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Eddy current testing method for steel products by encircling coil technique

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by Japanese Society for Non-Destructive Inspection (JSNDI)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 0568:1993** is replaced with this Standard.

This revision has been made based on **ISO 9304:1989** *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes—Eddy current testing for the detection of imperfections* for the purpose of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Eddy current testing method for steel products by encircling coil technique

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO 9304** *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes—Eddy current testing for the detection of imperfections* published in 1989 with some modifications of the technical contents, adding provisions that are not given in the said International Standard, and that are unique to Japanese Industrial Standard.

The corresponding International Standard limits the scope of application to seamless and welded (except submerged arc-welded) steel tubes, but in this Standard, steel wires, steel wire rods and round steel bars are also covered in order to accommodate to the domestic use status and needs.

The portions given sidelines or dotted underlines are the matters modified from the original International Standard. A list of modifications with the explanations is given in Annex (informative).

1 Scope This Standard specifies the general requirements for eddy current testing method (hereafter referred to as “test”) using encircling coils (hereafter referred to as “test coils”), which is intended to detect, if there are any, the cracks and other flaws in steel wires, steel wire rods, round steel bars (2 mm to 100 mm in diameter), and steel tubes (4 mm to 180 mm in outside diameter) (hereafter referred to as “test materials”).

Remarks : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 9304 : 1989 *Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes—Eddy current testing for the detection of imperfections* (MOD)

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0431 Qualification and certification of non-destructive testing (NDT) personnel for steel products

JIS Z 2300 Terms and definitions of nondestructive testing

JIS Z 2305 Non-destructive testing—Qualification and certification of personnel

JIS Z 2314 Test methods for performance characteristics of eddy current testing instruments

JIS Z 2315 Test methods for performance characteristics of eddy current flaw detecting system

3 Definitions For the purpose of this Standard the definitions given in **JIS Z 2300** apply.

4 Items to be specified For testing in accordance with this Standard, the items in the following shall be specified.

- a) Time for testing
- b) Surface conditions of test material
- c) Test apparatus (including test coil)
- d) Reference specimen
- e) Testing conditions such as test frequency and test speed
- f) Presence of magnetic saturation and necessity of demagnetization
- g) Acceptance criteria
- h) Related standard
- i) Other necessary items

5 Testing engineer The engineers who conduct the test shall have acquired the fundamental technology of the eddy current testing and shall be sufficiently familiar and experienced with the behaviour of steels and their testing methods.

Those who have been certified in accordance with **JIS G 0431** and **JIS Z 2305** or other equivalent certification standards may be deemed as qualified to conduct this test if so agreed between the purchaser and the manufacturer.

6 Test apparatus

6.1 Constitution The test apparatus shall mainly be composed of a flow detector, test coil, recorder, feeding device (including supporting device for the test coil, and so forth) and magnetic saturator. The magnetic saturator, however, may be excluded.

6.2 Flaw detector The flaw detector shall be composed of an oscillator, electrical device which processes electric signals, indicating device, etc., and its function and performance shall be as given in the following:

- a) The test frequency, in general, shall be in the range from 0.5 kHz to 1 024 kHz and shall be suitable for the purpose of the test.
- b) The type, test frequency and displaying system thereof shall have the performance appropriate for the purpose of test.
- c) The flaw detector shall operate stably at an ambient temperature from 0 °C to 40 °C and ± 15 % of fluctuation of supply voltage, and also shall be protected from external electric noise.
- d) The flaw detector shall be tested for its performance in accordance with **JIS Z 2314** at the time of manufacture and of repair, or in other occasions as necessary.

6.3 Test coil The test coil shall be as given in the following:

- a) The test coil shall conform to the purpose of test, dimensions of test material and flaw detector used for the test.
- b) The type and method for test coil, and their expression method shall be as shown in figure 1 and table 1, respectively. The method of expression for dimensions of the test coil shall be as shown in figure 2.

