INTERNATIONAL STANDARD

ISO 11951

Second edition
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Cold-reduced tinmill products — Blackplate

Aciers pour emballage laminés à froid — Fer noir

Reference number
ISO 11951:2016(E)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 17, *Steel*, Subcommittee SC 9, *Tinplate and blackplate*.

This second edition cancels and replaces the first edition (ISO 11951:1995), which has been technically revised.

Introduction

Selling of packaging steels is today a worldwide business. Therefore, revision of this International Standard was expected earlier since the last edition dated from 1995. Because of the long period between revisions, harmonization became difficult. In some regions, the properties of the packaging steels are determined by the hardness test whereas in other regions, a decade ago, the hardness test was replaced by the tensile test. Since the latest available techniques should be reflected in this International Standard, the possibility of using the tensile test as the reference test for determining the mechanical properties should be considered during the next revision of this International Standard.

Cold-reduced tinmill products — Blackplate

1 Scope

This International Standard specifies requirements for single and double cold-reduced blackplate in the form of coils which are intended for manufacturing electrolytic tinplate or electrolytic chromium/chromium oxide-coated steel (ECCS) in accordance with ISO 11949 or ISO 11950.

Single cold-reduced blackplate is generally specified in nominal thicknesses that are multiples of 0,005 mm from 0,150 mm up to and including 0,600 mm. Double cold-reduced blackplate is generally specified in nominal thicknesses that are multiples of 0,005 mm, from 0,100 mm up to and including 0,360 mm.

This International Standard applies to coils in nominal minimum rolling widths of 600 mm[1)] with either trimmed or untrimmed edges.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 404, *Steel and steel products — General technical delivery requirements*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

ISO 6892-1:—[2)], *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 11949, *Cold-reduced tinmill products — Electrolytic tinplate*

ISO 11950, *Cold-reduced tinmill products — Electrolytic chromium/chromium oxide-coated steel*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1
blackplate
cold-reduced low-carbon mild steel, normally oiled, for the production of electrolytic tinplate or ECCS in accordance with ISO 11949 or ISO 11950

3.2
single cold-reduced
description of product in which the blackplate has been reduced to the desired thickness in a cold-reduction mill and subsequently annealed and temper rolled

1) Nominal minimum rolling widths of 500 mm may be applied by agreement between the purchaser and the manufacturer.

2) To be published (Revision of ISO 6892-1:2009)

3.3
double cold-reduced
description of product in which the blackplate has had a second major reduction after annealing

3.4
batch annealed
box annealed
BA
annealed by the process in which the cold-reduced strip is annealed in coil form, within a protective atmosphere, for a predetermined time-temperature cycle

3.5
continuously annealed
CA
annealed by the process in which cold-reduced coils are unwound and annealed in strip form within a protective atmosphere

3.6
finish
appearance of the surface of blackplate resulting from controlled preparation of the work rolls used for the final stages of rolling

3.6.1
smooth finish
finish resulting from the use of temper-mill work rolls that have been ground to a low roughness

Note 1 to entry: This finish is used for the production of bright finish tinplate or bright finish ECCS.

3.6.2
stone finish
finish characterized by a directional pattern, resulting from the use of final-mill work rolls that have been ground to a higher level of roughness than those used for the smooth finish

3.6.3
matt finish
finish resulting from the use of temper-mill work rolls with dull surface textured by shot blast, electro discharge texturing (EDT), electron beam texturing (EBT) or another suitable method

3.7
coil
rolled flat strip product that is wound into regularly superimposed laps so as to form a coil with almost flat sides

3.8
longitudinal bow
line bow
residual curvature in the strip remaining along the direction of rolling

3.9
transverse bow
cross bow
mode of curvature in the strip such that the distance between its edges parallel to the direction of rolling is less than the strip width

3.10
centre fullness
centre buckle
full centre
intermittent vertical displacement or wave in the strip occurring other than at the edges

Note 1 to entry: See Figure 6.

3.11
edge wave
intermittent vertical displacement occurring at the strip edge when the strip is laid on a flat surface

Note 1 to entry: This parameter is only applicable to material supplied with trimmed edges.

3.12
feather edge
transverse thickness profile
variation in thickness characterized by a reduction in thickness close to the edges at right angles to the direction of rolling

Note 1 to entry: This parameter is only applicable to material supplied with trimmed edges.

