
**Geotextiles and geotextile-related
products — Determination of index
abrasion resistance characteristics
under wet conditions for hydraulic
applications**

*Géotextiles et produits apparentés — Détermination des
caractéristiques de résistance à l'abrasion d'indice dans des
conditions humides pour les applications hydrauliques*



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

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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).

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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 221, *Geosynthetics*.

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.

Introduction

The abrasion resistance under wet conditions is an important property for the application of geotextiles intended to be used as geobags (geotextile bags filled with soil) or filter beneath armourstone. The abrasion impact on geotextiles can be achieved under wet conditions by installing geotextile samples in a rotating drum. In the fixed rotating drum test facility, the drum is rotated with a defined speed and is filled with water and a mixture of angular-grained high-quality basalt chippings with determined sizes. The abrasion impact is caused by crushed stones tumbling over the geotextile. The assessment of the geotextile abrasion resistance characteristics can be achieved by comparing thickness and mechanical properties (tensile strength, elongation) and/or additional hydraulic properties (characteristic opening size, filtration behaviour) before and after abrasion impact.

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Geotextiles and geotextile-related products — Determination of index abrasion resistance characteristics under wet conditions for hydraulic applications

1 Scope

This document specifies a test method for determining the abrasion resistance of geotextiles and geotextile-related products under wet conditions. This document is applicable to geotextiles and geotextile-related products intended to be used as e.g. geo bags or filter beneath armourstone.

The test method simulates abrasion impacts on geotextiles and geotextile-related products such as that caused by the movement of rocks in an embankment or transport of sediment in rivers.

This document provides an index test which can be used for performance and acceptance testing. It can be used as performance test by comparison of mechanical and/or additional hydraulic properties before and after abrasion impact.

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 9073-3, *Textiles — Test methods for nonwovens — Part 3: Determination of tensile strength and elongation*

ISO 9862, *Geosynthetics — Sampling and preparation of test specimens*

ISO 9864, *Geosynthetics — Test method for the determination of mass per unit area of geotextiles and geotextile-related products*

ISO 10318-1, *Geosynthetics — Part 1: Terms and definitions*

ISO 10772, *Geotextiles — Test method for the determination of the filtration behaviour of geotextiles under turbulent water flow conditions*

ISO 11058, *Geotextiles and geotextile-related products — Determination of water permeability characteristics normal to the plane, without load*

ISO 12956, *Geotextiles and geotextile-related products — Determination of the characteristic opening size*

EN 1097-1, *Tests for mechanical and physical properties of aggregates — Part 1: Determination of the resistance to wear (micro-Deval)*

EN 1097-6, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10318-1 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
abrasion resistance ratio

R_A
ratio of the mechanical and/or additional hydraulic properties before and after abrasion impact

3.2
index test
test method which can be used for performance and acceptance testing

Note 1 to entry: It can be used as performance test by comparison of mechanical and/or additional hydraulic properties before and after abrasion impact.

3.3
abrasive material
defined mixture of stone chippings which includes crushed basalt aggregates

4 Principle

The test method simulates abrasion impacts on geotextiles such as that caused by the movement of rocks in an embankment. Abrasive materials and water pass over geotextile specimens installed in a rotating drum for two abrasion phases of 40 000 revolutions each, and thereby the direction of rotation is changed every 5 000 revolutions. The abrasion resistance can be assessed by comparing tensile strength and/or additional hydraulic properties before and after abrasion impact.

NOTE The test principle is also used for the assessment of the abrasion resistance of concrete^[1] and coating systems^[2].

