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Certification scheme for steel bars and wires for the reinforcement of concrete structures

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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.

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.

International Standard ISO 10144 was prepared by Technical Committee ISO/TC 17, *Steel*.

Annex A of this International Standard is for information only.

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Certification scheme for steel bars and wires for the reinforcement of concrete structures

1 Scope

This International Standard specifies rules for a certification scheme for continuous production of steel bars and wires for ordinary reinforcement of concrete structures in order to verify the conformity with requirements specified in product standards such as ISO 6935-1 and ISO 6935-2.

A certification scheme for continuous production consists of the following stages:

- suitability testing (see clause 4);
- internal inspection by the producer (see clause 5);
- inspection and supervision by an external body (see clause 6).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9002:1987, *Quality systems — Model for quality assurance in production and installation*.

ISO/IEC Guide 39:1988, *General requirements for the acceptance of inspection bodies*.

ISO/IEC Guide 40:1983, *General requirements for the acceptance of certification bodies*.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 certification scheme: Certification system as related to specified products, processes or services to which the same particular standards and rules, and the same procedure, apply. [ISO/IEC Guide 2]

3.2 certification body: Body that conducts certification of conformity. [ISO/IEC Guide 2]

3.3 characteristic value: Value having a prescribed probability of not being attained in a hypothetical unlimited test series. [ISO 8930]

NOTE 1 Equivalent to *fractile*, which is defined in ISO 3534.

3.4 inspection: Activities such as measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity. [ISO 8402]

3.5 inspection body (for certification): Body that performs inspection services on behalf of a certification body. [ISO/IEC Guide 2]

4 Suitability testing

4.1 Purpose

The purpose of suitability testing is to ensure that the producer has the capability and resources to produce reinforcing steels in accordance with the requirements specified in the product standards.

4.2 Organization

The certification body shall comply with the requirements of ISO/IEC Guide 40.

4.3 Procedure

Suitability testing consists of the following stages:

- inspection of conditions for production (4.3.1);
- sampling and testing of specimens (4.3.2);
- verification of the long-term quality level (4.3.3).

If satisfactory results are not achieved in one stage, all the stages shall be repeated. Suitability testing applies separately for each steel grade and each production method. If a steel grade is produced by various processes, suitability testing shall be carried out to its full extent for each of these processes.

4.3.1 Inspection of the production conditions

Inspection of the production conditions shall include the following:

- the competence of the personnel and satisfactory organization of the work;
- the adequacy of the equipment for production;
- the independence of the department responsible for quality assurance from the production department;
- the suitability of the test equipment for internal testing;
- the ability of the producers quality system to ensure the quality of the products. A quality system according to ISO 9002 is considered satisfactory.

The inspection report shall include an evaluation of the activities from melting to dispatch of product.

4.3.2 Sampling and testing of specimens

4.3.2.1 General

The test samples shall be taken from the production of the plant concerned. The test shall cover the entire range of product diameters for which certification is applied.

4.3.2.2 Extent of sampling and testing

Three different diameters, one from the lower range of diameters, one from the middle and one from the upper range, shall be tested for each grade and process. The specimens for each selected diameter shall come from at least 30 test pieces distributed equally between the casts shall be taken to determine each mechanical and geometrical property

specified in the product standard. The chemical composition shall be determined on one specimen from at least three casts for each selected diameter. The samples shall be taken at random from the test material presented for testing by a representative from the inspection body. Care should be taken to ensure that the specimens taken generally reflect the properties of the material.

4.3.2.3 Properties to be tested

All properties specified in the product standard shall be tested and compared with its requirements.

4.3.2.4 Evaluation of the test results

The results (individual values, average values, standard deviations) of the tests shall be collated in a test report. Based on the values determined for the standard deviations (related to each cast), it shall be judged whether simplified values, α , for internal inspection (see 5.2.1.2) may be used.

4.3.2.5 Approval

Once the test results have been evaluated positively by the certification body, a works symbols and an approval to produce for a specific period are granted to the producer. During this period the long-term quality level shall be verified.

4.3.3 Verification of the long-term quality level

4.3.3.1 Extent of testing

In order to verify the long-term quality level, the producer shall perform an increased number of tests (internal and external inspection) for a sufficiently long period (between 6 months and 1 year). The producer shall double the extent of testing specified in 5.2.1.1 for the internal inspection. During this period external inspection shall be carried out more intensively than specified in 6.3.

4.3.3.2 Evaluation

At the end of the period specified in 4.3.3.1, all results of internal and external inspection shall be evaluated separately and compared with each other. The long-term quality level determined by appropriate statistical methods shall correspond to the requirements of 5.2.2.2, if a characteristic value is specified in the product standard.

4.3.3.3 Approval

Once the test results have been evaluated positively by the certification body, a licence is issued to the producer.

5 Internal inspection by the producer

5.1 Purpose

Continuous internal inspection of production by the manufacturer is intended to ensure that the level of quality remains satisfactory with time and that, in the case of test results which do not conform to the conditions, necessary measures can be taken to improve production.

5.2 Procedure

Internal inspection by the producer consists of:

- testing of all partial quantities of continuous production (see 5.2.1);
- determination of the long-term quality level (see 5.2.2).

5.2.1 Testing the partial quantities

5.2.1.1 Extent of testing

The cast is used for testing partial quantities. For each of the characteristics specified in the product standard, except chemical composition, one test piece shall be taken per 40 t for all diameters, with at least three test pieces per cast and nominal diameter.