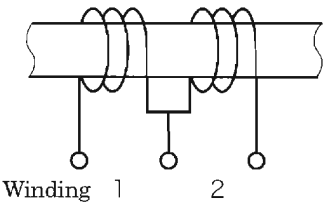
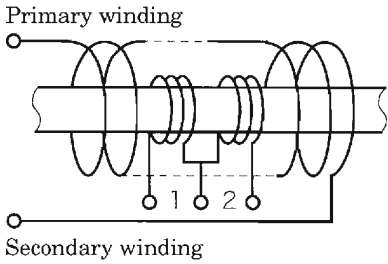
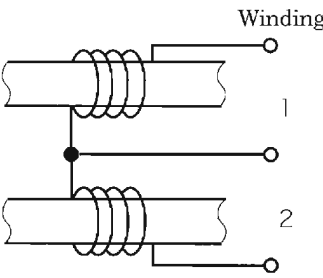
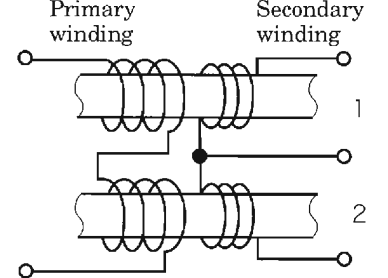
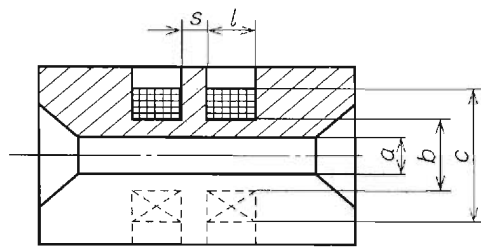
Method for test coil	Type of test coil	
	Self-induction type: S	Manual-induction type: M
Differential coil method: B		
Standard comparison coil method: A		

Figure 1 Type and method for test coil

Table 1 Designation system of test coil

Sequence of expression	Item	Method of expression
1	Type of test coil	Self-induction type: S, mutual-induction type: M
2	Method for test coil	Differential coil method: B, standard comparison coil method: A
3	Diameter of encirclement (a)	Expressed in mm
4	Average diameter of winding in test coil (D)	Expressed in mm

Example : SB-20-22 ... A test coil of self-induction type, differential coil method, 20 mm in diameter of encirclement and 22 mm in average diameter of winding built in test coil.



a : diameter of encirclement (mm)
 b : inside diameter of winding in test coil (mm)
 c : outside diameter of winding in test coil (mm)
 s : spaces between windings in test coil (mm)
 l : length of winding in test coil (mm)

Remarks : In the case of mutual-induction type coil arrangement, it is a secondary winding.

Further, the fill factor shall be used to express the dimensions of a test coil in relation to a test material. The fill factor shall be computed according to the following formula:

$$\eta = \frac{d^2}{D^2} \times 100$$

where, η : fill factor (%)

d : outside diameter of test material (mm)

$$D = \frac{b + c}{2} : \text{average diameter of winding in test coil (mm)}$$

Figure 2 Method of expression of dimensions of test coil

6.4 Recorder The recorder is a device to record the digital or analogous output obtained from a flaw detector, and shall have appropriate method and performance for its intended use.

6.5 Feeding device The feeding device shall not give vibration to the test material and test coil. It shall enable a test material to pass through the centre of test coil and shall be capable of feeding the test material at a uniform velocity.

6.6 Magnetic saturator The magnetic saturator shall be capable of providing continuously magnetization to the test material. In addition, the magnetic saturator should, as a rule, be attached with a demagnetizing device.

6.7 Performance of test apparatus The performance characteristics of a test apparatus shall meet the purpose of the test.

Measurement on performance characteristics shall be made at a time of periodical inspection of the test apparatus and also at each necessary timing according to JIS Z 2315.

7 Reference specimen

7.1 Purpose of use of reference specimen Reference specimens are used for verifying the performance characteristics of a test apparatus and for setting and verifying the testing conditions including the reference sensitivity.

7.2 Material of reference specimen The material of reference specimen shall be of the same or similar chemical composition, dimensions, surface finish and heat treatment to those of the test material. In addition, the said material shall be verified by the eddy current flaw detection that no indication false is caused.