

INTERNATIONAL STANDARD

ISO
6935-3

First edition
1992-12-15

Steel for the reinforcement of concrete —

Part 3: Welded fabric

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Acier à béton pour armatures passives —

Partie 3: Treillis soudés

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Reference number
ISO 6935-3:1992(E)

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 6935-3 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 16, *Steels for the reinforcement and prestressing of concrete*.

ISO 6935 consists of the following parts, under the general title *Steel for the reinforcement of concrete*:

- Part 1: Plain bars
- Part 2: Ribbed bars
- Part 3: Welded fabric

Annex A of this part of ISO 6935 is for information only.

Steel for the reinforcement of concrete —

Part 3: Welded fabric

1 Scope

This part of ISO 6935 specifies technical requirements for factory made sheets or rolls of welded fabric, manufactured from steel wires or bars with diameters from 4 mm to 16 mm and designed for the reinforcement of concrete structures and the ordinary reinforcement of prestressed concrete structures.

For the purpose of this part of ISO 6935 the term "wire" also includes bars.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6935. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6935 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 404:1992, *Steel and steel products — General technical delivery requirements*.

ISO 6892:1984, *Metallic materials — Tensile testing*.

ISO 6935-1:1991, *Steel for the reinforcement of concrete — Part 1: Plain bars*.

ISO 6935-2:1991, *Steel for the reinforcement of concrete — Part 2: Ribbed bars*.

ISO 10065:1990, *Steel bars for reinforcement of concrete — Bend and rebend tests*.

ISO 10287:—¹⁾, *Steel for the reinforcement of concrete — Determination of strength of joints in welded fabric*.

ISO 10544:—¹⁾, *Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric*.

ISO 11082:—¹⁾, *Certification scheme for welded fabric for the reinforcement of concrete structures*.

3 Definitions

For the purposes of this part of ISO 6935, the following definitions apply.

3.1 test unit: The number of pieces or the tonnage of products to be accepted or rejected together, on the basis of the tests to be carried out on sample products in accordance with the requirements of the product standard or order. [ISO 404]

3.2 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]

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

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

3.4 fabric: A geometrical arrangement of longitudinal and transverse wires that are arranged substantially at right angles to each other and welded together at all points of intersection.

1) To be published.

3.5 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]

3.6 length of fabric: The longest side of the fabric, irrespective of the manufacturing direction.

3.7 longitudinal wire: Wire in the manufacturing direction of the fabric.

3.8 nominal cross-sectional area: The cross-sectional area equivalent to the area of a circular plain wire of nominal diameter.

3.9 overhang: The length of longitudinal or transverse wires beyond the centre of the outer crossing wire in a fabric. For twin wire fabric, the overhang is measured from the tangent line of the adjacent wires. (See figure 1.)

3.10 spacing: The centre-to-centre distance of wires in a fabric. For twin wire fabric, the spacing is measured between the tangents of the adjacent wires. (See figure 1.)

3.11 transverse wire: Wire perpendicular to the manufacturing direction of the fabric.

3.12 twin wires: Two wires of the same type and size placed adjacently and in contact with each other as a pair.

3.13 width of fabric: The shortest side of the fabric, irrespective of the manufacturing direction.

3.14 wire: The material from which the fabric is welded.

NOTE 2 For the purposes of this part of ISO 6935, the term "wire" also includes bars within the size range specified in 4.1.1.

4 Form and dimensions

This part of ISO 6935 covers regular fabric (4.2) and designed fabric (4.3).

4.1 General requirements

4.1.1 The fabric shall be made of either

- cold-reduced wires with nominal diameters in the range from 4 mm to 16 mm (recommended: 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm and 12 mm) and with mass and geometry complying with ISO 10544;

or

- plain bars with nominal diameters of 6 mm, 8 mm, 10 mm, 12 mm or 16 mm (recommended: 6 mm, 8 mm, 10 mm and 12 mm) and with mass complying with ISO 6935-1;

or

- ribbed bars with nominal diameters of 6 mm, 8 mm, 10 mm, 12 mm or 16 mm (recommended: 6 mm, 8 mm, 10 mm and 12 mm) and with mass and geometry complying with ISO 6935-2.