3.13
edge camber
deviation of edge of coil/sheet from a straight line forming its chord

3.14
burr
metal displaced beyond the plane of the surface of the strip by shearing action

3.15
rolling width
width of the rolled strip perpendicular to the direction of rolling

3.16
consignment
quantity of material of the same specification made available for dispatch at the same time

3.17
pallet
base platform on which a coil is placed to facilitate ready transportation

3.18
anvil effect
effect that a hard anvil can produce on the numerical hardness value obtained when a hardness test is performed on very thin material supported on such an anvil

4 General technical delivery condition

In cases where the technical delivery condition is not specified in this International Standard, then ISO 404 shall apply.

5 Classification

Steel grades for this International Standard are generally classified as non-alloy quality steels.

6 Information to be supplied by the purchaser

6.1 Designation

For the purposes of this International Standard, blackplate is designated in terms of a steel grade classification based either on the Rockwell HR30Tm hardness values or on the tensile properties. For the hardness requirements, the steel grade designations are given in Table A.1 for single cold-reduced blackplate and in Table A.2 for double cold-reduced blackplate. For the tensile properties requirements, the steel grade designations are given in Table B.1.

Blackplate covered by this International Standard shall be designated by the following characteristics in the given sequence:

a) a reference to this International Standard, i.e. ISO 11951;

b) the steel grade designation in accordance with Table A.1, Table A.2, or Table B.1;

c) the type of annealing used by the manufacturer (see 7.2);

d) the type of finish (see 7.3);

e) the dimensions of the thickness and width, in millimetres;

f) whether mill-edge or trimmed.

EXAMPLE

Single cold-reduced blackplate coil, in accordance with this International Standard, steel grade T61, continuously annealed (CA), stone finish, with a thickness of 0,220 mm and a width of 800 mm after trimmed, shall be designated.

ISO 11951 - T61 CA - stone - 0,220 × 800 trimmed

Double cold-reduced blackplate coil, in accordance with this International Standard, steel grade T75, continuously annealed (CA), stone finish, with a thickness of 0,180 mm and a mill-edge width of 750 mm, shall be designated.

ISO 11951 - T75 CA - stone - 0,180 × 750 mill-edge

Blackplate coil, in accordance with this International Standard, steel grade TH415, continuously annealed (CA), stone finish (ST), with a thickness of 0,200 mm and a mill-edge width of 750 mm, shall be designated.

ISO 11951 - TH415 CA - ST - 0,200 × 750 mill-edge

Blackplate coil, in accordance with this International Standard, steel grade TS520, batch annealed (BA), stone finish, with a thickness of 0,140 mm and a width of 844 mm after trimmed, shall be designated:

ISO 11951 - TS520 BA - stone - 0,140 × 844 trimmed

6.2 Mandatory information

The following information shall be given in the enquiry and order to assist the manufacturer in supplying the correct material:

a) the designation as given in 6.1;

b) the quantity, expressed on a mass basis, e.g. 50 tons of sheets, 100 tons of coils;

c) the minimum and the maximum coil weight, the minimum and the maximum coil outer diameter, the coil internal diameter, the core vertical or horizontal, and the direction of winding (see 15.1);

d) whether or not the coil shall be supplied with the edges trimmed;

e) whether or not the coil shall be coated with a suitable oil.

f) other inspection document than that specified by the manufacturer (see Clause 14);

NOTE Appropriate steel grade is suitable for shaping operations such as stamping, drawing, folding, beading and bending, and assembly work such as joint forming and welding. The end use is important when the steel grade is selected.

6.3 Options

When ordering, the purchaser shall supply all the necessary information concerning the following:

a) the production facilities which he/she anticipates will be appropriate to the ordered blackplate;

b) the intended end use.

7 Manufacturing features

7.1 Manufacture

Continuously cast, fully-killed steel shall be applied, except when otherwise specified. The examples of the steel types of blackplate are shown in Annex C.

The steel type of blackplate shall be designed to secure food safety when blackplate is applied for food application. The purchasers should be aware of existing national regulations which may impose limitations on some elements.

The methods of manufacture of blackplate are the province of the manufacturer and are not specified in this International Standard.

NOTE It is recommended that the manufacturer supplies to the purchaser such details of the manufacturing process so as to assist the purchaser in his/her efficient use of the blackplate.

7.2 Annealing

Annealing of blackplate shall be either batch annealing (BA) or continuous annealing (CA) and shall be specified by the purchaser at the time of enquiry and order.

7.3 Finish

Blackplate is usually available in the finishes as indicated in Table 1. The type of finish is designated either by the blackplate finish or the code shown in Table 1.

Table 1 — Typical finishes for blackplate

Finish	**Code**[a]	**Surface roughness**[b, c] *Ra* µm
Smooth	BT	≤0,35
Fine stone	FS	0,25 – 0,45
Stone	ST	0,35 – 0,60
Matt	MM	≥0,90

NOTE Double cold-reduced blackplate is usually supplied with a stone finish.

