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

Reference number
ISO 9934-2:2015(E)

COPYRIGHT PROTECTED DOCUMENT

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

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 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).

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*

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*

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*

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

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.

6 Testing and test certificate

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.

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.

7.3.2 Definition of the particle size

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.

7.5.1 Type testing

7.5.1.1 Method

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

$$\beta = L/E_e \tag{1}$$

where

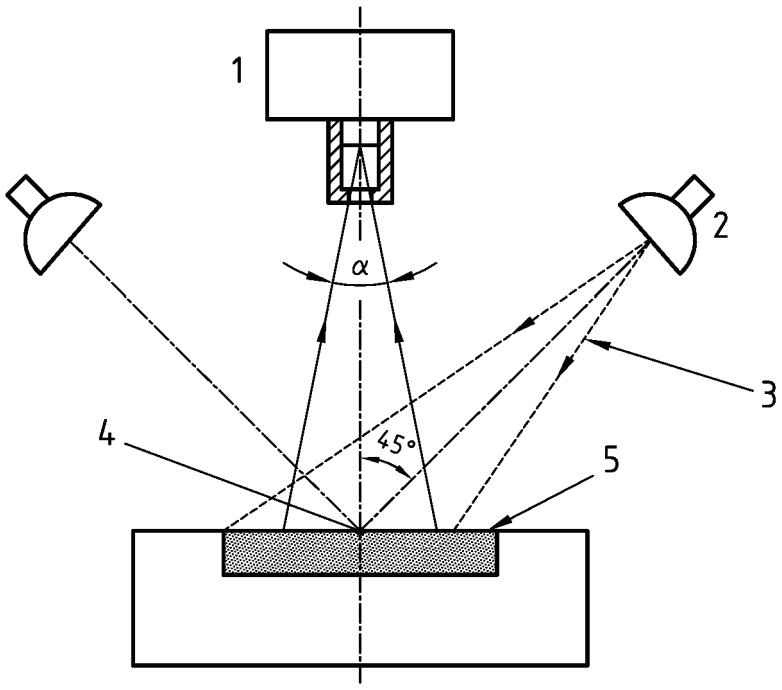
L is the luminance in cd/m^2 of a plane powder surface;

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.



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

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.

7.7 Flash point

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

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.

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.

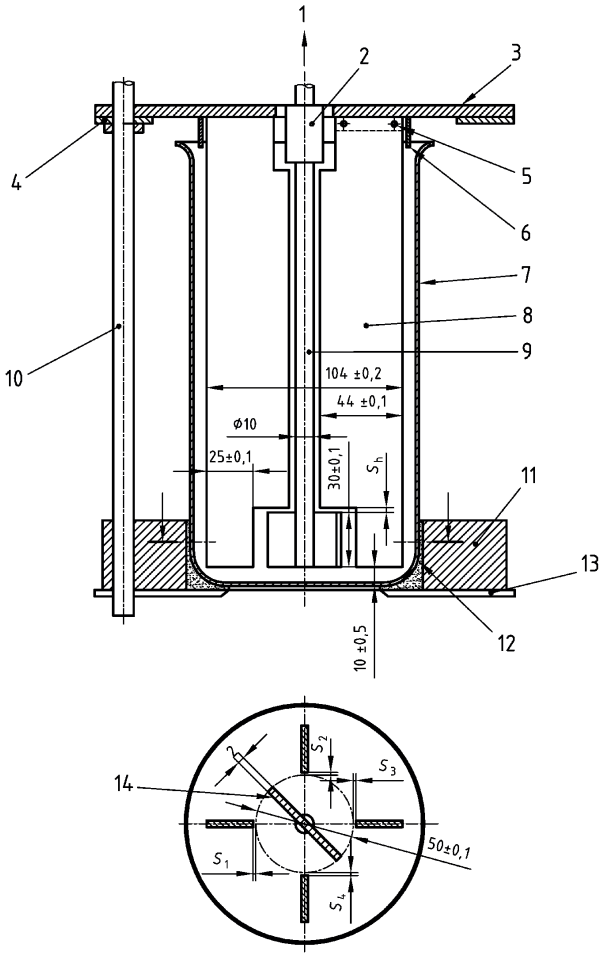
7.10.2.2 Procedure

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.

