

INTERNATIONAL STANDARD

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Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions

*Aciers pour traitements thermiques et aciers alliés — Classes de qualité
de surface des ronds et fils-machine laminés à chaud — Conditions
techniques de livraison*



Reference number
ISO 9443:1991(E)

Foreword

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International Standard ISO 9443 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 4, *Heat treatable and alloy steels*.

Annex A of this International Standard is for information only.

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Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions

1 Scope

1.1 This International Standard specifies delivery conditions which apply to the surface quality on the basis of the characteristics given in clause 4, for bars and wire rods with round section ordered in the hot-rolled surface condition.

NOTES

1 By agreement between manufacturer and purchaser, this International Standard might also be applied to other symmetrical shapes of cross-sections.

2 When agreed at the time of enquiry and order, this International Standard may also be applied to cold-drawn material, in particular the surface quality classes 5 to 7.

1.2 This International Standard applies particularly to steels for engineering applications, but may, by agreement, also be applied to structural steels or tool steels.

1.3 This International Standard does not include any requirements for the permissible depth of surface decarburization.

1.4 The material standards for steel bars and wire rods may exclude the application of one or other of the surface quality classes of this International Standard. They may also cover requirements for surface quality which deviate from this International Standard. In these cases the requirements of the material standard shall prevail.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publi-

cation, 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 404:1981, *Steel and steel products — General technical delivery requirements*.

ISO 6929:1987, *Steel products — Definitions and classification*.

ISO 7800:1984, *Metallic materials — Wire — Simple torsion test*.

3 Definitions

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

3.1 delivery lot: Unless otherwise specified in the order or product standard, a quantity of steel of the same type and the same diameter ordered with the same requirements for the surface quality and delivered at the same time.

3.2 Product forms

The definitions given in ISO 6929 apply.

3.3 Imperfections and defects

3.3.1 imperfections: Discontinuities with a depth smaller than or equal to the specified limiting value which may be left without repair.

3.3.2 defects: Discontinuities with a depth greater than the specified limiting value.

3.4 Sharp and shallow discontinuities

3.4.1 sharp discontinuities: All discontinuities which may act as a notch, for example, laps, seams and cracks.

3.4.2 shallow discontinuities: Discontinuities which have a less notch-like effect and a shallower aspect, such as rolled-in scale and slivers.

4 Requirements

All products shall have a workmanlike finish (see also clause 7) and shall comply with the requirements specified or agreed in accordance with clause 5.

5 Ordering

Unless the material standard gives exact specifications of this kind, the order shall, as demonstrated in the following examples, cover

a) the surface quality class (see table 1);

and

b) one of the following:

- 1) if the original depth of the surface discontinuities can still be determined after the processing of the material, the maximum admissible portion z_a of defective material in the total delivery lot found during or after further processing (see notes 3 to 5); or
- 2) if the total delivery lot can be checked before processing, the maximum admissible portion z_b of defective material in the total delivery lot found before processing (see notes 3 to 5); or
- 3) if it is not possible to check the total delivery, special agreements are to be made with regard to the maximum admissible portion z of defective material and with regard to its verification.

Example for case b) 1):

For an agreed surface quality class 3 and a maximum admissible portion z_a of defective material of 5 % of the total delivery lot found during or after further processing.

Designation

Surface quality ISO 9443 - class 3 - z_a 5,0.

Example for case b) 2):

For an agreed surface quality class 3 and a maximum admissible portion z_b of defective material of 5,0 % of the total delivery lot found before processing.

Designation

Surface quality ISO 9443 - class 3 - z_b 5,0.

NOTES

3 The method of calculation for the portion z_a or z_b of defective material should be agreed upon at the time of enquiry and order and should be based, for example, on the length of defects per total length of material delivered or the number of defective bars per total number of delivered bars or the number of defective coils per total number of delivered coils.

4 The exact verification of the compliance of the surface quality with the requirements agreed upon according to b) 2) is relatively complicated and expensive.

Therefore, if possible, method b) 1) is normally preferred. When method b) 1) is agreed upon, and if already during processing it becomes obvious that the portion of defective material in the total delivery is greater than z_a , the customer may stop further processing of the delivery lot and make a complaint (see also ISO 404 and 6.2.4).

5 The handling of defective material should also be agreed upon at the time of enquiry and order, for example, whether it shall be sent back to the manufacturer or scrapped etc. This also applies if the total delivery is accepted.

6 Testing

6.1 General

6.1.1 The manufacturer takes, under his own responsibility and according to his own judgment, suitable measures to supervise his production in view of the specified surface quality requirements.