[a] By agreement between the purchaser and the manufacturer, another code system may be applied.

[b] Values of surface roughness in this table are not mandatory. The values are given for reference in order to classify the finishes.

[c] The measurement of surface roughness is in accordance with ISO 4288.

7.4 Oiling

To avoid corrosion, blackplate shall normally be supplied with a sufficient layer of a suitable, non-mineral, protective oil. The oil shall be removed by an adequate inline cleaning process before any subsequent coating.

When blackplate is required without an oil coating, this shall be indicated at the time of ordering.

NOTE When unoiled blackplate is supplied, there is an increased risk of surface corrosion.

7.5 Imperfections

The production of blackplate coils in continuous-strip mill operations does not afford the opportunity for removal of all blackplate that does not comply with the requirements of this International Standard.

However, the manufacturer has to ensure that in coils complying with this International Standard, at least 90 % of the coil can be used for producing electrolytic tinplate or chromium/chromium oxide coated steel sheet which is

a) free from surface imperfections which render the material unsuitable for the intended use,

b) free from damage which render the material unsuitable for intended use, and

c) compliant with the requirements as specified in this International Standard.

The purchaser is expected to have adequate handling and roller levelling equipment and inspection facilities and to take reasonable care during these operations.

8 Mechanical properties

8.1 General

For the purposes of this International Standard, blackplates are classified into steel grades based on either Rockwell HR30Tm hardness values or tensile properties. The purchaser shall indicate the specification either by hardness requirement or by tensile properties requirement, but not for both when ordering the material.

When ordering the material for applications such as drawn cans, DWI cans, twist off caps, etc., it is recommended to indicate the specification according to the tensile property requirement.

Other mechanical properties might significantly influence the performance of blackplate in processing and the subsequent intended end use might vary depending on the steel type and the methods of casting, annealing, and temper rolling employed.

At the time of enquiry and order, it shall be agreed that properties of steel grade are to be verified either by the tensile test or by the hardness test.

8.2 Hardness requirement

The hardness values for blackplate shall be as given in Table A.1 and Table A.2 when tested as described in 12.1.

8.3 Tensile property requirement

The proof strength, $R_{p0,2}$, for blackplate shall be as given in Table B.1 when tested as described in 12.2.

For routine testing, the proof strength may be determined using the springback test as described in Annex D. However, in cases of dispute, the method described in 12.2 shall be applied.

9 Tolerances on dimensions and shape

9.1 General

Tolerances on dimensions (i.e. thickness, width, and length) and shape (i.e. edge camber and flatness) are specified in 9.2 to 9.6 together with appropriate methods of measurement.

9.2 Thickness and feather edge

9.2.1 Coil thickness

Nominal thickness shall be a multiple of 0,005 mm. Nominal thickness other than multiple of 0,005 mm may be specified by agreement between the purchaser and the manufacturer. Thickness out of the nominal thickness range may be specified by agreement between the purchaser and the manufacturer.

The thickness of blackplate shall not deviate from the ordered nominal thickness by more than +5 % to 8 % at any point except within 10 mm from the trimmed-edge.

The thickness shall be measured using a hand-operated, spring-loaded micrometer to an accuracy of 0,001 mm.

It is recommended that the micrometer should have a ball-ended shank and a curved-surface base anvil.

9.2.2 Feather edge

The thickness when measured at a distance of 10 mm from the mill trimmed edge shall not deviate from the actual centre thickness by more than −6 %.

9.3 Coil width

The width of the coil shall be measured to the nearest 0,5 mm at right angles to the direction of rolling.

For the products of this International Standard which are delivered with trimmed-edge, the measured width shall not deviate from the ordered width by more than +3, −0 mm. For mill-edge product, the measured width shall not deviate from the ordered width by more than +10, −0 mm.

9.4 Coil length

The difference between the actual length and the manufacturer's indicated length measured on any single coil shall not exceed by more than ±3 %, unless otherwise agreed.

9.5 Edge camber of trimmed coils

Edge camber is the maximum deviation (in the plane of the sheet) of an edge from a straight line forming a chord to its extremities (see Figure 1).

The edge camber, E, expressed as a percentage of the chord length, is calculated using Formula (1).

$$E = \frac{D}{L} \times 100 \tag{1}$$

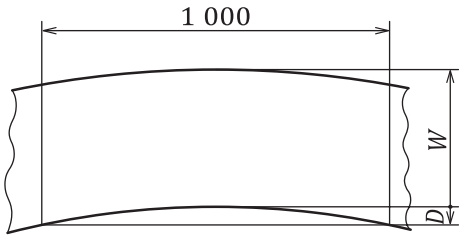
where

D is the deviation from a straight line, in millimetres;

L is the length of chord, in millimetres.

