INTERNATIONAL STANDARD

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Non-destructive testing — Equipment for eddy current examination —

Part 1: Instrument characteristics and verification

Essais non destructifs — Appareillage pour examen par courants de Foucault —
Partie 1: Caractéristiques de l'appareil et vérifications

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15548-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive Testing*, in collaboration with ISO Technical Committee TC 135, *Non-destructive Testing*, Subcommittee SC 4, *Eddy current methods*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 15548 consists of the following parts, under the general title *Non-destructive testing — Equipment for eddy current examination*:

— *Part 1: Instrument characteristics and verification*

— *Part 2: Probe characteristics and verification*

— *Part 3: System characteristics and verification*

Non-destructive testing — Equipment for eddy current examination —

Part 1: Instrument characteristics and verification

1 Scope

This part of ISO 15548 identifies the functional characteristics of a general-purpose eddy current instrument and provides methods for their measurement and verification.

The evaluation of these characteristics permits a well-defined description and comparability of eddy current equipment.

By careful choice of the characteristics, a consistent and effective eddy current examination system can be designed for a specific application.

Where accessories are used, these are characterised using the principles of this part of ISO 15548.

This part of ISO 15548 gives neither the extent of verification nor acceptance criteria for the characteristics. They are given in the application documents.

2 Normative references

The following referenced documents are indispensable for the application 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 12718, *Non-destructive testing — Eddy current testing — Terminology*

ISO 15549, *Non-destructive testing — Eddy current testing — General principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12718 apply.

4 Eddy current instrument characteristics

4.1 General characteristics

4.1.1 Type of instrument

a) An instrument has a general-purpose application when the relationship between the measured quantity and the display or output is established by the user. A range of probes can be connected to the instrument. The instrument manufacturer shall provide details of the internal electrical characteristics, in order that the user can design the examination system. The examination system shall be in accordance

with ISO 15549. The user shall be able to vary the value of frequency, gain, balance (unless an automatic balance is used), phase, filters and gain and zero of the display.

b) An instrument is of specific application when the relationship between the measured quantity and the display or output is explicitly defined in the range of application. The probe is specific to the instrument. For this type of instrument, this part of ISO 15548 may be partially applied.

4.1.2 Power supply

The instrument can be powered by batteries or by the local AC power supply. The nominal values of voltage, frequency and power consumption shall be stated, together with the tolerance for correct operation.

4.1.3 Safety

The instrument and its accessories shall meet the applicable safety regulations, for example, electrical hazard, surface temperature, explosion, etc.

4.1.4 Technology

The instrument can be wholly analogue or partly analogue and partly digital.

The excitation can be single frequency, multifrequency, swept frequency or pulsed.

The instrument can be single or multichannel.

The instrument settings can be manual, remote controlled, stored or preset.

The instrument shall have component outputs and can be with or without a self-contained display.

4.1.5 Physical presentation

The instrument can be portable, cased or rack mounted, with the component parts integrated or modular.

The weight and size shall be specified for the instrument and its accessories.

The plugs and sockets shall be specified regarding type and pin interconnections.

The instrument model number and the serial number shall be clearly readable and located in a readily accessible place.

4.1.6 Environmental effects

The warm-up time necessary for the instrument to reach stable operating conditions within specified limits shall be stated.

The temperature, humidity and vibration ranges for normal use, storage and transport shall be specified for the instrument and its accessories.

The instrument shall conform to relevant electromagnetic compatibility (EMC) regulations.

4.2 Electrical characteristics

4.2.1 General

The electrical characteristics of an instrument shall be evaluated after the warm-up time has elapsed.

The electrical characteristics are only valid for the stated operating conditions.

When relevant, the stability of the specified values with time, for specified environmental conditions, shall be stated.

The electrical characteristics apply to various items of the functional block diagram of the instrument. Where applicable, they are provided by the manufacturer. Some of these characteristics can be verified according to the methodology described in Clause 6.

4.2.2 Functional block diagram

The functional block diagram of a typical general-purpose eddy current instrument is shown in Figure 1.

