# SLOVENSKI STANDARD
# SIST EN 13860-1:2004

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**Neporuġitveno preskuġanje ï Preiskave z vrtinļnimi tokovi ï Karakteristike naprav in njihovo overjanje ï 1. del: Karakteristike aparatur in njihovo overjanje**

Non destructive testing - Eddy current examination - Equipment characteristics and verification - Part 1: Instrument characteristics and verification

Zerstörungsfreie Prüfung - Wirbelstromprüfung - Kenngrößen von Prüfeinrichtungen und deren Verifizierung - Teil 1: Kenngrößen von Prüfgeräten und deren Verifizierung



Essais non destructifs - Examen par courants de Foucault - Caractéristiques et vérification de l'appareillage - Partie 1: Caractéristiques de l'appareil et vérifications



**Ta slovenski standard je istoveten z:** **EN 13860-1:2003**

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**SIST EN 13860-1:2004** **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 13860-1

February 2003

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English version

# Non destructive testing - Eddy current examination - Equipment characteristics and verification - Part 1: Instrument characteristics and verification

Essais non destructifs - Examen par courants de Foucault - Caractéristiques des équipements et vérification - Partie 1: Caractéristiques des appareils et vérification

Zerstörungsfreie Prüfung - Wirbelstromprüfung - Kenngrößen von Prüfeinrichtungen und deren Verifizierung - Teil 1: Kenngrößen von Prüfgeräten und deren Verifizierung

This European Standard was approved by CEN on 12 December 2002.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.



This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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# Contents

## Foreword

This document (EN 13860-1:2003) has been prepared by CEN/TC 138, "Non-destructive testing", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2003, and conflicting national standards shall be withdrawn at the latest by August 2003.

EN 13860 comprises a series of European Standards for *Eddy current examination - Equipment* which is made up of the following:

EN 13860-1 *Non-destructive testing - Eddy current examination - Equipment characteristics and verification - Part 1: Instrument characteristics and verification.*

EN 13860-2 *Non-destructive testing - Eddy current examination - Equipment characteristics and verification - Part 2: Probe characteristics and verification.*

prEN 13860-3 *Non-destructive testing - Eddy current examination - Equipment characteristics and verification - Part 3: System characteristics and verification.*



Annexes A and B are informative, annex C is normative.



According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

# 1 Scope

This European Standard identifies the functional characteristics of a general purpose eddy current equipment and provides methods for their measurement and verification.

The evaluation of these characteristics permits a well defined description and comparability of an 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 should be characterised using the principles of this standard.

This European Standard gives neither the extent of verification nor acceptance criteria for the characteristics. They are given in the application documents.

# 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).



EN 1330-5:1998 *Non-destructive testing - Terminology - Part 5: Terms used in Eddy current testing.*

EN 12084 *Non-destructive testing - Eddy current testing - General principles and guidelines.*



# 3 Terms and definitions

For the purposes of this European Standard the terms and definitions given in EN 1330-5:1998 apply.

# 4 Eddy current instrument characteristics

## 4.1 General characteristics

### 4.1.1 Type of instrument

a) An instrument is of 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 EN 12084. The user shall be able to vary the value of frequency, gain, balance (unless automatic balance), 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 standard may be partially applied.

### 4.1.2 Power supply

The instrument can be powered by batteries or by the local A.C. 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, e.g. electrical hazard, surface temperature, explosion, etc.

#### 4.1.4 Technology

The instrument can be wholly analogue or part analogue and part 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 pre-set.

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.