The edge camber, measured over a distance (chord length) of 1 000 mm, shall not exceed 0,1 % (i.e. 1 mm).

Dimensions in millimetres



Key

W width

D deviation from a straight line

Figure 1 — Edge camber

9.6 Flatness

9.6.1 Edge wave

The height of edge wave, h_{ew}, at any point, shall not exceed 2,5 mm when tested as described in 12.3.2. No more than six waves in excess of 1,5 mm shall be present over a cut length of 1 m for coil.

9.6.2 Longitudinal and transverse bow

Bow may be either convex or concave face uppermost on the bulk package. The normal convention is to express convex bow uppermost as a positive (+) value and concave bow as a negative (-) value.

The individual values of both longitudinal and transverse bow in levelled condition shall not exceed 30 mm when tested as described in 12.3.3. Where both convex and concave bow are present in the same coil, the sum of the maximum values of each, ignoring the sign (±), shall not exceed 30 mm. In case of unlevelled sheet from coil before cutting, the requirement of bow may be agreed between the purchaser and the manufacturer.

9.6.3 Centre fullness

Centre fullness shall be determined by either the direct method as described in 12.3.4.1 or the indirect method as described in 12.3.4.2. The selection of the method is at the discretion of the manufacturer. In case of the direct method, the height of centre fullness, h_{cf}, shall not exceed 5 mm when tested as described in 12.3.4.1. In case of the indirect method, the height of centre fullness, h_{if}, shall not exceed 9 mm when tested as described in 12.3.4.2.

NOTE Centre fullness is not clearly visible in a coil, but usually becomes apparent during either printing or slitting.

10 Joint within a coil

10.1 General

The manufacturer shall ensure continuity of the coils within the limits of the lengths ordered, if necessary, by means of electrically welded joints made after cold reduction. Requirements relating to the numbers, locations and dimensions of the joints permitted within a coil are given in 10.2 to 10.4.

10.2 Number of joint

The number of joints in a coil shall not exceed three in lengths of 10 000 m.

10.3 Location of joint

The location of each joint in a coil shall be indicated clearly.

The location of each joint may be indicated, for example, by the insertion of a piece of non-rigid material and punched holes. However, alternative methods may be agreed between the purchaser and the manufacturer at the time of enquiry and order.

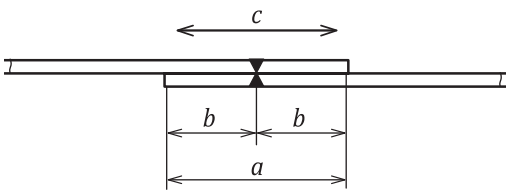
10.4 Dimension of joint

10.4.1 Thickness

The total thickness of any joint shall not exceed three times the nominal thickness of the material forming the joint.

10.4.2 Overlap

In any lap joint, the total length of overlap shall not exceed 10 mm. The free overlap shall not exceed 5 mm (see Figure 2).



Key

a total length of overlap

b free overlap

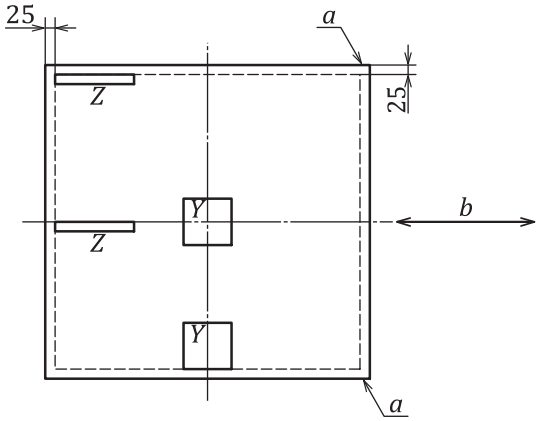
c direction of rolling

Figure 2 — Joint overlap

11 Sampling

For certifying the quality of product, the manufacturer shall take samples according to Figure 3 and carry out test. One sheet for test specimen shall be taken for every 30 tons or less and remainder thereof of the same properties, i.e. steel grade and dimensions.

Dimensions in millimetres



Key

Y test pieces for hardness

Z test pieces for tensile or springback tests

a trimmed edge

b direction of rolling

Figure 3 — Location of test pieces

12 Test method

12.1 Hardness test

12.1.1 Test piece

From each of the sample sheets obtained in accordance with Clause 11, take two test pieces from the positions marked *Y* on Figure 3.