Dimensions in millimetres



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

7.11 Foaming

Foaming shall be checked during mechanical stability test to 7.10.1 or 7.10.2. Significant foaming shall be cause for rejection.

7.12 pH

The pH of aqueous carrier liquids shall be determined according to ISO 4316. The value shall be reported.

7.13 Storage stability

The expiry date shall be given by the producer and shall be marked on each original container.

7.14 Solids content

The recommended magnetic particle content in g/l of magnetic inks shall be given by the supplier.

7.15 Sulfur and halogen content

For products designated low in sulfur and halogens, the sulfur and halogen content shall be determined by a suitable method which is accurate to ±10 mg/l (10 parts per million) at 200 mg/l (200 parts per million) (of sulfur/halogens.

— Sulfur content shall be less than 200 mg/l (200 parts per million)

— Halogens content shall be less than 200 mg/l (200 parts per million) (halogens shall be taken as chlorine + fluorine)

8 Testing requirements

Testing shall be carried out according to the requirements of Table 1.

Type testing (Q) and batch testing (B) shall be the responsibility of the supplier or manufacturer. In-service testing (P) shall be the responsibility of the user.

Table 1 — Testing requirements

Properties	Contrast aid paints	Dry detection media	Organic carrier liquid	Aqueous suspension ready for use	Organic suspension ready for use	Method	
						Clause	Standard/Remarks
Performance	Q/B	Q/B/P		Q/B/P	Q/B/P	7.1	
Colour	Q/B/P	Q/B/P	Q	Q/B/P	Q/B/P	7.2	by comparison
Particle size		Q/B		Q/B	Q/B	7.3	
Temperature resistance	Q	Q	Q	Q	Q	7.4	
Fluorescence coefficient		Q/B		Q/B	Q/B	7.5	
Fluorescence stability		Q		Q	Q	7.5.1.3	
Flash point	Q/B		Q/B		Q/B	7.7	
Q: type testing B: batch testing P: in-service testing							

Table 1 *(continued)*

Properties	Contrast aid paints	Dry detection media	Organic carrier liquid	Aqueous suspension ready for use	Organic suspension ready for use	Method	
						Clause	Standard/Remarks
Fluorescence of carrier liquid			Q/B	Q/B		7.6	by comparison
Corrosion on steel				Q		7.8.1	
Corrosion on copper				Q	Q	7.8.2	ISO 2160
Viscosity			Q	Q/B	Q/B	7.9	ISO 3104
Mechanical stability:							
Long term test				Q	Q	7.10.1	
Short-term test				Q/B	Q/B	7.10.2	
Foaming			Q	Q/B	Q/B	7.11	
pH (aqueous products)				Q		7.12	ISO 4316
Storage stability	Q	Q/B	Q/B	Q/B	Q/B	7.13	
Sulfur and halogen content	B		B	B	B	7.15	Only for products designated low in sulfur/halogen
Q: type testing B: batch testing P: in-service testing							

9 Test report

As agreed upon at the time of the order, the manufacturer or the supplier of the magnetic particle testing materials shall provide a certificate of compliance according to EN 10204.

Results of all tests required in Table 1 shall be reported.

10 Packaging and labelling

Packaging and labelling shall be in accordance with all applicable national and local regulations. Containers shall be compatible with the detection media. Containers shall be marked with the following information:

— product identification;

— type of detection media;

— batch number;

— date of manufacture;

— expiry date.

Annex A
(normative)

Procedure for type, batch, and in-service testing

A.1 Preparation of the detection media

The detection media shall be prepared in accordance with the manufacturer's instructions.

A.2 Cleaning of the reference blocks

The reference block shall be cleaned by a suitable method to ensure that it is free from fluorescent material, oxide, dirt, and grease and has a water break free surface.

A.3 Application of the detection media

Detection media shall be applied to reference blocks type 1 and type 2 as detailed in Annex B in accordance with ISO 9934-1.

Spraying: 3 s to 5 s.

Specimen pitch angle: 45° ± 10° (see Figure B.2)

Spraying direction: 90° ± 10° to the surface under examination.

A.4 Inspection and interpretation

A.4.1 Inspection

Test pieces shall be inspected under viewing conditions described in ISO 3059.

A.4.2 Interpretation

A.4.2.1 Type testing

The test shall be carried out three times and an average of the results shall be used. Indications shall be evaluated visually or by an equivalent measuring method.

