
**Geotechnical investigation and
testing — Geothermal testing
— Determination of thermal
conductivity of soil and rock using a
borehole heat exchanger**

*Reconnaissance et essais géotechniques — Essais géothermiques —
Détermination de la conductivité thermique des sols et des roches
dans les sondes géothermiques*



This document is a preview generated by EMS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviations	3
5 Installation of borehole heat exchangers	4
5.1 Drilling rigs and ancillary equipment	4
5.1.1 General	4
5.1.2 Requirements for the drilling rigs and equipment	4
5.2 Borehole heat exchangers, filling, and annular space filling materials	5
5.2.1 Borehole heat exchanger material	5
5.2.2 Heat transfer fluid of the borehole heat exchanger tubes	5
5.2.3 Annular space filling material	5
5.3 General requirements prior to installation	6
5.3.1 Requirements on the drilling and installation site	6
5.3.2 Selection of drilling techniques and installation methods	6
5.3.3 Preliminary information needed before starting drilling and installation	6
5.3.4 Environmental requirements	7
5.3.5 Safety requirements	7
5.4 Execution	7
5.4.1 Drilling	7
5.4.2 Installation of borehole heat exchangers	8
5.4.3 Annular space filling	8
5.4.4 Functional testing	9
5.4.5 Site reinstatement	12
6 Geothermal response testing	12
6.1 General	12
6.2 Test equipment	13
6.3 Test procedure	13
6.4 Test results	15
6.5 Evaluation of the test results	15
7 Report	16
7.1 Field report	16
7.1.1 Record of the installation of the heat exchanger tubes	17
7.1.2 Annular space filling record	17
7.1.3 Checking record	18
7.1.4 Record of measured values and test results	18
7.1.5 Record of evaluated test results	18
7.2 Report of the results	18
Annex A (informative) Example of a form for the preliminary information on the intended installation of heat exchanger	20
Annex B (informative) Field reports	22
Annex C (informative) Example of the graphical presentation of the installed borehole heat exchanger and the geology along the borehole	27
Bibliography	28

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

ISO 17628 was prepared by European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical investigation and testing*, in collaboration with ISO Technical Committee ISO/TC 182, *Geotechnics*, Subcommittee SC 1, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Geotechnical investigation and testing — Geothermal testing — Determination of thermal conductivity of soil and rock using a borehole heat exchanger

1 Scope

This International Standard specifies requirements for the Geothermal Response Test (GRT). This test comprises the *in situ* determination of the thermal conductivity in saturated and unsaturated soil and rock in a heat exchanger installed in a borehole. For this test, liquid heat transfer media not subjected to phase changes are used.

The thermal conductivity is an important parameter used in the design of thermal storage and thermal exchange systems.

A Geothermal Response Test measures the temperature response to a thermal energy forcing of a borehole heat exchanger (BHE) or the extraction of thermal energy from a borehole. The temperature response is related to the thermal parameters of the ground and borehole filling material, such as thermal conductivity and borehole resistivity, and is therefore used to obtain estimated or derived values of these parameters.

This International Standard applies to heat exchangers installed in vertical or inclined boreholes with length up to e.g. 400 m and with a diameter of up to 200 mm.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14688-1, *Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description*

ISO 14689-1, *Geotechnical investigation and testing — Identification and classification of rock — Part 1: Identification and description*

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

EN 16228-1, *Drilling and foundation equipment - Safety - Part 1: Common requirements*

EN 16228-2, *Drilling and foundation equipment - Safety - Part 2: Mobile drill rigs for civil and geotechnical engineering, quarrying and mining*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22475-1 and the following apply.

3.1

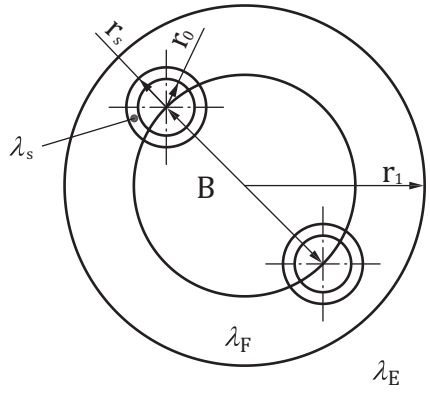
borehole heat exchanger

BHE

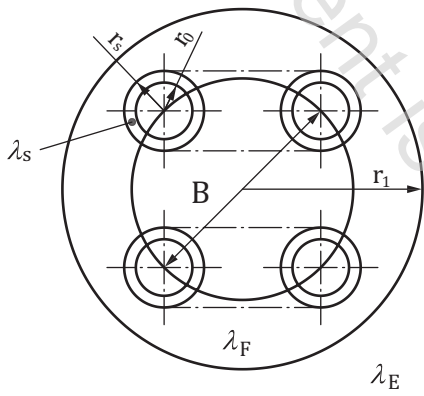
one or two U-tubes or one coaxial tube in a borehole through which the exchanger fluid circulates

Note 1 to entry: See [Figure 1](#) and [Figure 2](#).

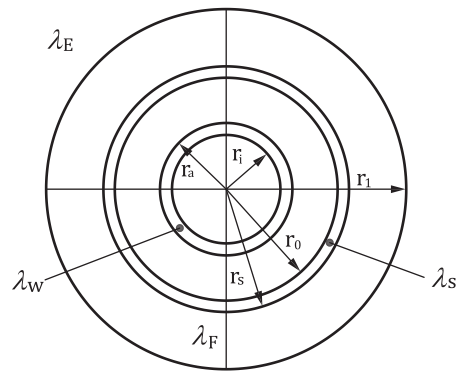
This document is a preview generated by EVS



a) single U-tube



b) double U-tube



c) coaxial tube

Key

r_1 borehole radius

r_i inner radius

r_a outer radius

r_o inner radius of the outer tube

r_s outer radius of the outer tube

λ_F thermal conductivity of the annular space filling

λ_w thermal conductivity of the inner borehole tube

λ_s thermal conductivity of the outer borehole tube

λ_E thermal conductivity of the ground

B tube spacing

Figure 1 — Cross-section of examples of borehole heat exchanger tubes