Before carrying out the hardness tests in accordance with 12.1.2, artificially age the test pieces at 200 °C for 20 min. The artificial aging may not be necessary for non-aging materials.

When necessary, the surface shall be finished with fine emery paper.

12.1.2 Test method

Determine the Rockwell HR30Tm indentation hardness either

a) directly, in accordance with ISO 6508-1, or

b) indirectly, on relatively thin sheets (e.g. 0,22 mm and thinner), by determining the HR15Tm hardness in accordance with ISO 6508-1 and then converting the HR15Tm values to HR30Tm values using Annex E.

By agreement, the hardness may be determined either by HR30Tm or HR15Tm for the sample thickness between 0,20 mm and 0,22 mm.

Make three hardness measurements on each of the test pieces taken in accordance with 12.1.1. Calculate the representative hardness for the consignment as the arithmetic mean of all the hardness measurements on all the sample sheets taken from the consignment.

To measure the indentation hardness, use a Rockwell superficial hardness testing machine employing the 30Tm or 15Tm scales specified in ISO 6508-1 with a hardened steel ball indenter, as appropriate.

Avoid testing near the edges of the test pieces because of a possible cantilever effect.

12.2 Tensile test

12.2.1 Test piece

For each sheet selected in accordance with Clause 11, cut two rectangular test pieces with the rolling direction parallel to the length of the test piece at positions marked *Z* on Figure 3. Ensure that the edge test pieces clear the edges of the sheet by a minimum of 25 mm. Before carrying out the tensile test described in 12.2.2, artificially age the test pieces at 200 °C for 20 min. The artificial aging may not be necessary for non-aging materials.

12.2.2 Test method

Determine the 0,2 % proof strength using the conditions specified in ISO 6892-1:—, Annex B for thin products.

Carry out one test on each of the test pieces selected in accordance with 12.2.1, i.e. two tests per sheet selected.

Calculate the representative proof strength for the consignment as the arithmetic mean of all the results on all the sample sheets taken from the consignment.

12.3 Flatness test

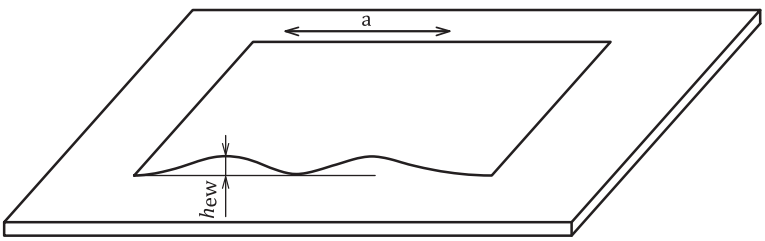
12.3.1 General

The method of measuring flatness is at the discretion of the manufacturer. In cases of dispute, the following method shall be applied as a referee method.

12.3.2 Edge wave

Each sample shall be laid on a flat horizontal surface which is larger than the sample itself. The height of edge wave, h_{ew}, shall be given as the feeler gauge diameter that just fits under the wave at the edge of the sample.

Heights of edge wave, h_{ew}, shall be determined by using feeler gauges of standard diameters in increments of 0,25 mm (Figure 4).



Key

h_{ew} edge wave

a direction of rolling

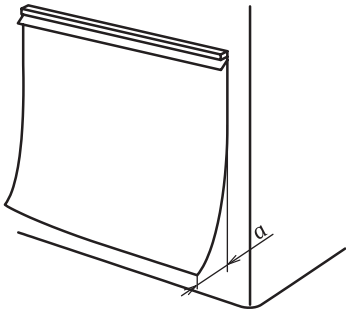
Figure 4 — Edge wave

12.3.3 Longitudinal or transverse bow

The maximum value of longitudinal or transverse bow shall be determined by hanging the sample from one horizontal edge against a rigid vertical surface noting whether the upper or lower surface is

against the vertical surface so that the bow causes the bottom edge of the sample to stand away from that surface. When selecting the sample, it is necessary to identify the outer and inner face of the coil.

The sample shall be evenly supported along the top to a depth not exceeding 25 mm from the edge. The maximum distance, the bottom edge stands away from the vertical (value *a* on Figure 5) is measured with a steel ruler to the nearest 1 mm and recorded with the appropriate plus or minus sign indicating convex or concave bow, respectively.



