

---

---

**Geotechnical investigation and  
testing — Field testing —**

**Part 4:  
Prebored pressuremeter test by  
Ménard procedure**

*Reconnaissance et essais géotechniques — Essais en place —*

*Partie 4: Essai pressiométrique dans un forage préalable selon la  
procédure Ménard*





## **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>v</b>
<b>Introduction</b>	<b>vi</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms, definitions and symbols</b>	<b>1</b>
3.1 Terms and definitions	1
3.2 Symbols	3
<b>4 Equipment</b>	<b>6</b>
4.1 General description	6
4.2 Pressuremeter probe	6
4.2.1 General	6
4.2.2 Probe with flexible cover	8
4.2.3 Probe with flexible cover and an additional more rigid protection	8
4.2.4 Probe with flexible cover and slotted tube	9
4.3 Connecting lines and injected fluid	10
4.4 Pressure and volume control unit	11
4.4.1 General	11
4.4.2 Measurement and control	11
4.4.3 Data logger	12
<b>5 Test procedure</b>	<b>12</b>
5.1 Assembling the parts	12
5.2 Calibration and corrections	13
5.3 Pressuremeter test pocket and probe placing	13
5.4 Preparation for testing	13
5.5 Establishing the loading programme	14
5.6 Establishing the pressure of the guard cells for tri-cell probes	15
5.7 Expansion	15
5.7.1 General	15
5.7.2 Readings and recordings	15
5.7.3 End of test	16
5.8 Back-filling of the pockets	16
5.9 Safety requirements	16
<b>6 Test results</b>	<b>16</b>
6.1 Data sheet and field print-out or display	16
6.1.1 Data sheet for type A control unit	16
6.1.2 Site print-out for type B and C control units	17
6.1.3 Raw pressuremeter curve	17
6.2 Corrected pressuremeter curve	17
6.3 Calculated results	18
<b>7 Reporting</b>	<b>19</b>
7.1 General	19
7.2 Field report	19
7.3 Test report	19
7.3.1 General	19
7.3.2 Ménard pressuremeter test report	19
7.3.3 Pressuremeter tests log	20
<b>Annex A (normative) Geometrical features of pressuremeter probes</b>	<b>22</b>
<b>Annex B (normative) Calibration and corrections</b>	<b>24</b>
<b>Annex C (normative) Placing the pressuremeter probe in the ground</b>	<b>33</b>
<b>Annex D (normative) Obtaining pressuremeter parameters</b>	<b>41</b>

<b>Annex E (normative) Uncertainties</b> .....	<b>51</b>
<b>Annex F (informative) Pressuremeter test records</b> .....	<b>53</b>
<b>Bibliography</b> .....	<b>60</b>

## 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](http://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](http://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 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](http://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).

This second edition cancels and replaces the first edition (ISO 22476-4:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

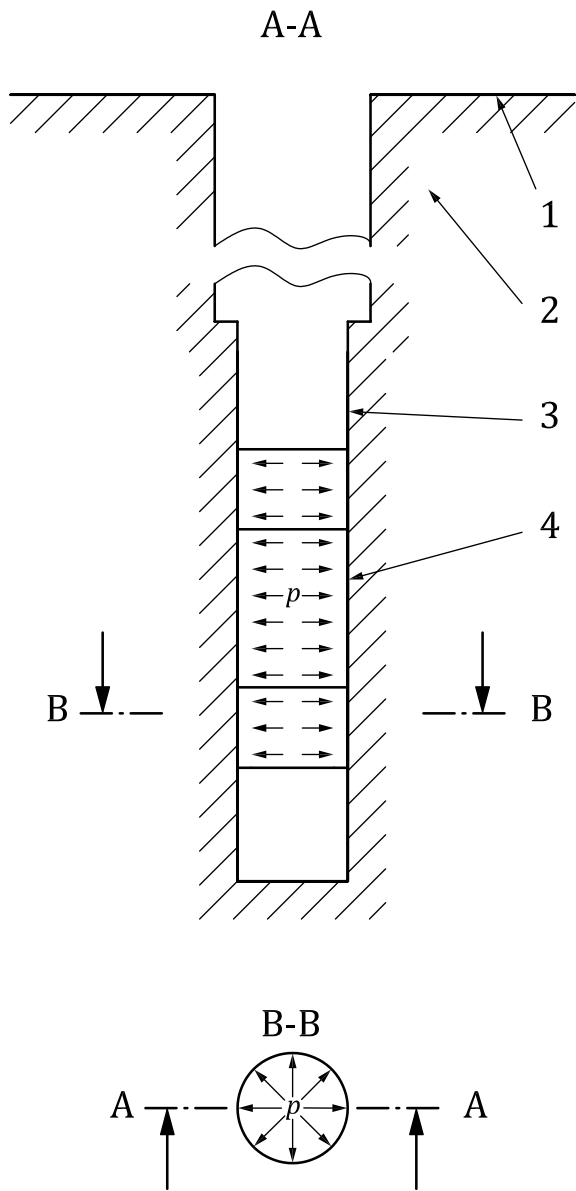
- types of probes;
- correction procedures;
- probe placing techniques in [Annex C](#);
- clarification of D;
- harmonization of terms and symbols.

