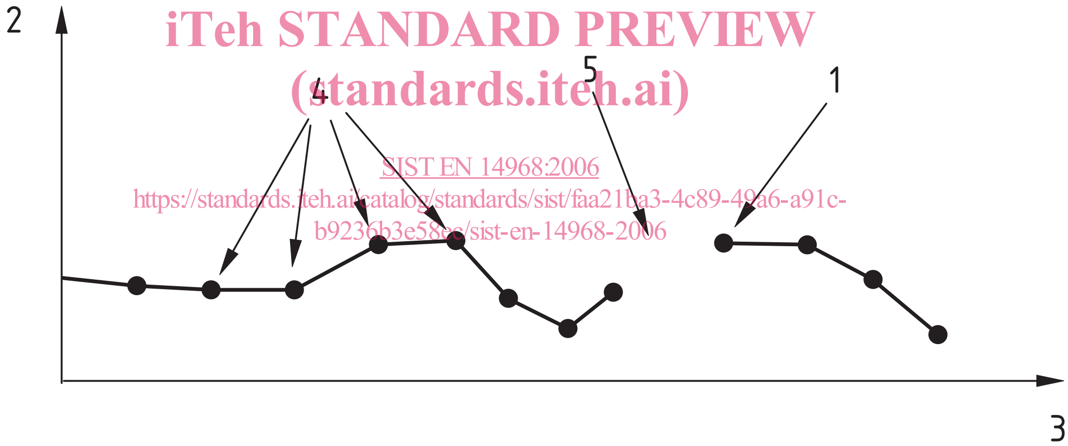
Time series shall be obtained by using graphical or electronic devices.

4.1.3 Time series presentation

Each time series is represented by a set of points in succession over time. Each point represents the groundwater level at a given moment.

Points represent the measures of discontinuous time series or the curve inflection point of the continuous time series.

To indicate the continuity between two points as shown in Figure 4, each point may be linked to the preceding point. If a point is not linked, it is the first point of a new sequence in the time series. The presence of an initial point therefore indicates that data were not available for the preceding period.



Key

1 initial points
2 depth
3 time
4 current points
5 discontinuity

Figure 4 — Continuous time series presentation

4.1.4 Validation of the measurements

The validity of each measurement is described according to the type of measurement method used. Four scenarios are possible:

a) Impossible to validate;

b) Valid;

c) Suspect ;

d) Not valid ;

By default, all values are specified as ‘Not validated yet’. The operator shall then assign one of the above-mentioned qualifications after examination.

A measurement is validated when the producer believes that the data and all the different procedures used to produce them comply with the monitoring protocol.

A measurement is not valid when the producer believes that the data or the procedures used to produce them do not comply with the measurement protocol.

A measurement is "Impossible to validate" when the operator does not have the information available to determine the validity of the data production according to the measurement protocol (e.g. historical data from archives).

4.2 Piezometer station

4.2.1 General

A piezometer is one method of measuring the piezometric height at a point within an aquifer system. It indicates the pressure at this point, enabling the observer to record the phreatic level or pressure. In the data interchange, only the depths to groundwater level of a piezometer are exchanged.

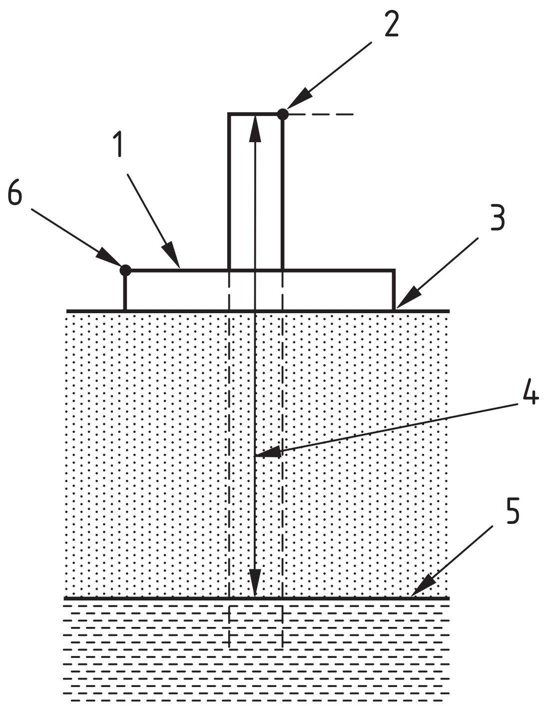
According to the scope of this standard, the concept of "piezometer" is extended to all artificial structures (well, borehole, gravel-pit) or natural structures (swallow, hole, grottos) which enables the groundwater level to be measured.

Each piezometer shall have a unique code given by the country where it is located.

4.2.2 Key features of a piezometer

4.2.2.1 General

Each piezometer has two key features: the level measurement point and the altitude benchmark measurement point as shown in Figure 5.



Key

1 plinth
2 level measurement point
3 altitude of surface in relation to the national altitude reference system
4 depth to groundwater level
5 groundwater level
6 altitude benchmark point

Figure 5 — Key features of a piezometer

4.2.2.2 Level measurement point

The level measurement point is the location on the piezometer used as a marker to measure the depth of the groundwater level (for example: the side of the tube of the borehole, the edge of the well, the reference ground level on a gravel-pit, etc.).

The level measurement point is 0, which is the basis for all depth measures. It applies to all measurement points. The real height is defined by using benchmark points.

4.2.2.3 Altitude benchmarks

Altitude benchmark points are used to compare data from all the piezometers in an aquifer system in order to determine the groundwater level of the system.