Key

a maximum distance between the bottom edge and the vertical

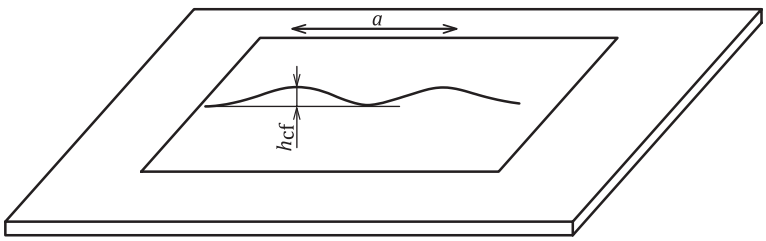
Figure 5 — Longitudinal or transverse bow

12.3.4 Centre fullness

12.3.4.1 Direct method

The sample sheet shall be laid on a flat and horizontal surface which is larger than the sample. A rigid, flat and straight bar, which is supported by two rigid blocks with the same and proper height, shall be set over the sample to be approximately right above the wave of the centre fullness and parallel to the rolling direction (see Figure 7).

Both distances at the points of the top and the bottom of the wave from the lower edge of the bar shall be measured, respectively. The height of centre fullness (value h_{cf} on Figure 6) shall be determined as the difference between these two values (values h_2 and h_1 on Figure 7).

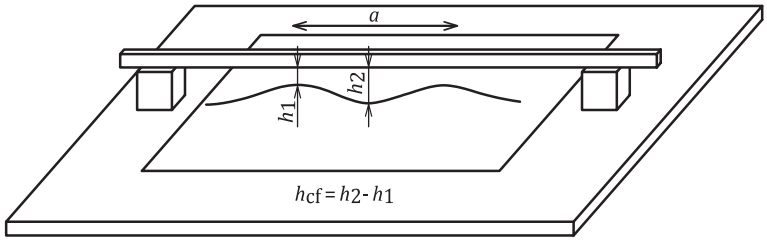


Key

h_{cf} centre fullness

a direction of rolling

Figure 6 — Definition of centre fullness



Key

a direction of rolling

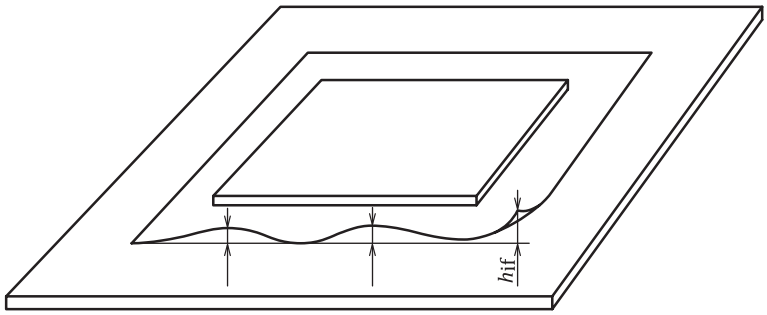
Figure 7 — Method of measuring centre fullness (direct method)

12.3.4.2 Indirect method

The sample sheet shall be laid on a flat and horizontal surface which is larger than the sample. A rigid and flat board shall be placed on the centre of the sample.

The board shall be moved around the surface of the sample centre until a position giving the highest edge lift can be identified. Pressure shall then be applied to the board so as to flatten the sample in the centre and raise the edge to a maximum height. During the test, the board shall not overlap the edges to be measured.

Edge lift shall be determined by using a 9 mm diameter feeler gauge and the product is deemed out of specification when the feeler gauge fits under the edge of the sheet at the point of maximum lift (value h_{if} on Figure 8).



Key

h_{if} maximum lift of the edge

Figure 8 — Method of measuring centre fullness (indirect method)

13 Retests

If any of the results obtained are unsatisfactory for mechanical properties, the manufacturer may either withdraw the test unit or perform retest. In case of retest, the measurements for that particular property shall be repeated twice on new sample sheets taken at a distance not less than 15 m from the coil end. If the results on both repeated tests meet the stated requirements, the consignment represented shall be deemed to comply with this International Standard, but if the results of either of the retests fail to meet the stated requirements, the consignment represented shall be deemed not to comply with this International Standard.

14 Inspection document

Blackplate complying with this International Standard shall be ordered and delivered with one of the inspection documents specified in ISO 10474. The type of document shall be agreed upon at the time of enquiry and order. Unless otherwise specified, the type of document shall be at the discretion of the manufacturer.