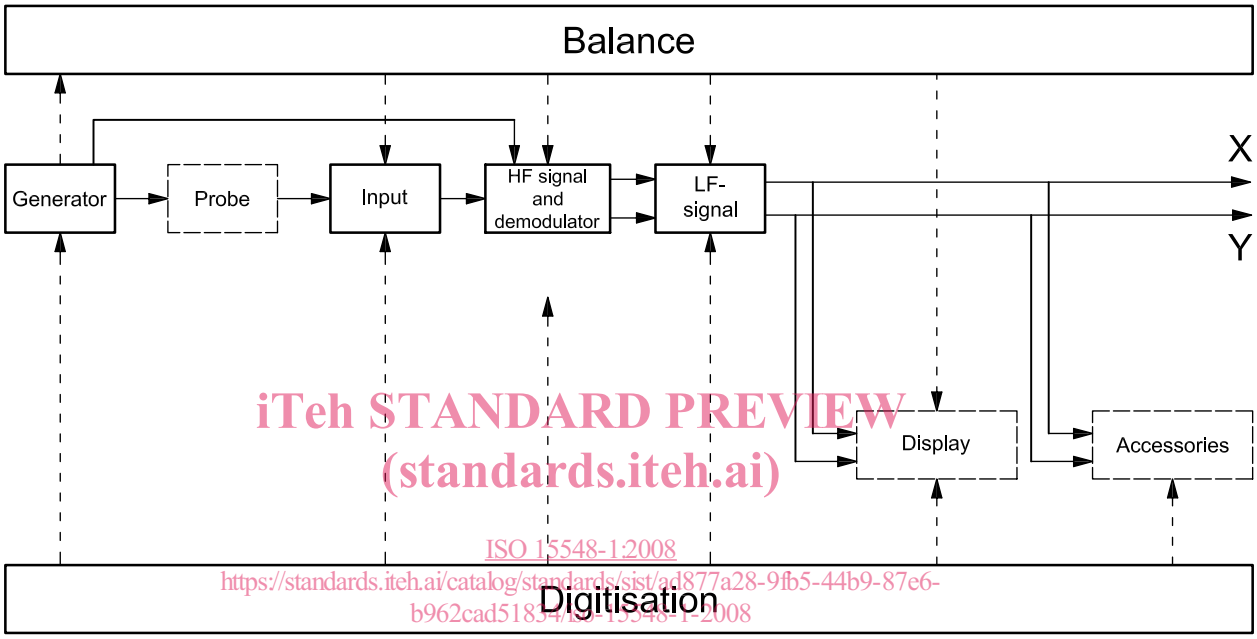

Figure 1 — Functional block diagram of an eddy current instrument

4.2.3 Generator unit

The source of excitation is the generator unit.

In the case of alternating excitation (sinusoidal, triangular, rectangular, etc.), the characteristics to be defined are as follows:

— type of generator: current or voltage;

— type of excitation: single or multifrequency;

— frequency setting: range, step size, deviation from nominal value;

— harmonic distortion;

— amplitude setting: range, step size, deviation from nominal value, maximum output voltage or current;

— source impedance with frequency dependence.

In the case of multifrequency excitation, it shall be stated whether frequencies are injected simultaneously or multiplexed, independent or related, and the multiplexing sequence shall be specified, when relevant.

4.2.4 Input stage characteristics

The input stage interfaces the probe to the instrument. It provides impedance matching and amplification, as required.

The characteristics to be defined are as follows:

— input impedance with frequency dependence;

— gain setting range, step size, deviation from nominal value;

— maximum input voltage;

— common-mode operating parameters, when relevant.

4.2.5 Balance

Balance is the compensation of the signal to achieve a predetermined operating point, e.g. zero. The compensation may be performed manually or automatically, at the input stage, or during HF signal processing, or during demodulated signal processing, or on the display.

The characteristics to be defined are as follows:

— maximum input range, which can be compensated;

— residual value at balance (expressed as a percentage of a specified range, e.g. full-scale output).

4.2.6 High-frequency signal processing

4.2.6.1 HF filtering

Filters reduce the signal frequency content which can have an undesirable effect on the test result.

The filters used before demodulation are referred to as carrier frequency filters (HF filters). These are usually band-pass filters which suppress any signal frequencies which do not correspond to the excitation frequency.

The characteristics to be defined are as follows:

— gain;

— bandwidth at 3 dB attenuation;

— rate of attenuation;

— transient response.

4.2.6.2 HF amplification

The characteristics to be defined are as follows:

— gain setting range, step size, deviation from nominal value;

— input signal range;

— bandwidth;

— output saturation level.

4.2.6.3 Demodulation

Synchronous demodulation extracts the vector components from the HF signal.

For positive polarity of demodulation, a delay in the signal will cause the signal vector to rotate clockwise. The polarity of demodulation shall be positive and shall be confirmed.

The characteristics to be defined are as follows:

— wave shape of the reference signal, e.g. sine, square, pulse;

— bandwidth for each wave shape of the reference signal;

— phase-dependent amplitude deviations;

— phase-dependent phase deviations.

Amplitude demodulation extracts the low-frequency amplitude variations from the HF signal.

4.2.7 Demodulated signal processing

4.2.7.1 Vector amplification

Vector amplification generally consists of two transmission channels of identical design. These channels amplify the vector components produced by synchronous demodulation. In some instruments, these components can be amplified with different gains.

The characteristics to be defined are as follows:

— gain setting range, step size, deviation from nominal value;

— input signal ranges;

— bandwidth;

— output saturation level.

4.2.7.2 LF filtering

The filters used after demodulation are referred to as low-frequency filters (LF filters). The bandwidth of the filter is chosen to suit the application, e.g. wobble, surface speed, etc.

The characteristics to be defined are as follows:

— gain;

— bandwidth at 3 dB attenuation;

— rate of attenuation;

— transient response.

4.2.7.3 Phase setting

Phase setting permits rotation of the demodulated signal vector on the complex plane display.

The characteristics to be defined are as follows:

— range;

— step size;

— amplitude variation of the signal vector with phase setting;

— deviation of indicated phase rotation from actual phase rotation.

4.2.8 Output and signal display

The type of display can be an indicator display, or a hard-copy display, or a screen display.

The type of presentation can be, for example, complex plane, ellipse, time-synchronous, frequency spectrum, imaging.

The related characteristics to be defined include:

— size;

— graticule divisions, major and minor;

— full-scale-display voltage range or time range;

— transfer factor e.g. volts/division;

— linearity;

— bandwidth.

The output can be analogue, digitised or logical.

The characteristics of analogue outputs to be defined are as follows:

— voltage or current range;

— output impedance;

— linearity;

— bandwidth.

The characteristics of digitised outputs to be defined are as follows:

— data protocol;

— serial or parallel;

— voltage and current levels;

— speed and format;

— sampling rate;

— analogue/digital A/D resolution, range and linearity.