
Hydrometric determinations — Geophysical logging of boreholes for hydrogeological purposes — Considerations and guidelines for making measurements

Déterminations hydrométriques — Répertoire géophysique des trous de sonde pour des besoins hydrogéologiques — Considérations et lignes directrices relatives aux mesurages

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Foreword

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Attention is drawn to the possibility that some of the elements of this Technical Report may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 14685 was prepared by Technical Committee ISO/TC 113, *Hydrometric determinations*, Subcommittee SC 8, *Ground water*.

Introduction

Geophysical logging of boreholes, wells and/or shafts (hereafter referred to as boreholes) for hydrogeologic purposes provides a measurement of various physical and chemical properties of formations penetrated by a borehole and of their contained fluids. Sondes measuring different parameters are lowered into the borehole and the continuous depthwise change in a measured parameter is presented graphically as a geophysical log.

Geophysical logging of boreholes is carried out to obtain information on:

- a) the lithology of the formations through which the borehole is drilled;
- b) the occurrence, quantity, location and quality of formation fluid (usually water);
- c) the dimensions, construction and physical condition of the borehole.

The logging equipment consists essentially of three parts: the downhole sensor and oblique tool (hereafter referred to as a sonde); cable and winch; power and a surface system of power, signal processing and recording units (see Figure 1).

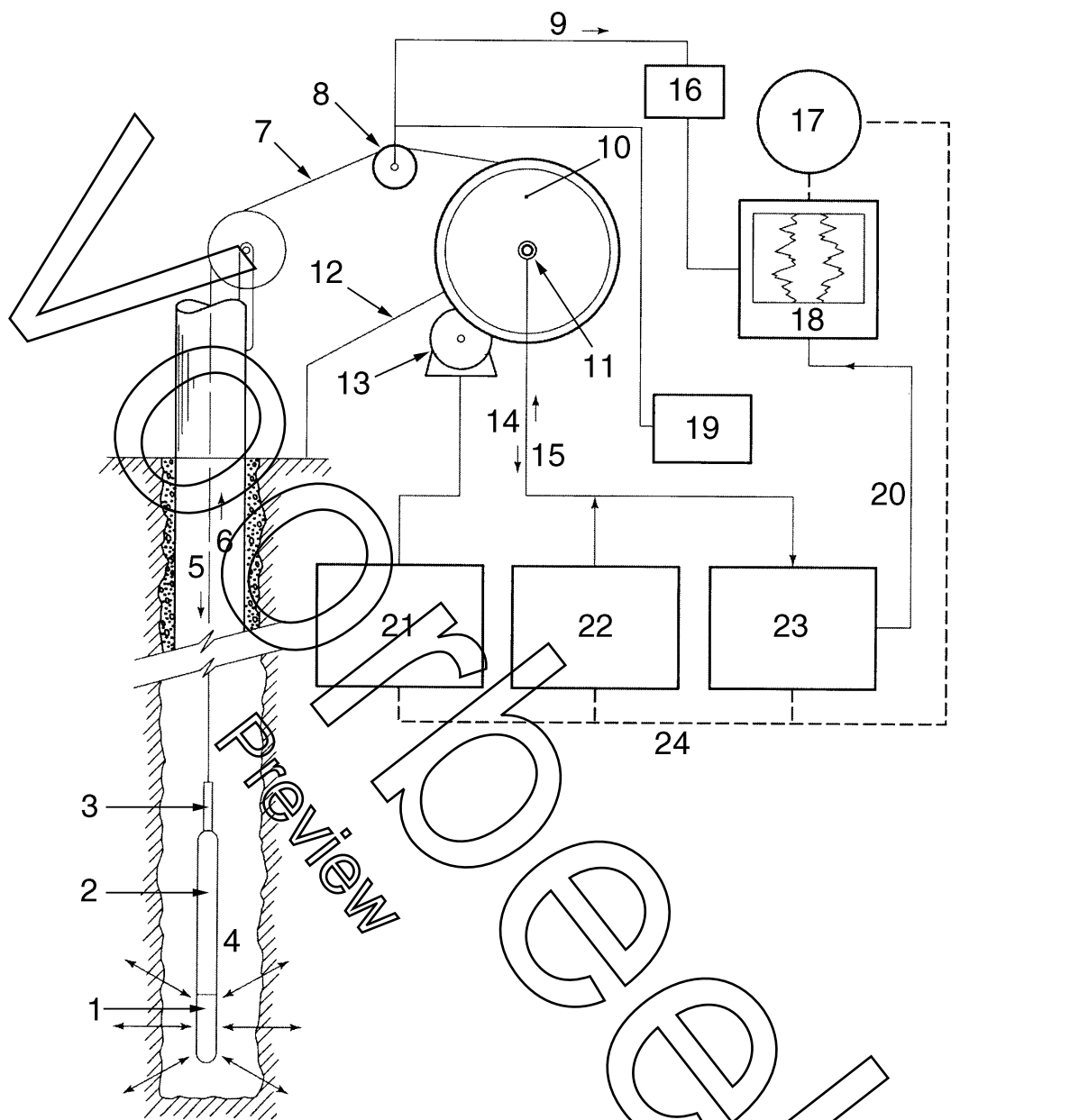
The various sondes contain sensors to enable specific properties to be measured. Output from the sondes is in the form of electronic signals, either analogue or digital. These signals are transmitted to the surface instruments via the cable and winch.

The cable serves the dual purpose of supporting the sonde and conveying electrical power and signals to and from the sonde. To this end it has a double outer layer of high tensile steel or polyurethane/kevlar.