NOTE 6 At the present state of development, facilities for the continuous testing of the specific surface quality classes at high temperatures do not exist. After rolling, the rod manufacturer can normally only check the ends of the coils for compliance with surface quality requirements.

6.1.2 The customer is free to check the surface quality of the delivered material by methods he regards as suitable. However, disputes shall be resolved by measuring depths of discontinuities by the techniques specified in 6.2.3.2 .

6.2 Test methods

6.2.1 General

6.2.1.1 The methods used for detecting discontinuities and measuring the depth of discontinuities shall be sufficiently accurate and shall give reproducible results.

6.2.1.2 Non-destructive methods (see 6.2.2.1 and 6.2.3.1) and also technological methods (see 6.2.2.2) are admitted.

6.2.1.3 In cases of dispute, the measurements carried out in accordance with 6.2.3.2 on products in the delivery condition shall be the deciding factor.

6.2.2 Methods for the detection of discontinuities.

The following methods or other suitable ones can be used for the detection of surface discontinuities.

6.2.2.1 Non-destructive methods

- visual examination;
- magnetic flux method, for example, magnetic particle inspection or probe methods;
- inductive methods (eddy currents);
- dye penetrant.

6.2.2.2 Technological test methods

The following tests may be taken into consideration:

- warm compression tests;
- cold compression tests;

— torsion tests (see ISO 7800).

6.2.3 Methods for measuring the depth of discontinuities

6.2.3.1 By non-destructive test methods such as:

- magnetic flux measurement with rotating or stationary probes;
- inductive methods;
- potential probe method using direct current;
- ultrasonic tests.

These methods can only determine the depth of discontinuities approximately.

6.2.3.2 The exact determination of the depth of a discontinuity is to be carried out either by filing the discontinuity down to its root or by examining a metallographic specimen. In both cases the depth is measured in the radial direction (see also table 1, footnote 1).

6.2.4 Production tests on trial batches

When inspection on arrival reveals questionable quality, the processing of a trial batch may be agreed upon in order to reveal whether the material is acceptable for the intended application. In this case the size of the trial batch shall be agreed upon.

7 Repairs

Local imperfections may be eliminated by removing defects until the surface is smooth within the limits prescribed by the removal level in table 1, column 5.

Table 1 — Surface quality classes *

1	2	3	4	5
Surface quality class	Nominal diameter	Maximum permissible depth ¹⁾ of		
	d_N mm	sharp discontinuities mm	shallow discontinuities mm	local repairs mm
1	$5 \leq d_N \leq 25$	0,5	0,5	0,5
	$25 < d_N \leq 120$	$0,02 \cdot d_N$	$0,02 \cdot d_N$	$0,02 \cdot d_N$
2	$5 \leq d_N \leq 30$	0,3	0,3	0,3
	$30 < d_N \leq 120$	$0,01 \cdot d_N$	$0,01 \cdot d_N$	$0,01 \cdot d_N$
3	$5 \leq d_N \leq 40$	0,2	0,2	0,2
	$40 < d_N \leq 80$	$0,005 \cdot d_N$	$0,005 \cdot d_N$	$0,005 \cdot d_N$
4	$5 \leq d_N \leq 60$	PDF ²⁾	PDF ²⁾	PDF ²⁾
5	$5 \leq d_N \leq 30$	0,3	3)	3)
	$30 < d_N \leq 60$	$0,01 \cdot d_N$	3)	3)
6	$5 \leq d_N \leq 40$	0,2	3)	3)
	$40 \leq d_N \leq 60$	$0,005 \cdot d_N$	3)	3)
7	$5 \leq d_N \leq 60$	PDF ²⁾	3)	3)
8	$50 \leq d_N \leq 120$	1,0	$0,04 \cdot d_N$	$0,04 \cdot d_N$
9	$25 \leq d_N \leq 120$	0,5	$0,04 \cdot d_N$	$0,04 \cdot d_N$
10	$5 \leq d_N \leq 60$	0,3	$0,04 \cdot d_N$	$0,04 \cdot d_N$
11	$5 \leq d_N \leq 60$	0,2	$0,04 \cdot d_N$	$0,04 \cdot d_N$
12	$5 \leq d_N \leq 60$	PDF ²⁾	PDF ²⁾	$0,04 \cdot d_N$
8A	$50 \leq d_N \leq 120$	1,0	$0,5 \cdot t$ ⁴⁾	$0,5 \cdot t$ ⁴⁾
9A	$25 \leq d_N \leq 120$	0,5	$0,5 \cdot t$ ⁴⁾	$0,5 \cdot t$ ⁴⁾
10A	$5 \leq d_N \leq 60$	0,3	$0,5 \cdot t$ ⁴⁾	$0,5 \cdot t$ ⁴⁾
11A	$5 \leq d_N \leq 60$	0,2	$0,5 \cdot t$ ⁴⁾	$0,5 \cdot t$ ⁴⁾
12A	$5 \leq d_N \leq 60$	PDF ²⁾	PDF ²⁾	$0,5 \cdot t$ ⁴⁾

*) See also figure 1 and annex A.