15 Dispatch and packaging

15.1 Coil orientation

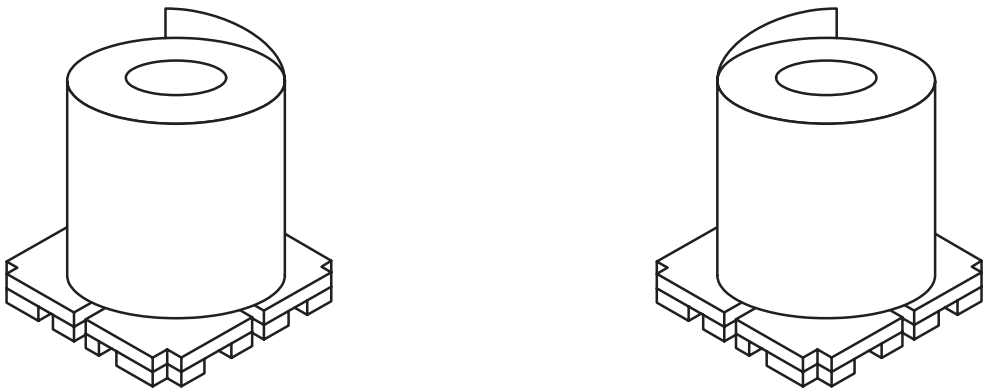
Coil shall be dispatched with their cores in either a vertical or horizontal position. The internal diameters of the coils shall be either ($420\ ^{+10}_{-15}$) mm or ($508\ ^{+10}_{-15}$) mm.

Unless otherwise requested at the time of ordering, coils shall be dispatched with their cores in a vertical position and an internal diameter of 420 mm.

Blackplate strip is usually supplied in consignments of coils with outside diameters of at least 1 200 mm, but a limited number of coils with smaller outside diameters may be included in the consignment.

If coils with a different internal diameter are required, this should be indicated at the time of ordering.

The manufacturer shall state the direction of winding in the coils to ensure that the correct surface is maintained throughout manufacture. Where coils are supplied with cores vertical (the normal method of delivery), the purchaser shall specify the required direction of winding (see Figure 9).



a) Anticlockwise (counterclockwise) **b) Clockwise**

Figure 9 — Direction of coil winding

15.2 Labelling

The products shall be marked by a label with the following items:

a) the manufacturer's trademark or symbol;

b) the steel grade;

c) the dimensions;

d) the identification number related to an appropriate inspection certificate.

Annex A
(normative)

Hardness requirements for blackplate

A.1 Hardness requirement for single cold-reduced blackplate

The hardness values for single cold-reduced blackplate shall be as given in Table A.1 when tested as described in 12.1.

Table A.1 — Hardness values (HR30Tm) for single cold-reduced blackplate

Steel grade		Hardness HR30Tm Thickness t mm		
Designation	Alternative designation	$t \leq 0{,}21$	$0{,}21 < t \leq 0{,}28$	$0{,}28 < t$
T49	T-1	50 ± 4	49 ± 4	48 ± 4
T53	T-2	54 ± 4	53 ± 4	52 ± 4
T55	T-2.5	56 ± 4	55 ± 4	54 ± 4
T57	T-3	58 ± 4	57 ± 4	56 ± 4
T59	T-3.5	60 ± 4	59 ± 4	58 ± 4
T61	T-4	62 ± 4	61 ± 4	60 ± 4
T65	T-5	66 ± 4	65 ± 4	64 ± 4

A.2 Hardness requirement for double cold-reduced blackplate

The hardness values for double cold-reduced blackplate shall be as given in Table A.2 when tested as described in 12.1.

Table A.2 — Hardness values (HR30Tm) for double cold-reduced blackplate

Steel grade		Hardness
Designation	Alternative designation	HR30Tm
T71	DR-7.5	71 ± 4
T72	DR-8	72 ± 4
T73	DR-8.5	73 ± 4
T75	DR-9	75 ± 4
T76	DR-9M	76 ± 4

Annex B
(normative)

Tensile property requirements for blackplate

The proof strength, $R_{p0,2}$, for blackplate shall be as given in Table B.1 when tested as described in 12.2.

For routine testing, the proof strength may be determined using the springback test as described in Annex D. However, in cases of dispute, the method described in 12.2 shall be applied.

Table B.1 — Tensile properties for blackplate

Steel grade	Annealing	$R_{p0,2}$[a] MPa	Deviation[b] MPa
TS200	BA	200	±50
TS230	BA	230	±50
TS245	BA	245	±50
TS260	BA	260	±50
TS275	BA	275	±50
TS290	BA	290	±50
TS340	BA	340	±50
TS480	BA	480	±50
TS520	BA	520	±50
TS550	BA	550	±50
TS580	BA	580	±50
TS620	BA	620	±50
TH230	CA	230	±50
TH245	CA	245	±50
TH260	CA	260	±50
TH275	CA	275	±50
TH300	CA	300	±50
TH330	CA	330	±50
TH350	CA	350	±50
TH385	CA	385	±50
TH400	CA	400	±50
TH415	CA	415	±50
TH435	CA	435	±50
TH450	CA	450	±50
TH480	CA	480	±50
TH520	CA	520	±50
TH550	CA	550	±50
TH580	CA	580	±50