4.1.2 All fabric shall be machine made, and the joints at the intersections of the longitudinal and transverse wires shall be made by electrical resistance welding to provide shear resistant connections complying with clause 6.

4.1.3 Each sheet of fabric shall contain the number of wires appropriate to its specified length, width, spacing and overhang dimensions.

The number of broken welds shall not exceed either 1 % of the total number of cross-welded joints in the sheet or half the number of cross-welded joints along any one wire.

4.1.4 Fabric shall be free from any defect which can be shown to affect adversely the mechanical properties of the steel. Fabric including butt-welded wires shall be permitted and missing wires resulting from test sampling in accordance with clause 7 shall not be considered as defects.

4.1.5 The longitudinal wires may be single or twin wires. The transverse wires shall be single wires.

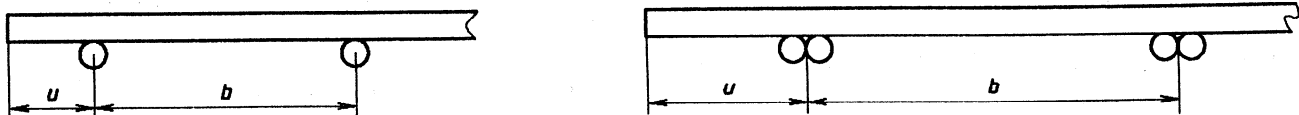


Figure 1 — Wire spacing, *b*, and overhang, *u*

4.1.6 The diameters of crossing wires in single-wire fabric shall meet the following requirement:

$$d_{\min} \geq 0,6 d_{\max}$$

where

d_{\max} is the nominal diameter of the thickest wire;

d_{\min} is the nominal diameter of the crossing wire.

For twin-wire fabric, the wire diameters shall meet the following requirement:

$$0,7d_T \leq d_L \leq 1,25d_T$$

where

d_T is the nominal diameter of the transverse wire;

d_L is the nominal diameter of one of the twin wires.

4.1.7 The dimensions of the fabric shall be specified as gross length in both directions.

4.1.8 The permitted geometric deviations for fabric are:

length and width: ± 25 mm ou $\pm 0,5$ %, whichever is greater;

wire spacing: ± 10 mm or $\pm 7,5$ %, whichever is greater.

4.1.9 The recommended spacing of longitudinal wires is a multiple of 50 mm and preferably not less than 100 mm.

The recommended spacing of transverse wires is a multiple of 25 mm and preferably not less than 100 mm.

4.2 Geometry of regular fabric

Regular fabric is characterized by having wires of equal nominal diameter across the length and width of the fabric. The spacing is also constant in each direction. The wire diameters and spacing may differ for the two directions.

All the wires in one direction shall be of equal length.

The recommended overhang, u , is not less than 25 mm.

4.3 Geometry of designed fabric

Designed fabric differs from regular fabric, which is described in 4.2.

The geometry and dimensions of designed fabric shall be agreed between the manufacturer and purchaser, and shall be specified on a drawing.

The recommended overhang, u , is not less than 25 mm.

5 Chemical composition

The chemical composition of the welded fabric shall comply with the product analysis requirements of

- ISO 10544 for cold-reduced wires;
- ISO 6935-1 for plain bars;
- ISO 6935-2 for ribbed bars.

6 Mechanical properties

The tensile and bending properties of the welded fabric shall comply with the requirements of

- ISO 10544 for cold-reduced wires;
- ISO 6935-1 for plain bars;
- ISO 6935-2 for ribbed bars.

The strength of the welded joints, in newtons, shall be at least 30 % of the specified characteristic yield or proof stress multiplied by the nominal cross-sectional area of the thickest wire.

7 Testing of mechanical properties

The testing shall be done on wires taken from the fabric in the delivery condition. The test piece shall not be worked before testing but it may be heated to 100 °C and then cooled freely in air to the test temperature.

7.1 Tensile test

The tensile properties shall be determined according to ISO 6892. The test piece shall have an original gauge length of 10 times the nominal diameter and shall have at least one crossing wire. The free distance between the grips shall be at least 20 times the nominal diameter, and not less than 180 mm.

In fabric with twin wires, the wire which is not under test shall be cut off approximately 20 mm from the joints.