1) The depth of surface discontinuities is measured from the actual surface of the product. The dimensional tolerance must also be considered when determining the section of the finished part which is guaranteed to be free of discontinuities/defects.

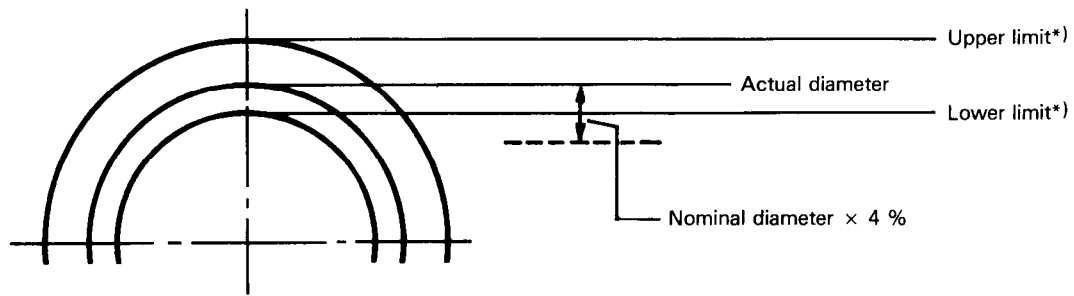
2) PDF = practically defect-free

This surface quality class shall exhibit a practically defect-free surface. This surface quality is dependent upon the steel production process and its quality control because existing non-destructive inspection techniques cannot measure such minor defects. The specific means of assuring this quality depend upon the customer's intended application and must be agreed upon by the customer and supplier.

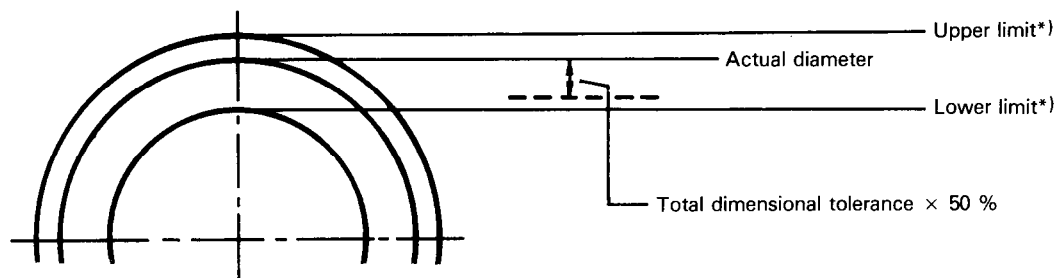
3) Shallow defects and local repairs are only permissible by special agreement between customer and supplier.

4) t = total diametric tolerance.

Class 8 to 12



Class 8A to 12A



*) Dimensional tolerance

Figure 1 — Explanation of the specifications in table 1 for the maximum admissible depth of shallow discontinuities or local repairs for the surface quality classes 8 to 12 and 8A to 12A.

Annex A (informative)

Additional explanations

A.1 Principal concepts

This International Standard covers two principally different concepts for specifying the surface quality of round steel bars and wire rods.

- a) It covers surface quality classes 1 to 7 by considering the natural correlation between the diameter of the products and the depth of (sharp) discontinuities.
- b) It also covers surface quality classes 8 to 12 and 8A to 12A by taking account of the fact that for some processing methods the admissible depth of sharp discontinuities is not a function of the product diameter and that, in view of the application of automatic control and marking devices, a specification of a constant admissible depth for the discontinuities offers advantages.

A.2 Application of the surface quality classes

It was originally intended to indicate in this International Standard that the surface quality classes 1 to 4 were mainly determined for products to be further processed by machining, classes 5 to 7 for products to be further processed by drawing and the other classes for products to be further processed by forging operations. Such indications proved, however, too incomplete and even misleading, because of the great number of different applications and of other aspects (e.g. the verification method) to be taken into account when choosing the appropriate surface quality class.

It is therefore intentional that this International Standard does not suggest the applicability of the various surface quality classes.

Some combinations of sharp and shallow defects in classes 8 to 12A are rarely suitable for customer applications. However, they are included in this International Standard because of the great variety of possible applications.

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