INTERNATIONAL STANDARD

ISO 9934-3

Second edition
2015-09-01

Non-destructive testing — Magnetic particle testing —

Part 3: Equipment

Essais non destructifs — Magnétoscopie —

Partie 3: Équipement

Reference number
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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

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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).

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).

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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

ISO 9934-3 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 9934-3:2002), 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 principles*

— *Part 2: Detection media*

— *Part 3: Equipment*

Non-destructive testing — Magnetic particle testing —

Part 3:
Equipment

1 Scope

This part of ISO 9934 describes three types of equipment for magnetic particle testing:

— portable or transportable equipment;

— fixed installations;

— specialized testing systems for testing components on a continuous basis, comprising a series of processing stations placed in sequence to form a process line.

Equipment for magnetizing, demagnetizing, illumination, measurement, and monitoring are also described.

This part of ISO 9934 specifies the properties to be provided by the equipment supplier, minimum requirements for application and the method of measuring certain parameters. Where appropriate, measuring and calibration requirements and in-service checks are also specified.

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

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

EN 10250-2, *Open steel die forgings for general engineering purposes — Non-alloy quality and special steels*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Safety requirements

The equipment design shall take into account all international, European, national and local regulations which include health, safety, electrical and environmental requirements.

4 Types of devices

4.1 Portable electromagnets (AC[1])

4.1.1 General

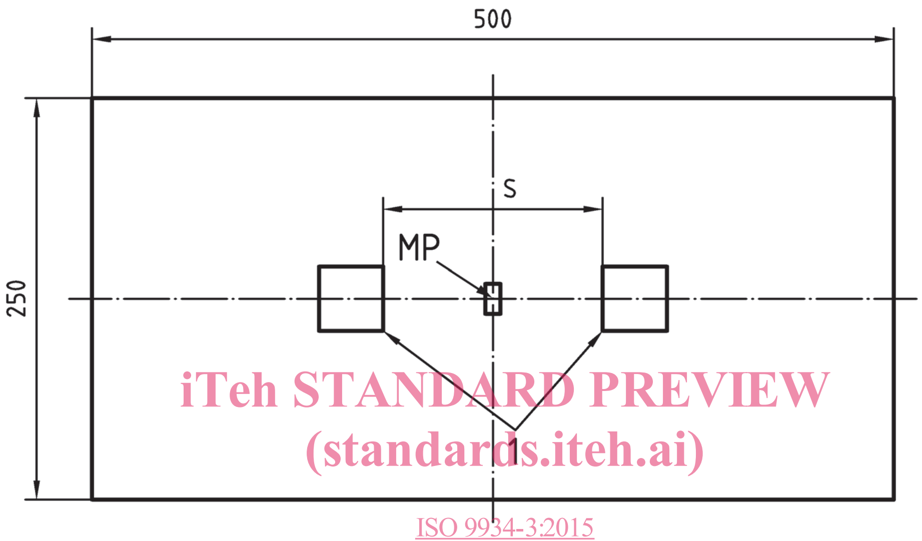
Hand-held portable electromagnets (yokes) produce a magnetic field between the two poles. When testing according to ISO 9934-1, DC[1] electromagnets should only be used if agreed at enquiry and order stages.

1) AC = alternating current, and DC = rectified current.

Magnetization shall be determined by measuring the tangential field strength, H_t, at the centre of a line joining the centres of the pole faces of the electromagnet with pole extenders where used. The electromagnet with a pole spacing, *s*, is placed on a steel plate as shown in Figure 1. The plate shall have the dimensions (500 ± 25) mm × (250 ± 13) mm × (10 ± 0,5) mm and shall be of steel conforming to C22 (1.0402) of EN 10250-2. Periodic functional checks can be carried out either by the method described above or by a lift test. The electromagnet shall be capable of supporting a steel plate or rectangular bar conforming to C22 (1.0402) of EN 10250-2 and having a minimum mass of 4,5 kg, with the magnet poles set at their recommended spacing. The major dimension of the plate or bar shall be greater than the pole spacing, *s*, of the electromagnet.

NOTE To lift a steel plate with a mass of 4,5 kg requires a lifting force of 44 N.

Dimensions in millimetres



Key

1 poles

s pole spacing

MP measuring point for the tangential field strength

Figure 1 — Determination of the characteristics of portable electromagnets

4.1.2 Technical data

The following data shall be provided:

— recommended pole spacing (maximum and minimum pole spacing) (s_{max}, s_{min});

— cross sectional dimensions of the poles;

— electrical supply (voltage, current, and frequency);

— current wave forms available;

— method of current control and effect on waveform (e.g. thyristor);

— duty cycle at maximum output (ratio of current “ON” to “Total” time expressed as a percentage);

— maximum current “ON” time;

— tangential field strength H_t at s_{max} and s_{min} (following 4.1);

— overall dimensions of the equipment;

— equipment mass, in kilograms;

— specified electrical protection degree (IP) according to IEC 60529.

4.1.3 Technical requirements

The following requirements shall be satisfied at an ambient temperature of 30 °C and at maximum output:

— duty cycle	≥10 %
— current “ON” time	≥5 s
— surface temperature of handle	≤40 °C
— tangential field strength at s_{max} (see 4.1)	≥2 kA/m (RMS)
— lifting force	≥44 N

4.1.4 Additional requirements

The electromagnet shall be supplied with a power ON/OFF switch, preferably mounted on the handle.