The chemical composition (cast analysis) shall also be determined for all casts. The contents of the elements specified in the product standard shall be determined in this analysis.

5.2.1.2 Evaluation of the test results

When characteristic values are specified, the following requirements for the individual values (x_i) and the mean value (m) of the test unit are to be met:

$$a) x_i > 0,95f_k$$

where

f_k is the required characteristic value according to the product standard.

$$b) m \geq f_k + k s$$

where

k is the acceptability index according to 5.2.2.2;

s is the standard deviation of the test results.

Proven values of $k s$ for each product and manufacturer shall be used.

If simplified values can be used (see 4.3.2.4), $k s$ is replaced by the following values, a , for ribbed and plain bars:

For tensile strength: $a = 15$ MPa

For yield stress: $a = 10$ MPa

For elongation after rupture: $a = 1,5$ %

The mean value requirement in b) does not apply if all individual values lie above the required characteristic value.

All casts shall comply with the requirements for the chemical composition including the carbon equivalent. All other requirements shall be met for each individual test piece.

Where test results are unsatisfactory according to this sub-clause, the producer shall immediately take the necessary precautions. Casts which do not conform to the requirements shall be set aside.

5.2.2 Determination of the long-term quality level

The long-term quality level shall be evaluated separately for each steel grade and each nominal diameter.

5.2.2.1 Extent of testing

The results of tests on all partial quantities of the continuous production in accordance with 5.1 shall be collated and statistically evaluated and submitted to the inspection body and/or the certification body after at least 200 results have been presented, and at least every 3 months, in order to determine the long-term quality level.

5.2.2.2 Evaluation where characteristic values are specified

The average value (m) shall satisfy the following requirement:

$$m \geq f_k + k \times s_n$$

where

s_n is the standard deviation of the n results according to 5.2.2.1.

The values for the acceptability index (k) are listed in table 1, for a failure rate of 5 % ($p = 0,95$) at a probability of 90 % ($1 - \alpha = 0,90$).

Table 1 — Acceptability index(*k*) as a function of the number (*n*) of the test results

<i>n</i>	<i>k</i>	<i>n</i>	<i>k</i>
5	3,40	30	2,08
6	3,09	40	2,01
7	2,89	50	1,97
8	2,75	60	1,93
9	2,65	70	1,90
10	2,57	80	1,89
11	2,50	90	1,87
12	2,45	100	1,86
13	2,40	150	1,82
14	2,36	200	1,79
15	2,33	250	1,78
16	2,30	300	1,77
17	2,27	400	1,75
18	2,25	500	1,74
19	2,23	1000	1,71
20	2,21	∞	1,64

6 Inspection by an external body

6.1 Purpose

The purpose of external inspection is:

- continuous inspection of the conditions of production for compliance with the conditions established in the suitability test (see 4.3.1);
- continuous supervision of the proper procedure of internal inspection as specified in clause 5.

6.2 Organization

The certification body may authorize an inspection body to carry out the external inspection and supervision. The inspection body shall satisfy the requirements of ISO/IEC Guide 39.

6.3 Procedure

6.3.1 External inspection and supervision by the organization specified in 6.2 shall be carried out at maximum intervals of 6 months.

All properties subjected to internal inspection shall be tested. The specimens shall be taken from the producer's or consumer's stock. The test results shall be statistically evaluated and compared with the results from internal inspection. The number of tests in external inspection shall be sufficient to allow an assured assessment.

The results of external and internal inspection shall also be assessed for systematic errors in sampling, test procedures and evaluation. To this end, parallel tests on test pieces from at least 10 bars with the same nominal diameter and from the same cast

shall be carried out in each case by the producer and the body undertaking external inspection, and the results of these tests shall be compared.

6.3.2 The long-term quality level shall be determined at least twice a year and this shall be compared with the results achieved in internal inspection (see 5.2.2).

6.4 Evaluation

The results of external inspection shall be recorded in a supervision report which shall be sent to the certification body. If the results show that the production does not conform to the requirements, appropriate measures shall be taken, depending on the type and significance of the deficiencies noted, for example:

- warning the producer;
- intensification of inspection (increase the frequency of testing);
- requesting that the conditions of production should be changed;
- withdrawal of approval.

7 Delivery document

7.1 Reinforcing steels which have been produced in compliance with the requirements of a relevant product standard and subjected to quality assurance as described in clause 4, clause 5 and clause 6 of this International Standard, shall be supplied with a delivery document which contains the following information:

- a) name of the producing works;
- b) symbol or number of works;
- c) body carrying out external supervision;
- d) nominal diameter;
- e) designation according to the product standard;
- f) quantity supplied;
- g) date of manufacture;
- h) recipient.

7.2 Where reinforcing steels are supplied via a dealer or bending works, the dealer or bending works shall confirm on the delivery document that the reinforcing bar only originates from producing works which carry out quality supervision according to the requirements of this International Standard.

Annex A (informative)

Bibliography

- [1] ISO 3534:1977, *Statistics — Vocabulary and symbols*.
- [2] ISO 6935-1¹⁾, *Steel for the reinforcement of concrete — Part 1: Plain bars*.
- [3] ISO 6935-2¹⁾, *Steel for the reinforcement of concrete — Part 2: Ribbed bars*.
- [4] ISO 8402:1986, *Quality — Vocabulary*.
- [5] ISO 8930:1987, *General principles on reliability for structures — List of equivalent terms*.
- [6] ISO/IEC Guide 2:1986, *General terms and their definition concerning standardization and related activities*.

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