

INTERNATIONAL STANDARD

ISO
5954

Second edition
1998-04-15

Corrected and reprinted
1999-12-01

Cold-reduced carbon steel sheet according to hardness requirements

*Tôles en acier au carbone laminées à froid à caractéristiques spéciales de
dureté*



Reference number
ISO 5954:1998(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 5954 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This second edition cancels and replaces the first edition (ISO 5954:1984), which has been technically revised.

Annex A of this International Standard is for information only.

© ISO 1998

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

Cold-reduced carbon steel sheet according to hardness requirements

1 Scope

1.1 This International Standard applies to cold-reduced carbon steel sheet and corresponding hardness requirements. It is suitable for applications where surface is of prime importance.

1.2 The fabrication limits of cold-reduced carbon steel sheet according to hardness requirements are dependent on the specific range of hardness specified or agreed to. It is produced in thicknesses of 0,36 mm and above (commonly produced up to 3 mm) and in widths of 600 mm and over in coils and cut lengths. The hardness is commonly reported as Rockwell B.

1.3 The following are common hardness ranges (see 5.6):

CRH-50 Rockwell B 50 to 70

CRH-60 Rockwell B 60 to 75

CRH-70 Rockwell B 70 to 85

CRH Any Rockwell B range of 15 points up to and including HRB 90 maximum (designated minimum of specified range will be shown)

1.4 Cold-reduced sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

1.5 This International Standard does not cover commercial quality or drawing qualities (covered in ISO 3574) and cold-reduced carbon steel strip.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6508:1986, *Metallic materials — Hardness test — Rockwell test (scales A - B - C - D - E - F - G - H - K)*.

3 Definitions

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

3.1 cold-reduced steel sheet: A product obtained from hot-rolled descaled steel sheet by cold-reducing to the required sheet thickness followed by annealing to recrystallize the grain structure. The product is normally supplied skin passed (see 3.2).

3.2 skin pass: A light cold rolling of the product. The purpose of the skin passing is one or more of the following:

- a) to minimize the appearance of coil breaks, stretcher strains and fluting;
- b) to control the shape;
- c) to obtain the required surface finish.

Some increase in hardness and some loss in ductility will result from skin passing. Cold-reduced sheet supplied in the skin-passed condition tends to strain-age and this may lead to increase in hardness value. Because of this, the hardness values at time of shipment will be the determining factor as to whether the hardness requirement has been met.

4 Surface characteristics

4.1 General

The surface characteristics consist of the surface quality and the surface finish.

The surface quality and finish shall be specified by the purchaser at the time of the order.

For non-skin-passed products, surface quality B (exposed) is not applicable and no requirement for a particular surface finish can be made.

4.2 Surface quality

The products are supplied with either of the surface qualities A or B.

4.2.1 Surface quality A (unexposed)

Imperfections such as pores, slight indentations, small marks, minor scratches and slight colouring which do not effect formability or the application of surface coatings are permitted.

4.2.2 Surface quality B (exposed)

The better surface shall be free of imperfections which might affect the uniform appearance of a quality paint or an electrolytic coating (see 4.4). The other surface shall at least conform to surface quality A.

In the case of delivery of coil and slit coil the percentage of defects may be greater than in the case of delivery in sheet or cut lengths. This should be taken into account by the purchaser and the percentage of admissible surface defects may be agreed at the time of the enquiry and order. Unless otherwise agreed, a single surface of the product shall comply with the specified requirements. The other surface shall be such that during subsequent treatment it does not have a deleterious effect on the better surface.

4.3 Surface finish

When cold-reduced steel sheet is deformed during fabrication, localized areas may roughen to some degree and such affected portions of the part may require hand-finishing to prepare the surface for the intended application.

By agreement at the time of the enquiry and order, ranges for surface roughness may be specified for specific end uses.

4.4 Suitability for surface coating

The products may be required for metallic coating by the hot dip coating or electrolytic coating process, or organic coating or other coating. When such a coating is intended, it shall be specified at the time of ordering.

4.5 Oiling

As a deterrent to rusting, a coating of oil is usually applied to the product. The oil is not intended as a drawing or forming lubricant and shall be easily removed using degreasing chemicals. The product may be ordered unoiled, if required, in which case, the supplier has limited responsibility if oxidation occurs.

5 Conditions of manufacture

5.1 Steelmaking

The processes used in marking the steel and in manufacturing cold-reduced sheet to hardness requirements are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process being used.

5.2 Chemical composition

The chemical composition (heat analyses) shall not exceed the values given in table 1.