A.4.2.1.1 Reference block type 1

The candidate material shall be tested using the type 1 block and the results recorded by a photograph or other suitable method.

A.4.2.1.2 Reference block type 2

The cumulative length of the indications shall be reported.

A.4.2.2 Batch testing

A.4.2.2.1 Reference block type 1

Indications shall be compared with those produced at the time type testing was carried out. This can be achieved by any suitable method, for example, by use of a photograph or by using retained suitable samples. The result shall be reported.

A.4.2.2.2 Reference block type 2

The cumulative length of the indications shall be reported.

A.4.2.3 In-service testing

Using test block type 1 or type 2, the indications produced shall be compared with known results.

A.5 Contrast aid paint

Contrast aid paint shall be tested in accordance with A.1 to A.4.2.1 except that the contrast aid paint shall be applied in accordance with the manufacturer's instructions after cleaning the reference test block (see A.2).

Annex B
(normative)

Reference blocks

B.1 Reference block type 1

B.1.1 Description

The reference block is a disc with two types of natural cracks in the surface as seen in Figure B.1. It shall contain coarse cracks and fine cracks produced by grinding and stress corrosion. The block shall be permanently magnetized by a central conductor through the hole. Evaluation of a detection media is made by visual or other appropriated method of comparison of the indications.

NOTE For information, Block Type 1 was described in a German patent: G 01 N 27/84 Auslegeschrift 23 57 220; this patent expired on 1990.

B.1.2 Manufacturing

Material preparation: using steel (Grade 90MnCrV8), the surfaces shall be plane ground to 9,80 mm ± 0,05 mm then hardened at 860 °C ± 10 °C for 2 h and quenched in oil to give a surface hardness 63 HRC to 70 HRC.

Process: grind at a velocity of 35 m/s, using grit size 46J7 with infeed of 0,05 mm per surface, indexing 2,0 mm. Black oxidize at 145 °C to 150 °C for 1,5 h.

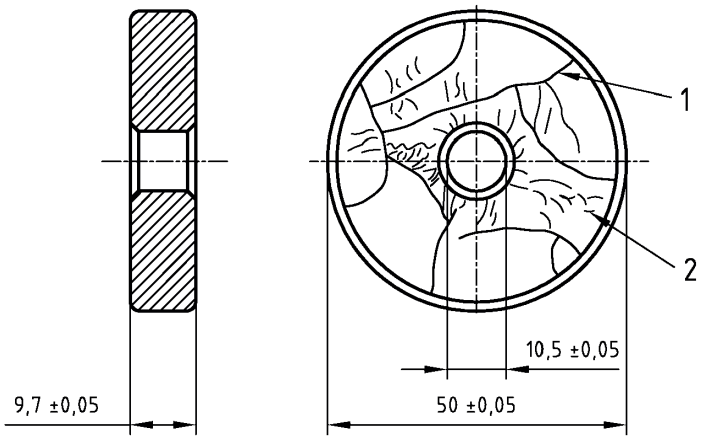
Magnetization: magnetization shall be achieved using a central conductor and direct current at a value of 1 000 A (peak).

B.1.3 Verification

Initial assessment: fluorescent detection media shall be used and the results recorded.

Identification: each reference block shall be uniquely identified. A certificate stating its conformance with ISO 9934-2 is supplied with the reference block.

Dimensions in millimetres



Key

1 grinding cracks

2 stress-corrosion cracks

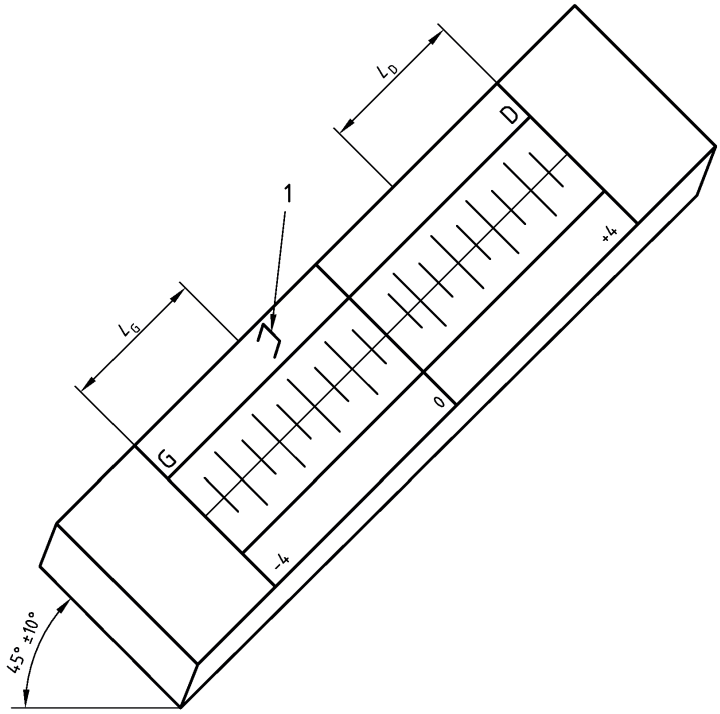
Figure B.1 — Typical reference block type 1