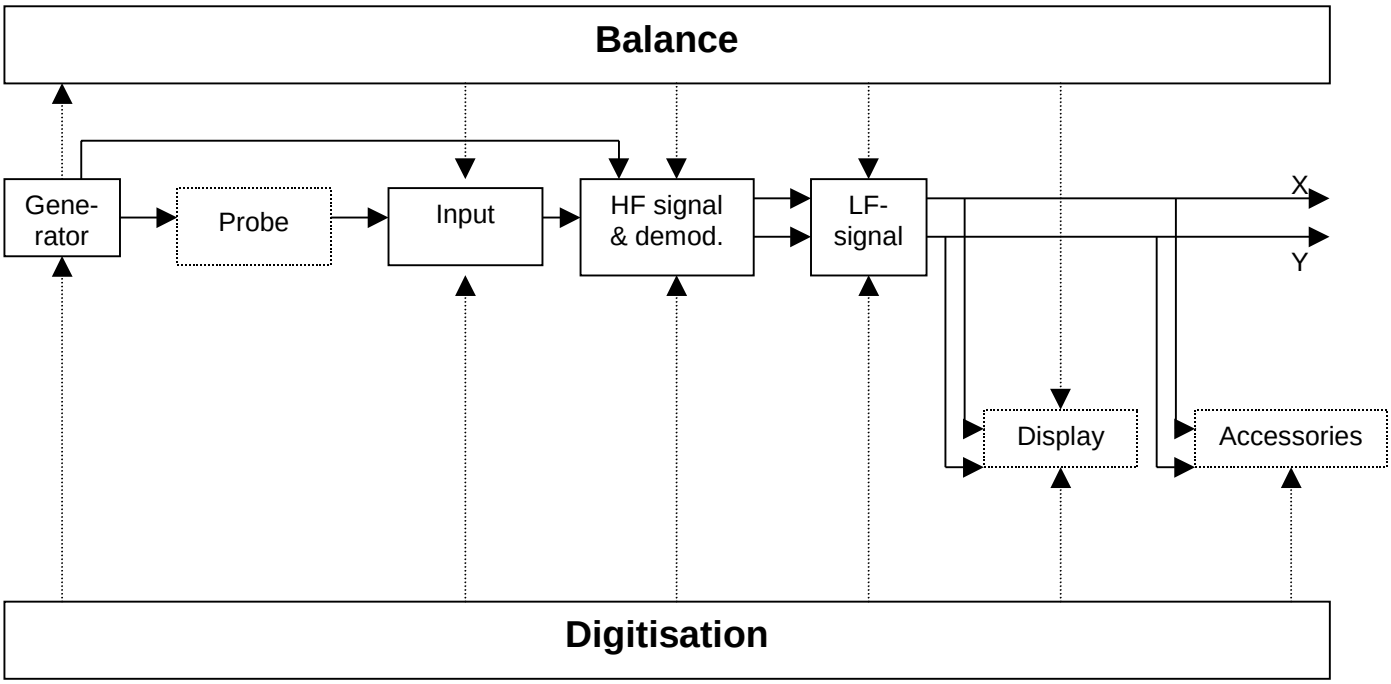


**Figure 1 — Functional block diagram of an eddy current instrument**



### 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:

— 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 if frequencies are injected simultaneously or multiplexed, independent or related, and the multiplexing sequence, 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:

— 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:

— 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:



— gain;

— bandwidth at 3dB attenuation;

— rate of attenuation;

— transient response.

##### 4.2.6.2 HF amplification

The characteristics to be defined are:

— 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:

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

— bandwidth for each wave shape of 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:

— 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:

— 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:

— 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 e.g. 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:

— voltage or current range;

— output impedance;

— linearity;

— bandwidth.



The characteristics of digitised outputs to be defined are:



— data protocol;

— serial or parallel;

— voltage and current levels;

— speed and format;

— sampling rate;

— A/D resolution, range and linearity.

The characteristics of logical outputs to be defined are:

— voltage and current levels;

— settling delay;

— hysteresis;

— active high or low.

### 4.2.9 Digitisation

#### 4.2.9.1 General

Whenever digitisation is performed the following characteristics shall be defined:

— stage of digitisation in the signal processing;

— digitisation technique;

— A/D resolution;

— sampling rate.

The information supplied by the manufacturer shall therefore include data on the following parameters.

#### 4.2.9.2 Stage of digitisation

Digitisation may be performed either before or after signal demodulation.

#### 4.2.9.3 Digitisation technique

Digitisation can be performed using an internal clock or an external encoder.

#### 4.2.9.4 A/D Resolution

Resolution is the nominal value of the converter input voltage corresponding to one digitisation bit.

The number of digitisation bits is an equally useful information even though it can be directly accessed through the maximum input voltage and the resolution.

#### 4.2.9.5 Sampling rate

The sampling rate is the frequency, in hertz, at which the A/D conversion is made.



## 5 Verification



### 5.1 General

For a consistent and effective eddy current examination it is necessary to verify that the performance of the component parts of the eddy current test system is maintained within acceptable limits.

The physical condition of the reference blocks shall be verified to be within acceptable limits before being used to verify the system, or probes.

The measuring equipment used for verification shall be in a known state of calibration.

For a better understanding, the verification procedure is identically described in all three parts of EN 13860.

### 5.2 Levels of verification

There are three levels of verification. Each level defines the time intervals between verification and the complexity of the verification.

It is understood that initial type testing has already been done by the manufacturer or under his control.

LEVEL 1: Global functional check

A verification performed at regular intervals of time on the eddy current test system using reference blocks to verify that the performance is within specified limits.

The verification is usually performed at the examination location.

The time interval and the reference pieces are defined in the verification procedure.

LEVEL 2: Detailed functional check

A verification on an extended time scale, performed to ensure the stability of selected characteristics of the eddy current instrument, probe, accessories, and reference blocks.