Table B.1 *(continued)*

Steel grade	**Annealing**	$R_{p0,2}$[a] MPa	**Deviation**[b] MPa
TH620	CA	620	±50
TH650	CA	650	±50
NOTE 1 Steel grades TS480 may be delivered in either single or double reduced form. Steel grades TS520/TH520, TS550/TH550, TS580/TH580, TS620/TH620, and TH650 are usually delivered in double reduced form only. All other grades are delivered in single reduced form. NOTE 2 The deviations shown refer to measurements of individual samples.			
[a] R_{eL} or R_{eH} may be applied for steels that show a yield point elongation by agreement between the purchaser and the manufacturer. [b] In case that the deviation is out of ±50 MPa, blackplate may be supplied by agreement between the purchaser and the manufacturer.			

Annex C
(informative)

Steel types

The chemical composition of blackplate determined by cast analysis should be less than the following maximum values (% mass fraction): C: 0,13, Si: 0,03, Mn: 0,60, P: 0,020 and S: 0,030.

The following are examples of steel types:

a) steel type MR: base steel, low in residual elements that has corrosion resistance, widely used in general applications;

b) steel type L: base steel, extremely low in residual elements that has excellent corrosion resistance to certain types of food can;

c) steel type D: base steel, low in residual elements that has corrosion resistance, involving deep drawing or other types of severe forming that tend to give rise to Lueder's lines.

The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In cases of dispute, the method for analysis used shall be agreed taking into account the relevant existing International Standards.

NOTE The list of available International Standards on chemical analysis is given in ISO/TR 9769.[1]

Annex D
(informative)

Springback test for routine determination of proof strength for blackplate

D.1 General

The test described in this annex is not the reference method. In cases of dispute, the method described in 12.2 (i.e. ISO 6892-1) shall be applied.

D.2 Principle

This test provides a simple and rapid means of estimating the proof strength of double cold-reduced blackplate from measurement of thickness and angle of springback of a rectangular strip test piece after bending through 180° around a cylindrical mandrel, and then releasing.

D.3 Test pieces

The test pieces used are identical to those for the tensile test described in 12.2.1.

D.4 Test method

Make one test on each of the test pieces obtained in accordance with 12.2.1 (i.e. two tests per sheet selected).

In making the test, strictly observe the operational instructions provided with the springback tester. The principal steps in the test are the following:

a) measure the thickness of the blackplate test piece to the nearest 0,001 mm;

b) insert the test piece into the tester and fix it firmly in the testing position by gently tightening the clamping screw using light finger pressure;

c) bend the test piece through an angle of 180° around the mandrel by a gentle swing of the forming arm;

d) return the forming arm to its “start” position and read and record the springback angle by sighting directly over the test piece;

e) remove the test piece from the tester and, using the recorded thickness of the test piece and the springback angle, determine the appropriate springback index value from a suitable conversion formula (e.g. Bower) agreed between the purchaser and the manufacturer.

Calibrate each new springback tester using the standard tensile test (see 12.2) or another “reference” springback tester. In addition, since malfunctions arising, for example, from excessive wear or inadvertent abuse of the test equipment, may not be readily apparent, it is recommended that the springback test readings should be regularly compared with readings from the standard tensile test or a “reference” springback tester. It is also recommended that such direct cross-checks be further supplemented by the frequent use of reference blackplate samples of known proof stress.

Annex E
(normative)

Rockwell HR15Tm values and their HR30Tm equivalents

Table E.1 — Rockwell HR15Tm values and their HR30Tm equivalents

HR15Tm value	Equivalent HR30Tm value	HR15Tm value	Equivalent HR30Tm value
93,0	82,0	83,0	62,5
92,5	81,5	82,5	61,5
92,0	80,5	82,0	60,5
91,5	79,0	81,5	59,5
91,0	78,0	81,0	58,5
90,5	77,5	80,5	57,0
90,0	76,0	80,0	56,0
89,5	75,5	79,5	55,0
89,0	74,5	79,0	54,0
88,5	74,0	78,5	53,0
88,0	73,0	78,0	51,5
87,5	72,0	77,5	51,0
87,0	71,0	77,0	49,5
86,5	70,0	76,5	49,0
86,0	69,0	76,0	47,5
85,5	68,0	75,5	47,0
85,0	67,0	75,0	45,5
84,5	66,0	74,5	44,5
84,0	65,0	74,0	43,5
83,5	63,5	73,5	42,5

Bibliography

[1] ISO/TR 9769, *Steel and iron — Review of available methods of analysis*

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