INTERNATIONAL STANDARD

ISO 9934-2

Second edition
2015-09-01

Non-destructive testing — Magnetic particle testing —

Part 2: Detection media

Essais non destructifs — Magnétoscopie —

Partie 2: Produits indicateurs

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Foreword

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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 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.

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ISO 9934-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive testing*, in collaboration with ISO/TC 135, *Non-destructive testing*, Subcommittee SC 2, *Surface methods*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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This second edition cancels and replaces the first edition (ISO 9934-2:2002), which has been technically revised.

ISO 9934 consists of the following parts under the general title *Non-destructive testing — Magnetic particle testing*:

— *Part 1: General principle*

— *Part 2: Detection media*

— *Part 3: Equipment*

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Non-destructive testing — Magnetic particle testing —

Part 2:
Detection media

1 Scope

This part of ISO 9934 specifies the significant properties of magnetic particle testing products (including magnetic ink, powder, carrier liquid, contrast aid paints) and the methods for checking their properties.

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 2160, *Petroleum products — Corrosiveness to copper — Copper strip test*

ISO 2591-1, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate*

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ISO 3059, *Non-destructive testing — Penetrant testing and magnetic particle testing — Viewing conditions*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

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ISO 4316, *Surface active agents — Determination of pH of aqueous solutions — Potentiometric method*

ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principle*

ISO 9934-3, *Non-destructive testing — Magnetic particle testing — Part 3: Equipment*

ISO 12707, *Non-destructive testing — Terminology — Terms used in magnetic particle testing*

EN 1330-1, *Non-destructive testing — Terminology — Part 1: List of general terms*

EN 1330-2, *Non-destructive testing — Terminology — Part 2: Terms common to the non-destructive testing methods*

EN 1330-7, *Non-destructive testing — Terminology — Part 7: Terms used in magnetic particle testing*

EN 10083-2, *Quenched and tempered steels — Part 2: Technical delivery conditions for non-alloy steels*

EN 10204, *Metallic products — Types of inspection documents*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1330-1, EN 1330-2, EN 1330-7, ISO 12707, and the following apply.

3.1
batch
quantity of material produced during one manufacturing operation having uniform properties throughout and with a unique identifying number or mark

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4 Safety precautions

The materials used in magnetic particle inspection and those used in their testing include chemicals that can be harmful, flammable, and/or volatile. All necessary precautions should be observed. All relevant regulations, including national and local regulations pertaining to health and safety, anti-pollution requirements, etc., shall be observed.

5 Classification

5.1 General

The magnetic particle materials covered by this specification shall be classified as follows.

5.2 Magnetic inks

Magnetic inks shall consist of finely divided coloured or fluorescent magnetic particles in a suitable carrier liquid. They shall form a uniform suspension when agitated.

Magnetic inks can be produced from products supplied as concentrates, including paste and powders, or ready for use.

5.3 Powders

Powders for the dry technique shall consist of finely divided coloured or fluorescent magnetic particles.

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6 Testing and test certificate

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6.1 Type testing and batch testing

Type testing and batch testing of magnetic particle materials shall be carried out in accordance with the requirements of ISO 9934-1, ISO 9934-2, and ISO 9934-3.

Type testing is carried out in order to demonstrate suitability of a product for the intended use. Batch testing is carried out in order to demonstrate conformity of the characteristics of a batch to the product type specified.

The supplier shall provide a test certificate showing compliance with this International Standard having used the methods detailed. This certificate shall include results obtained and tolerances allowed.

If any changes are made to the detection media, then a new type test shall be performed.

6.2 In-service testing

In–service testing is carried out to demonstrate the continued performance of the detection media.

7 Requirements and test methods

7.1 Performance

7.1.1 Type testing and batch testing

Type testing and batch testing shall be carried out according to Annex A using the reference blocks type 1 or type 2 as described in Annex B.

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7.1.2 In-service testing

In-service testing shall be carried out according to Annex A using one of the reference blocks type 1 or type 2 as described in Annex B or a test block which exhibit similar discontinuities to those normally found in components typically processed in the equipment.

7.1.3 Contrast aid paints

Type testing and batch testing shall be carried out according to 7.1.1 after having applied the paint in accordance with the manufacturer instructions and using a type test approved, compatible magnetic ink.

7.2 Colour

The colour of magnetic particles detection media under working conditions shall be stated by the supplier.

The colour of the batch test sample shall not differ from the colour of the type test sample when visually compared.

7.3 Particle size

7.3.1 Method

The method for determination of particle size is dependent on the range of the particle size distribution. For magnetic inks, the particle size distribution can be determined by the Coulter Method [2] or an equivalent method.