B.2 Reference block type 2

B.2.1 Description

Reference block type 2 is a self-contained unit requiring no external magnetic field induction. It comprises two steel bars and two permanent magnets as shown in Figure B.2. It shall be calibrated such that the +4 mark represents +100 A/m and the −4 mark represents −100 A/m

Indication lengths (L_G and L_D) give a measure of performance of the detection media. Indications start at the ends and decrease towards the centre. Increased length show better performance. Results shall be the cumulative length of the left and right hand indications.



Key

1 spray direction

L_G length of left direction

L_D length of right direction

Figure B.2 — Reference block type 2

B.2.2 Manufacturing

B.2.2.1 Machine 2 square bars in steel grade C15 in accordance with EN 10083-2, 10 mm × 10 mm and 100,5 mm ± 0,5 mm in length. Machine a bar holder and two protective tips in non-magnetic material to hold and protect the magnets (see Figure B.2).

B.2.2.2 Grind one face of each bar to R_a approximately 1,6 µm and flatness <5 µm.

Caution — The temperature of the bar should not exceed 50 °C.

B.2.2.3 Demagnetize the two bars.

B.2.2.4 Insert between the ground faces of the two bars a sheet of aluminium having a thickness of 15 µm, then place the set in the bar holder.

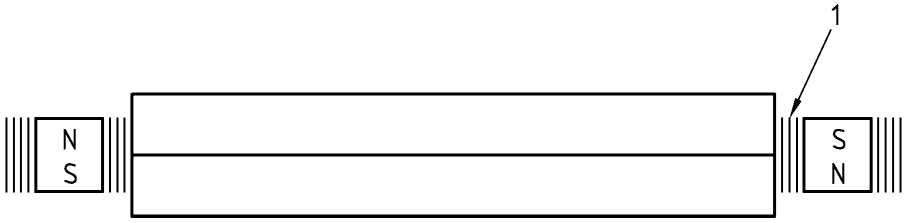
B.2.2.5 Clamp the bars in position.

B.2.2.6 Fit the magnets' protective tips.

B.2.2.7 Grind the upper surface of the assembly to R_a approximately 1,6 µm.

B.2.2.8 Remove the magnets' protective tips.

B.2.2.9 Insert the magnets (small door catch type: for example, CF 12-6N[1)] as shown by the schema (Figure B.3). The shunts in steel with thickness of 0,2 mm are used to adjust the value of the magnetic field.



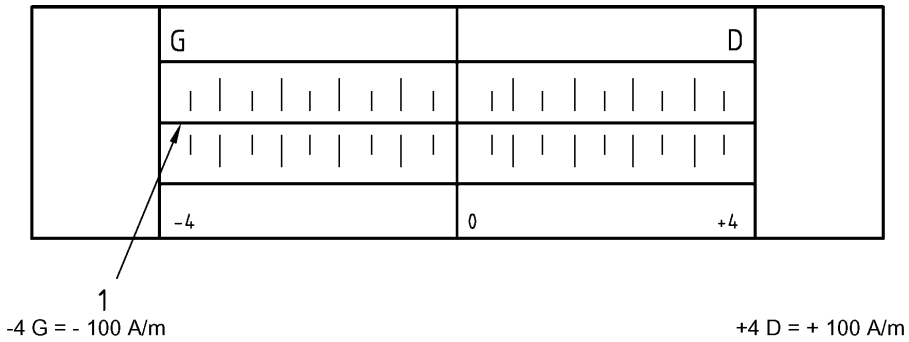
Key

1 shunt

Figure B.3 — Schema showing the inserted magnets

B.2.2.10 Assemble the magnets' protective tips.

