
**Geotechnical investigation and
testing — Geotechnical monitoring by
field instrumentation —**

**Part 4:
Measurement of pore water pressure:
Piezometers**

*Reconnaissance et essais géotechniques — Surveillance géotechnique
par instrumentation in situ —*

Partie 4: Mesure de la pression interstitielle: Piézomètres

ISO 18674-4:2020

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 182, *Geotechnics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical Investigation and Testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 18674 series can be found on the ISO website.

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

Geotechnical investigation and testing — Geotechnical monitoring by field instrumentation —

Part 4: Measurement of pore water pressure: Piezometers

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document specifies the measurement of pore water pressures and piezometric levels in saturated ground by means of piezometers installed for geotechnical monitoring. General rules of performance monitoring of the ground, of structures interacting with the ground, of geotechnical fills and of geotechnical works are presented in ISO 18674-1.

If applied in conjunction with ISO 18674-5, the procedures described in this document allow the determination of effective stresses acting in the ground.

This document is applicable to:

- monitoring of water pressures acting on and in geotechnical structures (e.g. quay walls, dikes, excavation walls, foundations, dams, tunnels, slopes, embankments, etc.);
- monitoring of consolidation processes of soil and fill (e.g. beneath foundations and in embankments);
- evaluating stability and serviceability of geotechnical structures;
- checking geotechnical designs in connection with the Observational Design procedure.

NOTE This document fulfils the requirements for the performance monitoring of the ground, of structures interacting with the ground and of geotechnical works by the means of piezometers, installed as part of the geotechnical investigation and testing in accordance with References [4] and [5]. This document relates to measuring devices, which are installed in the ground. For pore water pressure measurements carried out in connection with cone penetration tests, see ISO 22476-1.

2 Normative references

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

ISO 18674-1:2015, *Geotechnical investigation and testing — Geotechnical monitoring by field instrumentation — Part 1: General rules*

ISO 22475-1, *Geotechnical investigation and testing — Sampling by drilling and excavation methods and groundwater measurements — Part 1: Technical principles for execution*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18674-1 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

piezometer

field instrument system for measuring *pore water pressure* (3.2) or *piezometric level* (3.4) where the *measuring point* (3.15) is confined within the ground or geotechnical fill so that the measurement responds to the fluid pressure around the measuring zone/point and not to fluid pressures at other elevations

Note 1 to entry: The system consists of a sealed *reservoir* (3.1.2) filled with fluid, a *filter* (3.1.3) and a *measuring device* (3.1.7).

Note 2 to entry: The system is either an *open piezometer system* (3.6) or a *closed piezometer system* (3.7).

3.1.1

intake zone

zone confined by *seals* (3.1.6), between which water in the ground can flow to the measuring device, thus defining the *measuring point* (3.15)

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: It is assumed that a hydrostatic *pore water pressure* (3.2) distribution is established along the intake zone.

Note 3 to entry: The constant of proportionality between flow into or out of a *piezometer* (3.1) and the change of pore water pressure is called the intake factor *F*.

3.1.2

reservoir

space between the ground and the *measuring device* (3.1.7), occupied by a fluid, which allows the *pore water pressure* (3.2) to act on the sensing element of the measuring device

Note 1 to entry: The pores within the *filter* (3.1.3) are an integral part of the reservoir.

Note 2 to entry: In *open piezometer systems* (3.6), the water-filled part of the standpipe is part of the reservoir.

3.1.3

filter

permeable section of a *piezometer* (3.1) defining the *intake zone* (3.1.1), which allows water to enter and at the same time restricts soil particles entering the standpipe or *measuring device* (3.1.7)

Note 1 to entry: The filter can be a combination of elements, such as a sand pocket, a perforated pipe, a geotextile sleeve, a filter tip (3.1.4) and grout backfill in specific cases.

3.1.4

filter tip

filter (3.1.3) element which is a common part of a *closed piezometer system* (3.7)

Note 1 to entry: Filter tips are formed of a material with purpose-designed pore diameters, i.e. *HAE filter* (3.1.4.1) or *LAE filter* (3.1.4.2).

3.1.4.1

high air entry filter

HAE filter

filter tip (3.1.4) with comparatively small pores giving a higher resistance to the passage of air than to the passage of water

Note 1 to entry: Commonly, high air entry filter tips have pore diameters of between 1 µm and 3 µm.

Note 2 to entry: HAE filter tips are used when it is intended to keep gas out of the *measuring device* (3.1.7).

Note 3 to entry: In unsaturated soil or when negative *pore water pressures* (3.2) are to be measured (i.e. suction; see Annex F), the pressure of the gaseous phase is always higher than that of the pore water. The required pore diameter of the HAE filter tip depends on the difference between the pore air pressure and the pore water pressure.

3.1.4.2 low air entry filter LAE filter

filter tip (3.1.4) with comparatively large pores giving a lower resistance to the passage of air readily allowing the passage of both air and water

Note 1 to entry: Commonly, low air entry filter tips have pore diameters of between 20 µm and 50 µm.

3.1.5 filter pack

permeable material, placed around a slotted section of an open *piezometer* (3.1) or around the *filter tip* (3.1.4), allowing water to reach the *measuring device* (3.1.7)

3.1.6 seal

layer in a borehole, made with a material that has a permeability suitable for hydraulical separation of two *aquifers* (3.10)

Note 1 to entry: Seals are generally used to confine an *intake zone* (3.1.1).

3.1.7 measuring device

part of the *piezometer* (3.1) system used to measure the *piezometric level* (3.4) in an *open system* (3.6) or the *pore water pressure* (3.2) in a *closed system* (3.7)

Note 1 to entry: For an *open piezometer system* (3.6), the measuring device is commonly a *water level meter* (3.1.7.1) for manual measurements or a pressure transducer for automatic measurements.

Note 2 to entry: For a *closed piezometer system* (3.7), the measuring device is typically a diaphragm pressure transducer (see 7b in Figure 1 b)). The diaphragm separates a *reservoir* (3.1.2) and an inner chamber in the transducer. The deflection of the diaphragm is a function of the *pore water pressure* (3.2) (see Figure 3).

Note 3 to entry: For closed piezometer systems, the measuring device is often synonymously termed a piezometer in a narrow sense.

3.1.7.1 water level meter

measuring device with a marked length measuring tape and a tip that activates a signal (light, sound) when it comes into contact with water

Note 1 to entry: A water level meter is commonly used for manual measurements in *open systems* (3.6) or during the installation procedure of *piezometers* (3.1).

3.1.7.2 electric piezometer

piezometer (3.1) where the *measuring device* (3.1.7) has a diaphragm and the deflection of the diaphragm due to *pore water pressure* (3.2) is measured by an electric sensor

Note 1 to entry: Electric piezometers are commonly based on strain gauge, piezo-electric, vibrating wire or capacitive sensors. Data acquisition devices exist which accommodate all types of electric piezometers.

Note 2 to entry: See Figure 3.