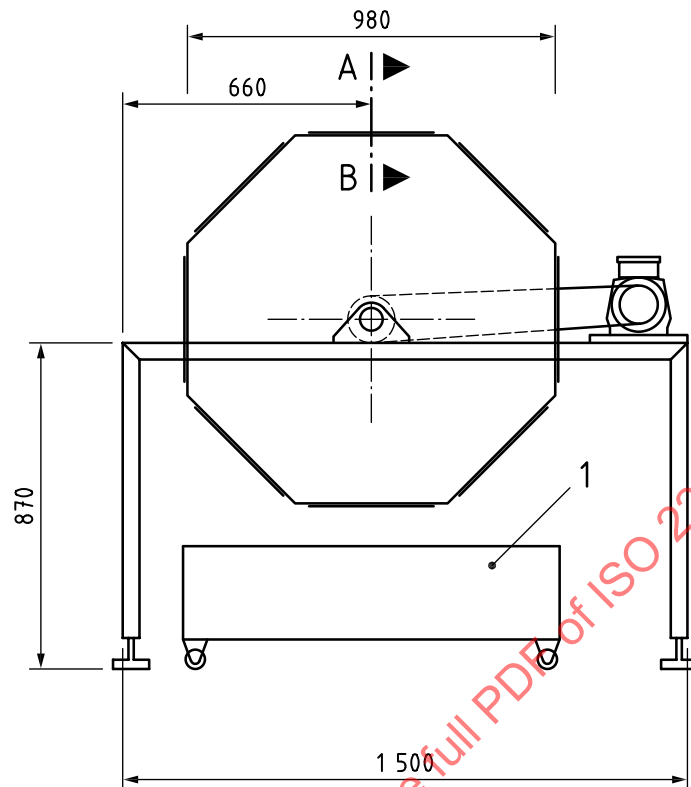
5 Apparatus and materials

5.1 Abrasion drum test machine.

The test apparatus shall comprise an octagonal steel drum with eight test sections driven by a horizontal shaft, an adjustable drive motor, an electronic control system and a test frame. It shall be possible to change the direction of rotation and it shall be possible to set the number of revolutions per minute and the total number of revolutions as required.

NOTE A typical abrasion drum test machine is shown in [Figures 1](#) and [2](#).

Dimensions in millimetres



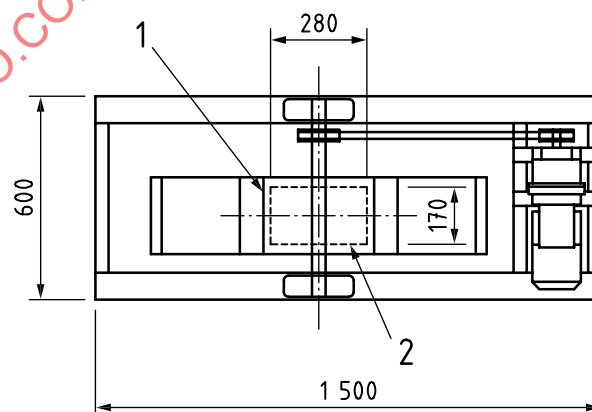
Key

- 1 moveable collection container

Figure 1 — Lateral view of the abrasion drum test machine

NOTE For cross section A-B, see [Figure 3](#).

Dimensions in millimetres



Key

- 1 geotextile specimen 300 mm × 200 mm
2 test area 280 mm × 170 mm

Figure 2 — Top view of the abrasion drum test machine

5.2 Abrasive material.

The composition of the abrasive material shall be as follows:

- 2 kg of 8/11 mm crushed basalt aggregates;
- 1 kg of 5/8 mm crushed basalt aggregates;
- 1 kg of 2/5 mm crushed basalt aggregates;
- 8 l of water.

The particle density of the basalt chippings, determined in accordance with EN 1097-6, shall be $(3,0 \pm 0,2) \text{ Mg/m}^3$.

The water absorption, WA_{24} , of the basalt chippings, determined in accordance with EN 1097-6, shall be $\leq 2 \%$.

The Micro-Deval coefficient, M_{DE} , of the basalt chippings, determined in accordance with EN 1097-1, shall be ≤ 15 and ≥ 10 .

5.3 Water.

The water shall be at a temperature between 18 °C and 22 °C, which should preferably be at or above the ambient temperature of the test laboratory.

5.4 Stopwatch.

For measuring time to an accuracy of 0,1 s.

5.5 Thermometer.

To determine the water temperature to an accuracy of 1 °C.

6 Test specimens

6.1 Handling

The sample shall not be folded and shall be handled as little as possible to avoid disturbance to its structure.

6.2 Sampling

If the weakest direction is not known, a tensile test in accordance with ISO 9073-3 shall be carried out to find out the weakest direction of either machine direction or cross-machine direction. Take specimens from the sample in accordance with ISO 9862. The full area of the sample shall be considered.