B.2.2.11 Engrave the upper face as shown in Figure B.4. Engraving shall not be closer than 2 mm to the gap.



Key

1 gap

Figure B.4 — Engraving of reference block type 2

B.2.3 Verification

B.2.3.1 Using a tangential field strength meter, measure the field perpendicular to the artificial defect at the +4 and −4 graduations.

B.2.3.2 Acceptance criteria

Value of the field at graduation −4: - (100 ± 10) A/m.

Value of the field at graduation +4: + (100 ± 10) A/m.

If these values are not satisfied, repeat the procedure from B.2.2.9, adjusting the field values with the shunts.

1) Magnet CF 12-6N produced by ARELEC company is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

B.2.3.3 Identification

Each reference block type 2 is identified by a unique serial number.

A certificate stating its conformance with ISO 9934-2 is supplied with the reference block.

Annex C
(normative)

Corrosion testing of steel

C.1 Principle

The corrosive properties of detection media shall be determined by visual examination of the corrosion traces left on a filter paper by granules previously impregnated with the liquid for examination under specified conditions.

After the corrosion test, the manufacturer of magnetic particle testing products shall report the conditions of the granules. However, it is recommended to use granules permitting test reproducibility.

If mutually agreed, specific granules can be supplied by the user for the manufacturer to use in corrosion testing of the magnetic particle testing products.

If these are not available or in case of a dispute, the granules defined in C.3 shall be used.

C.2 Apparatus

C.2.1 Petri-dish made of glass, of 100 mm outside diameter.

C.2.2 Pipette with ml scale.

C.2.3 Round filter paper, ø 90 mm, with a 40 mm diameter circle inscribed on it with indelible ink.

C.2.4 Stainless steel spatula, Mesh 5 sieve in accordance with ISO 2591-1.

C.2.5 Balance, accurate to 0,1 g.

C.3 Reagents and materials

C.3.1 Acetone.

C.3.2 Xylene.

C.3.3 Steel granules grade 2C40 (according to EN 10083-2), generally 2,5 × 2,5 mm.

C.3.4 Lamellar graphite general purpose cast iron granules, (S > 0,18 %, P < 0,12 %) dry machined, approximately 2,5 mm × 2,5 mm.

The granules shall be carefully degreased with xylene in appropriate equipment.

C.3.5 Hard water.

C.3.6 Different stock solutions shall be prepared.

a) Solution A: dissolve 40 g $CaCl_2 \cdot 6H_2O$ in distilled water and complete to 1 l.

b) Solution B: dissolve 44 g $MgSO_4 \cdot 7H_2O$ in distilled water and complete to 1 l.

C.3.7 From these stock solutions, prepare three diluted solutions as follows:

a) ds1: 2,90 ml of solution A + 0,5 ml of solution B in 1 l of distilled water;

b) ds2: 10,7 ml of solution A + 1,7 ml of solution B in 1 l of distilled water;

c) ds3: 19 ml of solution A + 3 ml of solution B in 1 l of distilled water.

C.4 Test procedure

C.4.1 Preparation of the solutions (100 ml)

Introduce successively into three 100 ml volumetric flasks the same test portion of the product under examination. Dilute each test portion to the mark using waters of different hardness (solutions ds1, ds2, and ds3 prepared in C.3.7). Proceed similarly for the other two concentrations.

C.4.2 Preparation of the granules and filters

The degreased cast iron and steel granules shall first be visually inspected for rust deposits.

Prepare a set of filters bearing ø 40 mm concentric circles inscribed with an oil pencil.

The following is required to test each magnetic particle testing product:

— 9 filters for testing with steel granules (solutions with three different increasing concentrations, prepared from waters with three different hardness);

— 9 filters for testing with cast iron granules.

Sieve the granules to remove any undersized particles and traces of dust.

Place the prepared filters in the Petri-dishes. Distribute 2 g ± 0,1 g of granules over the circumscribed area of each filter.

C.4.3 Corrosion testing

Wet the granules in each of the dishes using 2 ml of the relevant solution applied in one application.

Repeat the same operation for each solution with the steel and cast iron granules.

Check that there is no bubble under the filter paper, cover the Petri-dishes.