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7.3.2 Definition of the particle size

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The range of particle size shall be as follows:

— lower diameter, d_l: no more than 10 % of the particles shall be smaller than d_l;

— average diameter, d_a: 50 % of the particles shall be larger and 50 % by volume smaller than d_a;

— upper diameter, d_u: no more than 10 % by volume of the particles shall be larger than d_u.

d_l, d_a, and d_u shall be reported.

For dry powders, d_l is generally ≥40 µm.

7.4 Temperature resistance

There shall be no degradation of the product after 5 min heating at the maximum temperature specified by the supplier. This shall be verified by repeating the performance test as specified in 7.1.1.

7.5 Fluorescent coefficient and fluorescent stability

To carry out these tests, it is necessary to use a dry sample of the particles.

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7.5.1 Type testing

7.5.1.1 Method

The fluorescent coefficient β in cd/W is defined as given in Formula (1):

$$\beta = L/E_e \quad (1)$$

where

L is the luminance in cd/m^2 of a plane powder surface;

E_e is the level of UV-irradiance in W/m^2 at the surface of the powder.

The arrangement of the apparatus used is shown in Figure 1.

The powder surface shall be evenly irradiated with UV-A at an angle of 45° ± 5°. Luminance shall be measured with a suitable meter with an accuracy of ±10 % or better. It shall measure the luminance from the powder surface and be unaffected by areas outside of the target area. The level of irradiance shall be measured with a meter conforming to ISO 3059 with its UV sensor replacing the powder surface.

The recommended arrangement is using a luminance meter with a 200 cd/m^2 range and a viewing angle (α) of 20° placed 80 mm above the plane powder surface, diameter 40 mm. UV-A lamps are placed so as to give an even irradiance at the powder surface, with E_e between 10 W/m^2 and 15 W/m^2.

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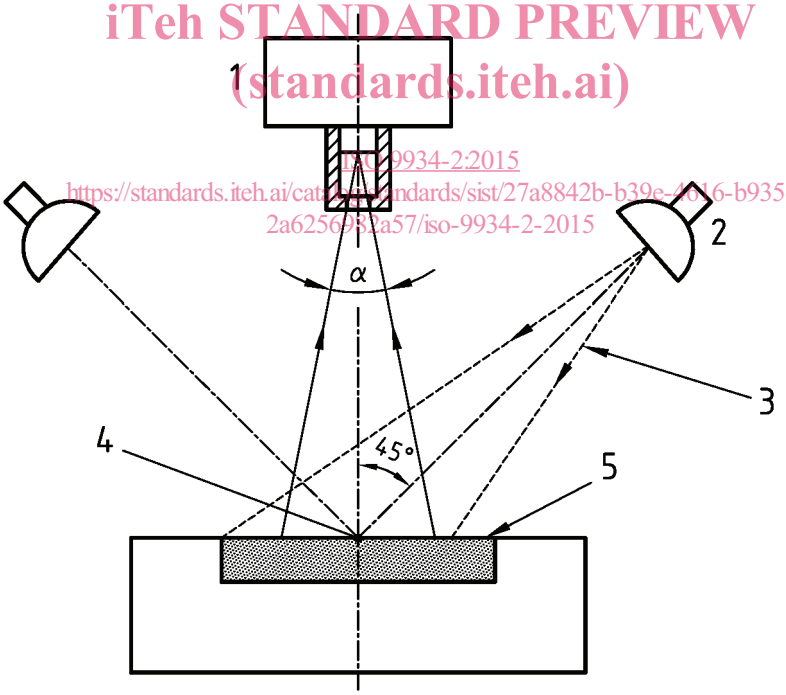

Key

1 measurement of luminance
2 lamp
3 UV-A radiation
4 measurement point of the irradiance
5 powder surface

Figure 1 — Determination of the fluorescent coefficient, β, for magnetic particles

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7.5.1.2 Requirements

The fluorescent coefficient (β) shall be greater than 1,5 cd/W.

7.5.1.3 Fluorescence stability

The sample shall first be tested according to the method described in 7.5.1.1.

The sample shall then be exposed and re-tested as described in 7.5.1.1 after 30 min of exposure to UV-A irradiance of 20 W/m^2 (minimum). The fluorescent coefficient shall not decrease more than 5 %.

7.5.2 Batch testing

Batch testing shall be carried out according to 7.5.1.1. The fluorescent coefficient shall be within 10 % of the type test value.

7.6 Fluorescence of carrier liquid

The fluorescence of the carrier liquid shall be checked by visually comparing with quinine sulfate solution when irradiated with UV-A of at least 10 W/m^2.

The concentration of the quinine sulfate solution shall be 7×10^{-9} M in 0,1 N H_2SO_4.

The carrier liquid under test shall exhibit no more fluorescence than the quinine sulfate solution.