A list of all parts in the ISO 22476 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](http://www.iso.org/members.html).

Introduction

The Ménard pressuremeter test is performed by the radial expansion of a cylindrical probe of a minimum slenderness of 6, placed in the ground (see [Figure 1](#)). During the injection of the fluid volume in the probe, the inflation of the measuring cell first brings the outer cover of the probe into contact with the pocket wall and then producing ground displacement. Pressure applied to and the associated radial expansion of the probe are measured either by volume or radial transducers and recorded so as to obtain the stress-strain relationship of ground as tested.



- Key**

  - 1 ground surface
  - 2 ground
  - 3 pressuremeter test pocket
  - 4 expanding pressuremeter probe
- $p$  applied pressure
  - A-A axial section
  - B-B cross section

Figure 1 — Principle of a Ménard pressuremeter test

Together with results of investigations with ISO 22475-1 being available or at least with identification and description of the ground according to ISO 14688-1 and ISO 14689 obtained during the pressuremeter

test operations, the tests are performed in order to obtain the quantitative determination of a ground profile, including

- the Ménard pressuremeter modulus  $E_M$ ,
- the Ménard pressuremeter limit pressure  $p_{LM}$ , and
- the Ménard creep pressure  $p_f$ .

NOTE 1 This document fulfils the requirement for the Ménard pressuremeter test, as part of geotechnical investigation and testing according to EN 1997-1 and EN 1997-2.

NOTE 2 This document refers to a probe historically described as the “60 mm (also called BX) G type probe”, that corresponds to a 58 mm diameter probe with a drilling diameter between 60 mm and 66 mm with a pressure limitation of 5 MPa. If specified by the relevant authority or agreed for a specific project by the relevant parties, a different pressure, not higher than 8 MPa, can be set.

NOTE 3 G type probe refers to probes with an external cover creating guard cells (see 4.2).

NOTE 4 Ménard pressuremeter tests can be carried out with other diameter probes such as 32 mm, 44 mm and 76 mm probes.

NOTE 5 Examples of other probe and pocket drilling dimensions are indicated in Table 1.

**Table 1 — Probe and pocket drilling dimensions**

Probe Designation	Probe Diameter mm	Drilling diameter (mm)	
		Min	Max
AX	44	46	52
NX	70/74	74	80

NOTE 6 Tests with maximum pressures higher than 8 MPa are dealt by ISO 22476-5.

NOTE 7 For the scope of this document (and the associated measuring device and maximum uncertainties given in Table E.1),  $E_M$  values up to 500 MPa (that can be determined by calculation) can be commonly obtained. Enhancement of equipment to reduce uncertainties can be implemented to increase the range of measurements. For example, use of GA type equipment and of a shunt for volume measurement can allow measuring  $E_M$  values up to 10 000 MPa. Uncertainty calculation can be used to confirm the relevance of these pressuremeter moduli.