Generally electromagnets should be usable with one hand.

4.2 Current generators

4.2.1 General

Current generators are used to supply current for magnetizing equipment. A current generator is characterized by the open circuit voltage, U_0, the short circuit current, I_k and the rated current, I_r (RMS-values).

The rated current, I_r, is defined as the maximum current for which the generator is rated at the duty cycle of 10 % and for a current “ON” time of 5 s if not otherwise specified.

The open circuit voltage, U_0, and the short circuit current, I_k, are derived from the load-characteristic of the generator at maximum power (with any feedback controls disconnected). The load line of the generator can be derived by connecting two widely different loads, such as different lengths of cable, in turn to the generator. For the first cable, the current, I_1, through the cable and voltage, U_1, across the output terminals are measured and plotted, to give point P_1 on Figure 2. The process is repeated with a second load to give point P_2. The load line is constructed by drawing a straight line between P_1 and P_2. The open circuit voltage, U_0, and short circuit current, I_k, are then given by the intercepts on the axes, as shown in Figure 2.

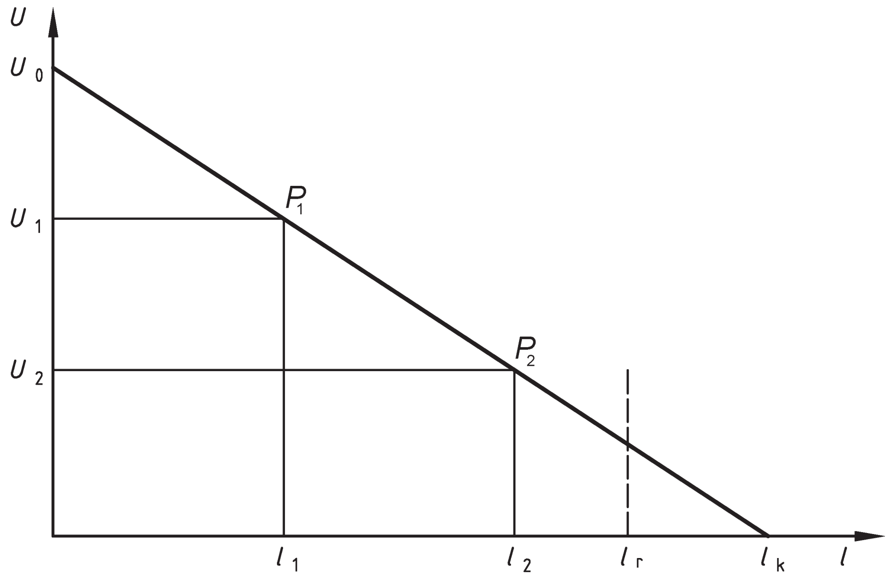


Figure 2 — Load characteristics of the current generator

4.2.2 Technical data

The following data shall be provided:

- open circuit voltage, U_0 (RMS);
- short circuit current, I_k (RMS);
- rated current, I_r (RMS);
- duty cycle at maximum output (if other than as specified in 4.2.1);
- maximum current "ON" time (if other than specified in 4.2.1);
- current wave forms available;
- method of current regulation and effect on waveform;
- working range and incremental setting steps;
- method of constant current control if available;
- type of meter (digital, analog);
- resolution and accuracy of current output meter;
- electrical supply requirements at maximum current output (voltage, phases, frequency, and current);
- specified electrical protection degree (IP) according to IEC 60529;
- overall dimensions of equipment;
- equipment mass, in kilograms;
- type of demagnetization, if available (see Clause 8).

4.2.3 Technical requirements

The following requirements shall be satisfied at an ambient temperature of 30°C and at the rated current I_r:

— duty cycle: ≥10 %;

— current "ON" time: ≥5 s.

NOTE High testing rates will require a higher duty cycle.

4.3 Magnetic benches

4.3.1 General

Fixed installation benches can include facilities for current flow and magnetic flow techniques. Magnetic flow can be achieved either by an electromagnetic yoke or a fixed coil. The characteristics of the current generator are defined in 4.2.

When facilities for multidirectional magnetization are included, each circuit shall be independently controlled. Magnetization shall be sufficient to achieve the required detection capability in all directions.

The characteristic of the electromagnetic yoke is the tangential field strength, H_t, measured, in kiloamperes per metre, at the midpoint of the length of a cylindrical bar conforming to C22 (1.0402) of EN 10250-2, of specified dimensions (length and diameter) appropriate to the acceptance range of the equipment.

If the bench is to be used for magnetic flow testing of components longer than 1 m, or segments of the length are magnetized individually, the supplier shall define how magnetizing capability is determined. This shall include a specification of the tangential field strength for a bar of suitable length and diameter.

4.3.2 Technical data

The following data shall be provided:

— types of magnetization available;

— current wave forms available;

— method of current control and effect on waveform;

— working range and incremental setting steps;

— method of constant current control, if available;

— monitoring of magnetizing current(s);

— magnetizing duration range;

— automated features;

— duty cycle at maximum output;

— maximum current "ON" time (if other than specified in 4.2);

— tangential field strength, H_t (see 4.3);

— open circuit voltage, U_0 (RMS);

— short circuit current I_k (RMS);

— rated current I_r (RMS);

— cross sectional dimensions of poles;