The winch serves to raise or lower the sonde and to measure its precise depth. This is achieved by passing the cable round a measuring sheave of known diameter linked to an accurate depth measuring system.

The surface instrumentation typically consists of two sections to provide power and process the electronic signals from each of the sondes for recording purposes.

Data recorder units are either analogue or digital, comprising pen and ink recorders, film, a dedicated computer, encoding the signal data from the sonde or surface modules, formatting them and storing them on magnetic tape or disk, and driving the plotter to produce filed logs.



Key

- | | | |
|--------------------------|------------------------------|---|
| 1 Sensor | 9 Recorder drive | 17 ac power source (regulated) |
| 2 Electronic section | 10 Winch | 18 Recorder |
| 3 Cable head | 11 Slip ring | 19 Depth indicator |
| 4 Sonde | 12 Ground (electric logging) | 20 Varying dc voltage (mV) for driving recorder pens |
| 5 Power (down) | 13 Motor | 21 Logging speed and direction |
| 6 Signal (up) | 14 Signal | 22 Downhole power (not universal) |
| 7 Logging cable | 15 Power | 23 Signal conditioning; zero positioning; sensitivity; time constant etc. |
| 8 Cable-measuring sheave | 16 Vertical scale control | 24 Logging controls |

NOTE Taken from reference [14].

Figure 1 — Schematic of a basic geophysical logging system

Hydrometric determinations — Geophysical logging of boreholes for hydrogeological purposes — Considerations and guidelines for making measurements

1 Scope

This Technical Report is a summary of best practice for those involved in geophysical borehole logging for hydrogeological purposes. It describes the factors that need to be considered and the measurements that are required to be made when logging boreholes. There can, however, be no definite “standard” logging procedure because of great diversity of objectives, groundwater conditions and available technology. Geophysical logging of boreholes is an evolving science, continually adopting new and different techniques. Every application poses a range of problems and is likely to require a particular set of logs to gain maximum information. This Technical Report therefore provides information on field practice with the objective of how variations in measured parameters may be useful to take account of particular local conditions. It deals with the usual types of logging carried out for delineation of aquifer boundaries; mapping aquifer geometry; assessing the chemical quality and quantity of ground water; water-supply purposes; landfill investigations and contamination studies; borehole construction and conditions; and subsurface lithological information.

Applications not specifically considered in this Technical Report include mineral and hydrocarbon evaluation and geotechnical and structural engineering investigations. However, this Technical Report may be a source of general information for any borehole geophysical logging effort.

NOTE Interpretation of the data collected during logging is referred to in this Technical Report only in a general way. For full details of the analysis and interpretation of geophysical logs, reference should be made to specialized texts. Examples of such texts are included in the Bibliography.

2 Terms and definitions

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

2.1

abstraction

removal of water from a borehole or well

2.2

access tube

dip tube

pipe inserted into a well to permit safe installation of instruments, thus safeguarding them from touching or becoming entangled with the pump or other equipment in the well

2.3

air lifting

method of producing a discharge of water from a borehole by the injection of compressed air

2.4

aquifer

lithological unit, group of lithological units, or part of a lithological unit containing sufficient saturated permeable material to yield significant quantities of water to wells, boreholes, or springs

2.5

aquifer properties

properties of an aquifer that determine its hydraulic behaviour and its response to abstraction

2.6

argillaceous

containing clay minerals

2.7

bed resolution

minimum bed thickness that can be resolved

2.8

bonding

seal between a borehole lining and the geological formation

2.9

cable boom

rigid support from which the geophysical sonde and cable are suspended

2.10

calibration tail

section of field log carrying information on sonde calibration

2.11

casing

tubular retaining structure, which is installed in a drilled borehole or excavated well, to maintain the borehole opening

NOTE

Plain casing prevents the entry of water.

2.12

casing string

set of lengths of casing assembled for lowering into a borehole

2.13

composite log

several well logs of the same or similar types suitable for correlation, spliced together to form a single continuous record

2.14

core

section of geological formation obtained from a borehole by drilling

2.15

curve matching

comparison of individual borehole data in graphical form with standard or control data

2.16

drawdown

reduction in static head within the aquifer resulting from abstraction

2.17

drilling circulation

movement of drilling fluid (air foam or liquid) used to clear the borehole during drilling

2.18**filter pack**

granular material introduced into a borehole between the aquifer and a screen or perforated lining to prevent or control the movement of particles from the aquifer into the borehole

2.19**fishing tool**

grappling equipment used to locate and recover items from within a borehole

2.20**flushed zone**

zone at a relatively short radial distance from the borehole immediately behind the mudcake where all of the pore spaces are filled with borehole fluid

2.21**fluid column**

that part of a borehole filled with fluid

2.22**formation**

geological unit or series of units

2.23**geophysical log**

continuous record of a physical or chemical property plotted against depth or time

2.24**grain size**

principal dimension of the basic particle making up an aquifer or lithological unit

2.25**grout**

cement and water mixture

2.26**header information**

description of type of data required for inclusion in a table or as input to a computer program

2.27**invaded zone**

portion of formation surrounding a borehole into which drilling fluid has partially penetrated

2.28**jig**

calibrating device for logging sondes

2.29**leachate**

liquid that has percolated through solid wastes

2.30**lining**

tube or wall used to support the sides of a well and sometimes to prevent the entry of water

2.31**lithology**

physical character and mineralogical composition that gives rise to the appearance and properties of a rock or sediment

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