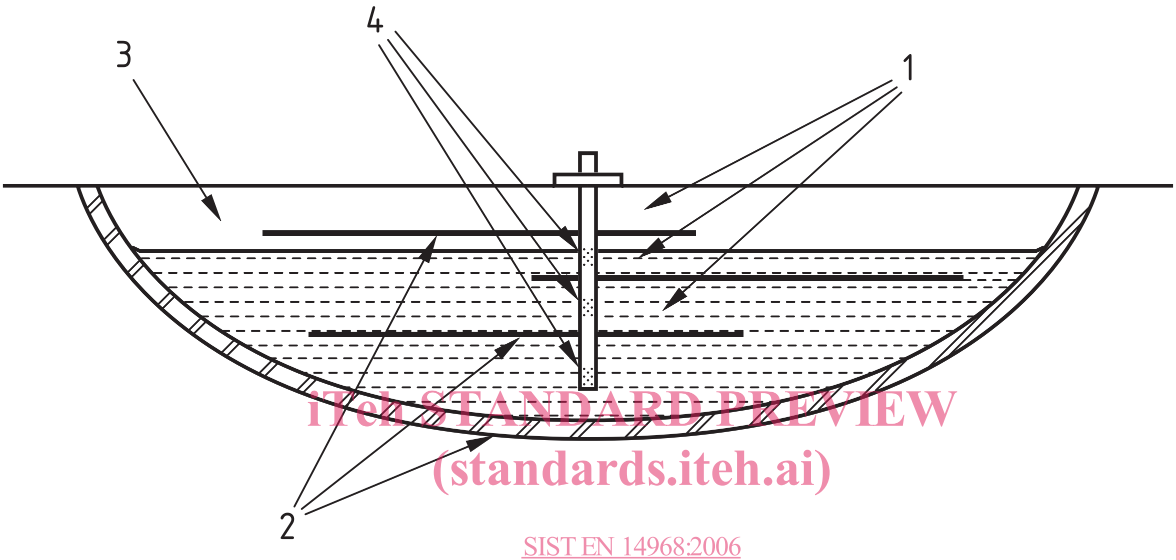
Three main locations are generally used to establish an altitude benchmark point: the level measurement point itself (when it is a permanent fixture), the altitude of the surface level or the plinth altitude.

The altitude of the benchmark altitude point can be determined by several means such as maps, GPS, topographic surveying, etc. and it is valid only for a given period of time. The altitude shall be based on the national altitude reference system.

The definition of the altitude benchmark point shall ensure the continuity within the time series when the piezometer has been damaged (a chipped tube has been broken), or modified (a new collar has been built).

4.2.3 Monitored aquifer systems

A piezometer should be used to monitor the depth of groundwater level of only one aquifer system as shown in Figure 6, even if it has to go through numerous aquifer horizons.



Key

1 aquifer horizons

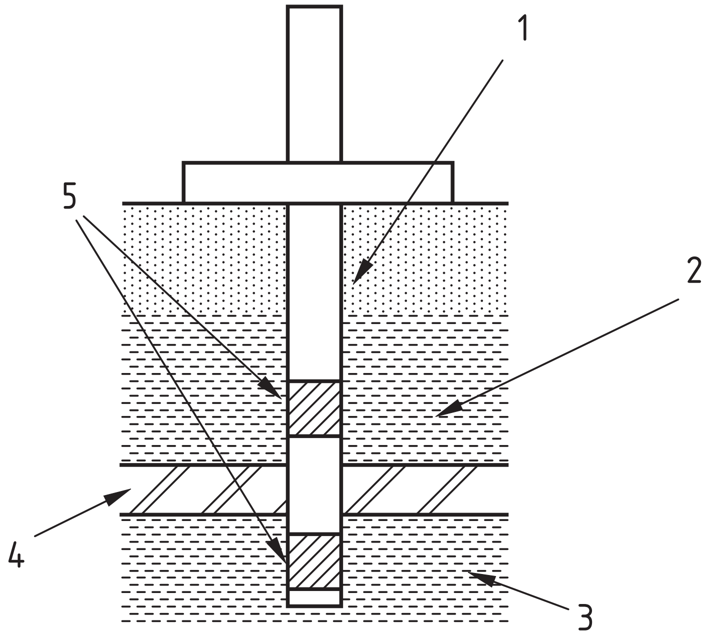
2 impermeable layers (aquiclude)

3 aquifer system

4 strainers

Figure 6 — Aquifer horizons

Nevertheless, boreholes going through several aquifer systems may sometimes be also used as piezometers, especially in areas where the number of piezometers is limited (see Figure 7). This situation should be avoided as far as possible, but if such boreholes are used, data related to them shall be identified as coming from multi-aquifer boreholes, so that they can be carefully interpreted.



Key

1 casing

2 unconfined aquifer

3 confined aquifer

4 impermeable layer

5 screens

Figure 7 — A borehole linked to two aquifers

The lithology at the piezometer location should also be described, so that information on local variations in the general lithology defined for the whole aquifer can also be provided.

4.2.4 Piezometer history

Many events can happen during the lifetime of the piezometer. This kind of information shall be stored with the date since it can be very useful to understand the time series described. These events might be:

— a new topographic survey;

— the building of a new collar/plinth;

— a new measuring equipment;

— the destruction of the piezometer head by works; etc.

4.3 Groundwater level producer

At a given date, a piezometer is always the responsibility of a producer. The producer might change during the life cycle of the piezometer because the responsibility can move from one producer to another. It is therefore important to keep track of such changes.