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7.7 Flash point

For magnetic inks, other than water-based, the flash point (open cup method) of the carrier fluid shall be reported.

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7.8 Corrosion induced by detection media

7.8.1 Corrosion testing on steel

The corrosive effect on steel shall be tested and reported according to Annex C.

7.8.2 Corrosion testing of copper

The corrosive effect on copper shall be tested. ISO 2160 can be used for petroleum-based products.

7.9 Viscosity of the carrier liquid

The viscosity shall be tested according to ISO 3104.

The dynamic viscosity shall not be higher than 5 mPa·s at 20 °C ± 2 °C.

7.10 Mechanical stability

7.10.1 Long term test (endurance test)

The manufacturer shall show that the detection media is unaffected by use in a typical magnetic particle testing bench over a period of 120 h.

This can be proven in a magnetic particle testing bench or by using an arrangement to simulate this; a recommended arrangement is as follows.

A 40 l sample of the detection media, contained in a corrosion resistant reservoir fitted with a centrifugal pump is recirculated and the flow interrupted by a valve.

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Technical data:

Type of the sump pump	EN 12157 T 160-270-1
Diameter of the return flow	nominally 25 mm or 1” bore
Cycle time	
— valve opened	5 s
— valve closed	5 s

The detection media is checked with a reference block (see 7.1.1) before use and after 120 h.

Any discernible change in the quality of indications is cause for rejection.

7.10.2 Short-term test

7.10.2.1 Equipment

A stirring arrangement similar to Figure 2 shall be used.

1) Speed of stirring blade: 3 000 +0/-300 r/min.
2) Stirring cup: Capacity 2 l.
3) Reference blocks type 1 and type 2 as detailed in Annex B.
4) UV-A source to give irradiance of 10 W/m^2, to the requirement of ISO 3059.

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7.10.2.2 Procedure

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Stir a sample for 2 h. Compare the indications on reference block Type 1 and Type 2 as is defined in Annex B, produced by the stirred probe and the reference probe.

7.10.2.3 Requirements

Any discernible change in the quality of indications shall be cause for rejection.

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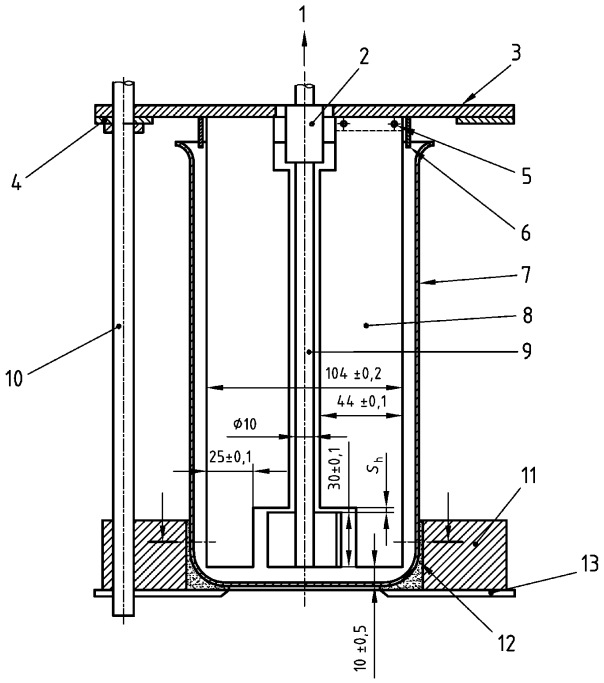
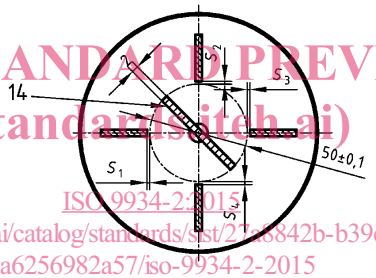
Dimensions in millimetres





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Key

1	motor shaft	8	4 stator plates, 2 mm thick – Height of support ~ 170 mm
2	clutch	9	axle
3	support plate for stator plates	10	support (adjustable)
4	support ring distance setting 10 mm from the bottom	11	pilot ring
5	fixing angle for stator plates	12	non-slip pad
6	spraying plate	13	base plate
7	cup ISO 3819 – HF 2000	14	blade

Gap dimensions:

$S_h = 2 \pm 0,5$

$s_1, \ldots, s_4 = 2 \pm 0,5$

$(s_1 + s_3)/2 = 2 \pm 0,2$

$(s_2 + s_4)/2 = 2 \pm 0,2$

NOTE 1 Tolerances are to be ensured in the 4 blade positions.

NOTE 2 Made from corrosion resistant non-ferromagnetic material.

Figure 2 — Construction of the stirring arrangement to 7.10.2.1

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