Leave the dishes at room temperature (23 ± 1) °C for 2 h ± 10 min, in a place protected from drafts and sunshine.

At the end of this time interval, remove the granules by turning the filter paper upside down by hand.

Rinse copiously with distilled water, dispensed from a water wash bottle, to remove any granules adhering to the paper.

Dip twice in acetone then dry at room temperature.

C.5 Interpretation of the results

The corrosion marks left on the filter paper after washing and drying shall be immediately interpreted by visual examination without optical instruments. Figure C.1 is intended to facilitate reading. A transparent (1 mm square) paper grid may be used to assist evaluation

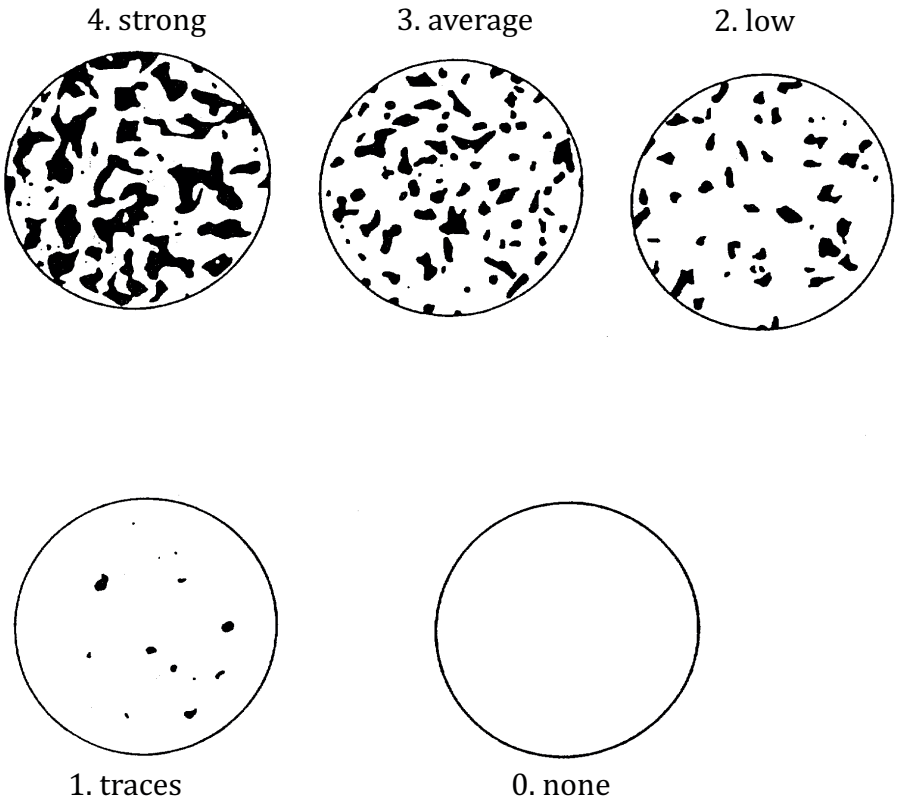


Figure C.1 — Evaluation of corrosion marks

Table C.1 — Grading of corrosion stains on the filter paper

Grade	Corrosion	Surface description
0	none	no stain
1	traces	max. three stains of less than 1 mm diameter
2	low	less than 1 % of the surface
3	average	more than 1 % and less than 5 % of the surface
4	strong	more than 5 % of the surface

C.6 Expression of results

In case of uncertainties as to the grade, allocate the higher numbered grade.

The results shall be recorded together with the following:

— identification of the tested sample;

— product concentration and water hardness;

— any required comment on the test;

— date.

C.7 Uncertainties

The applicability of the test results shall be assessed from the following tests of:

— repeatability

two tests carried out by one operator under the same conditions are considered acceptable and valid when the four values of the two measuring pairs do not differ by more than one scale unit;

— reproducibility and precision

two tests carried out in two different laboratories under reproducible analogous conditions are considered acceptable and valid when the readings for the same measurements do not differ by more than one scale unit.

Bibliography

[1] ISO 3819, *Laboratory glassware — Beakers*

[2] BS 3406-5, *Methods for determination of particle size distribution — Recommendations for electrical sensing zone method (the Coulter principle)*

[3] EN 12157, *Rotodynamic pumps — Coolant pumps units for machine tools — Nominal flow rate, dimensions*

ICS 19.100

Price based on 21 pages