For calculation of yield or proof stress and tensile strength, the nominal cross-sectional area of the wire shall be used.

7.2 Bend test

The bend test shall be carried out according to ISO 10065.

The test piece shall be taken from the thickest wire in fabric with single wires in both directions. In the case of twin-wire fabric, the test piece shall be taken from the twin wire.

The length of the test piece shall be at least 200 mm, and it shall be free from crossing wires in the length subject to bending.

The test piece shall be bent to an angle between 160° and 180° over a mandrel of the diameter specified in

- ISO 10544 for cold-reduced wires;
- ISO 6935-1 for plain bars;
- ISO 6935-2 for ribbed bars.

The angle of bend shall be measured before unloading.

7.3 Strength of welded joints

The joints shall be tested according to ISO 10287.

A test piece with the recommended minimum dimensions shown in figure 2 shall be cut from the fabric. In addition to the weld to be tested, the test

piece may have one or more welds, depending on the spacing.

For fabric with single wires in both directions, the thicker wire shall be used as the pulling wire.

For fabric with twin wires, one of the twin wires shall be the pulling wire. The other twin wire is cut off from the crossing wire without affecting the weld under test.

Test pieces previously subjected to tensile testing may be used for the weld shear test, provided that the necking at the fracture is clear of the weld zone.

8 Designation

8.1 Regular fabric

Regular fabric shall be designated in the following order:

- welded fabric ISO 6935-3;
- spacing in the direction of length and width respectively, in millimetres;
- length × width, in metres;
- designation of the wires in the direction of length and width respectively, according to the International Standard whose requirements shall apply.

Dimensions in millimetres

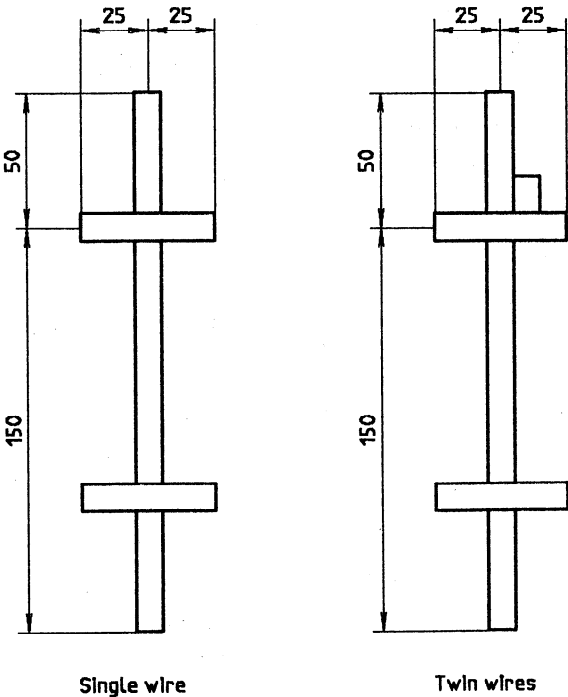


Figure 2 — Test pieces

Example of designation of regular fabric:

Welded fabric ISO 6953-3 — 150 mm × 200 mm — 5 m × 2 m, Reinforcing steel ISO 10544, 8 mm indented, Reinforcing steel ISO 10544 6 mm indented.

8.2 Designed fabric

Designed fabric according to this part of ISO 6935 should be designated in the following order:

- welded fabric ISO 6935-3;
- D (for designed);
- length × width, in metres;
- drwg. No. (for drawing);
- pos. No. (for position);
- designation of the wires according to the International Standard whose requirements shall apply.

Example of designation of designed fabric:

Welded fabric ISO 6935-3 — D 6,2 m × 3,4 m, drwg. No. 318 — pos. No. 3, Reinforcing steel ISO 6935-2 — 16 RB 500W, Reinforcing steel ISO 6935-1 — 10 PB 300.

9 Marking

Each bundle of welded fabric shall have a label stating the manufacturer, the number of this part of ISO 6935 (ISO 6935-3), and a reference number related to the test certificate. For designed fabric the position number shall be included.

10 Certification and inspection

Certification and inspection of reinforcement shall be performed

- in accordance with a certification scheme monitored by an external body, see ISO 11082;
- according to testing of a specific delivery.