6.3 Number and dimensions

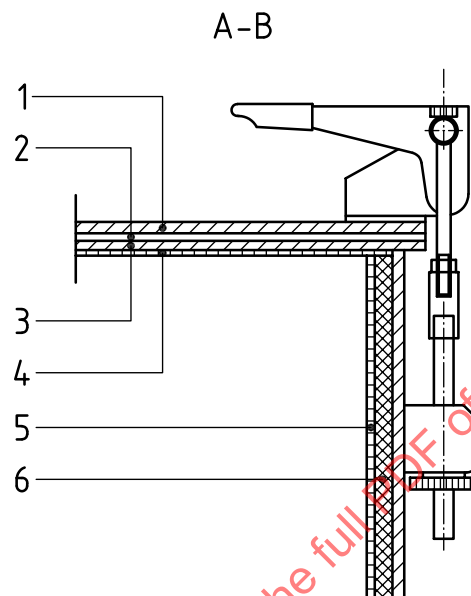
For one abrasion test run, eight specimens and eight control specimens, each measuring 200 mm × 300 mm, shall be cut out of the sample in the direction of the weaker tensile force (length 300 mm). The specimens shall be clean, free from surface deposits and without visible damage or folding marks.

6.4 Conditioning

The specimens shall be stored under water at a temperature of $(20 \pm 5) \text{ °C}$ for a minimum of 24 h prior to the test.

7 Test procedure

The specimens shall be fastened onto steel plates for the test and installed in the abrasion sections of the test apparatus as shown in [Figure 3](#). The upper surface foreseen for the on-site installation (installation surface) of the geotextile shall be exposed to the abrasion impacts. The test comprises two abrasion phases of 40 000 revolutions each. The drum rotating speed shall be set at 16 r/min and the direction of rotation shall be reversed every 5 000 revolutions.



Key

- 1 steel plate
- 2 rubber seal
- 3 steel plate
- 4 geotextile specimen
- 5 abrasion protection plate, rust proof steel, 3 mm thick
- 6 thermoplastic, 8 mm thick

Figure 3 — Installation of the geotextile specimen (cross section A-B from [Figure 1](#))

Examine the specimens visually after the first 40 000 revolutions. The abrasion mixture shall be renewed for the second phase of the first abrasion drum run. Before conducting the tests after abrasion impact, the specimens shall be prepared by washing thoroughly with running water and air-drying them till constant mass.

The tensile strength shall be tested in accordance with ISO 9073-3. The mass per unit area shall be tested in accordance with ISO 9864. These tests shall be undertaken on the first abrasion drum run.

A second abrasion drum run shall be done and the characteristic opening size shall be determined in accordance with ISO 12956 after abrasion impact.

A third abrasion drum run shall be done and the filtration behaviour under turbulent water flow conditions shall be determined in accordance with ISO 10772.

A further abrasion drum run shall be done and the water permeability characteristics shall be determined in accordance with ISO 11058.

The entire specimen of 300 mm × 200 mm shall be tested although the exposed area is 280 mm × 170 mm only.

8 Calculation and expression of results

The abrasion resistance R_A of the tested properties shall be obtained as the ratio of the property before and after abrasion impact.

Calculate the abrasion resistance $R_{A,TS}$ (in percentage) by tensile strength using [Formula \(1\)](#):

$$R_{A,TS} = \frac{S_{T1}}{S_{T2}} \times 100 \quad 1$$

where

S_{T1} is the tensile strength in N/m of the weakest direction before abrasion impact;

S_{T2} is the tensile strength in N/m of the weakest direction after abrasion impact.

Calculate the abrasion resistance $R_{A,090}$ (in percentage) by characteristic opening size using [Formula \(2\)](#):

$$R_{A,090} = \frac{O_{901}}{O_{902}} \times 100 \quad 2$$

where

O_{901} is the characteristic opening size in μm before abrasion impact;

O_{902} is the characteristic opening size in μm after abrasion impact.

Calculate the abrasion resistance $R_{A,F}$ (in percentage) by changing soil passing using [Formula \(3\)](#):

$$R_{A,F} = \frac{F_{B1}}{F_{B2}} \times 100 \quad 3$$

where

F_{B1} is the filtration behaviour as soil passing value in g before abrasion impact;

F_{B2} is the filtration behaviour as soil passing value in g after abrasion impact.

Calculate the abrasion resistance $R_{A,WP}$ (in percentage) by changing water permeability using [Formula \(4\)](#):

$$R_{A,WP} = \frac{W_{P1}}{W_{P2}} \times 100 \quad 4$$

where

W_{P1} is the water permeability in m/s before abrasion impact;

W_{P2} is the water permeability in m/s after abrasion impact.

Express the values of the abrasion resistance R_A to the nearest 0,1 %.

9 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 22182:2020;