10.1 Certification scheme

In the case of certification scheme, certification and inspection shall be performed in accordance with ISO 11082.

10.2 Testing of a specific delivery

Provisions regarding the nature, extent and evaluation of acceptance tests on deliveries of welded

fabric not subject to a certification scheme are given in 10.3 and 10.4.

Testing of a specific delivery shall be performed according to 10.3.

By agreement between manufacturer and purchaser, 10.4 may be used.

10.3 Verification of conformity

10.3.1 Organization

The tests shall be organized and carried out according to an agreement between purchaser and manufacturer, taking into consideration the national rules of the receiving country.

10.3.2 Extent of sampling and testing

For the purpose of testing, the delivery shall be subdivided into test units with a maximum mass of 25 t or a fraction thereof. Each test unit shall consist of products of the same fabric type and from the same production lot.

Fifteen test pieces (if appropriate 60 test pieces; see 10.3.3.1) from various fabrics shall be taken from each test unit.

10.3.3 Evaluation of the results

10.3.3.1 Inspection by variables

For properties which are specified as characteristic values, the following shall be determined:

- a) all individual values, x_i , of the 15 test pieces ($n = 15$);
- b) the mean value m_{15} (for $n = 15$);
- c) the standard deviation s_{15} (for $n = 15$).

The test unit corresponds to the requirements if the condition stated below is fulfilled for all properties:

$$m_{15} - 2,33 \times s_{15} \geq f_k$$

where

f_k is the required characteristic value;

2,33 is the value for the acceptability index k for $n = 15$ for a failure rate of 5 % ($p = 0,95$) at a probability of 90 % ($1 - \alpha = 0,90$).

If the condition stated above is not fulfilled, the index

$$k' = \frac{m_{15} - f_k}{s_{15}}$$

is determined from the test results available. Where $k' \geq 2$, testing can be continued. In this case 45 additional test pieces shall be taken and tested from various fabrics, so that a total of 60 test results are available ($n = 60$).

The test unit shall be considered to comply with the requirements if the condition stated below is fulfilled for all properties:

$$m_{60} - 1,93 \times s_{60} > f_k$$

where 1,93 is the value for the acceptability index k for $n = 60$ for a failure rate of 5 % ($p = 0,95$) at a probability of 90 % ($1 - \alpha = 0,90$).

10.3.3.2 Inspection by attributes

When testing properties specified as maximum or minimum values, all results determined on the 15 test pieces shall comply with the requirements of this part of ISO 6935. In this case the test unit shall be considered to comply with the requirements.

The tests can be continued when at most 2 results not conforming to conditions occur. In this case 45 further test pieces from various fabrics in the test unit shall be tested, so that a total of 60 test results are available. The test unit complies with the requirements if at most 2 of the 60 results do not conform to the conditions.

10.4 Verification of guaranteed minimum values

Tests shall be carried out according to the following.

- For the purpose of testing, the delivery shall be subdivided into test units with a maximum mass

of 50 t or a fraction thereof. Each test unit shall consist of products of the same nominal diameter from the same production lot.

- For each mechanical property specified, one test shall be carried out for each test unit. Each individual test result shall meet the requirements specified in clause 6.
- If any test result does not meet the requirements, retests may be carried out, according to ISO 404.
- the manufacturer shall submit a test report stating that products of the delivery satisfy the mechanical properties specified in clause 6 and a confirmation that the other requirements of this part of ISO 6935 are fulfilled.

11 Test report

The test report shall contain the following information:

- a) works producing the welded fabric;
- b) designation of the fabric according to clause 8;
- c) number on the bundle;
- d) name of the organization carrying out the test, if appropriate;
- e) date of testing;
- f) mass of the test unit;
- g) test results.

Annex A
(informative)

Bibliography

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| [1] ISO 3534:1977, <i>Statistics — Vocabulary and symbols.</i> | [3] ISO 8930:1987, <i>General principles on reliability for structures — List of equivalent terms.</i> |
| [2] ISO 8402:1986, <i>Quality — Vocabulary.</i> | [4] ISO/IEC Guide 2:1991, <i>General terms and their definitions concerning standardization and related activities.</i> |

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