Table 1 — Chemical composition (heat analysis), %

Designation	C ¹⁾ max.	Mn max.	P ¹⁾ max.	S max.
CRH-50	0,15	0,60	0,15	0,05
CRH-60	0,25	0,60	0,15	0,05
CRH-70	0,25	0,60	0,15	0,05
CRH-	0,25	0,60	0,15	0,05

1) The hardness requirements are normally obtained by a combination of carbon and/or phosphorus.

5.3 Chemical analysis

5.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer in order to determine compliance with the requirements given in table 1. On request, at the time of ordering, this analysis shall be reported to the purchaser or his representative.

5.3.2 Product analysis

A product analysis may be made by the purchaser to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to product analysis.

For killed steels, the sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering.

5.4 Weldability

This product is normally suitable for welding if appropriate welding conditions are selected. The hardness may be changed in the heat-affected zone of the welds. When the carbon content exceeds 0,15 % and/or the phosphorus content exceeds 0,05 % welding becomes more difficult.

5.5 Application

It is desirable that cold-reduced steel sheet and corresponding hardness requirements be identified for fabrication by name of the part or by intended application. Proper identification of the part may include visual examination, prints or description, or a combination of these. Details of fabrication and special requirements (exposed or unexposed, freedom from stretcher strains or fluting) shall be specified as well as hardness range.

5.6 Hardness ranges

The Rockwell hardness ranges represent the values as-shipped. Because of variations in testing standards and equipment a tolerance for check testing of two Rockwell B points on the "B" scale below minimum and above maximum of the range is allowed. It is recommended that hardness ranges be specified to the same scale as that to be used during testing (see table 2).

Table 2 — Hardness ranges

Designation	Hardness ranges	
	HRB ¹⁾	HR30T ²⁾
CRH-50	50/70	50/62,5
CRH-60	60/75	56,5/67
CRH-70	70/85	62,5/75
CRH-	As agreed on by manufacturer and purchaser	
1) 1 mm and heavier		
2) thinner than 1 mm		

6 Dimensional tolerances

6.1 Dimensional tolerances applicable to cold-reduced steel sheet shall be as given in tables 3 to 9. See also figures 1 and 2.

If flatness tolerances are required, they shall be negotiated.

6.2 Restricted thickness tolerances are in given in table 4.

Table 3 — Normal thickness tolerances for coils and cut lengths

Dimensions and tolerances in millimetres

Width	Specified thicknesses ¹⁾								
	≤ 0,4	> 0,4 ≤ 0,6	> 0,6 ≤ 0,8	> 0,8 ≤ 1,0	> 1,0 ≤ 1,2	> 1,2 ≤ 1,6	> 1,6 ≤ 2,0	> 2,0 ≤ 2,5	> 2,5 ≤ 3,0
> 600 ≤ 1 200	± 0,05	± 0,06	± 0,08	± 0,09	± 0,10	± 0,12	± 0,14	± 0,17	± 0,20
> 1 200 ≤ 1 500	± 0,06	± 0,07	± 0,09	± 0,10	± 0,11	± 0,13	± 0,15	± 0,18	± 0,21
> 1 500	—	± 0,09	± 0,10	± 0,11	± 0,13	± 0,15	± 0,18	± 0,20	± 0,23

NOTE — The thickness tolerances for sheets in coil form are the same as for sheets supplied in cut lengths, but in cases where welds are present, the tolerances are double those given over a length of 15 m in the vicinity of the weld.

1) Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Table 4 — Restricted thickness tolerances for coils and cut lengths

Dimensions and tolerances in millimetres

Width	Specified thicknesses ¹⁾								
	≤ 0,4	> 0,4 ≤ 0,6	> 0,6 ≤ 0,8	> 0,8 ≤ 1,0	> 1,0 ≤ 1,2	> 1,2 ≤ 1,6	> 1,6 ≤ 2,0	> 2,0 ≤ 2,5	> 2,5 ≤ 3,0
> 600 ≤ 1 200	± 0,025	± 0,035	± 0,04	± 0,045	± 0,055	± 0,07	± 0,08	± 0,10	± 0,11
> 1 200 ≤ 1 500	± 0,035	± 0,045	± 0,05	± 0,06	± 0,07	± 0,08	± 0,09	± 0,11	± 0,12
> 1 500	—	± 0,05	± 0,05	± 0,06	± 0,07	± 0,08	± 0,09	± 0,11	± 0,12
NOTE — The thickness tolerances for sheets in coil form are the same as for sheets supplied in cut lengths, but in cases where welds are present, the tolerances are double those given over a length of 15 m in the vicinity of the weld.									
1) Thickness is measured at any point on the sheet not less than 25 mm from a side edge.									

Table 5 — Width tolerances for coils and cut lengths, not resquared

Dimensions and tolerances in millimetres

Specified widths	Tolerance (all plus)
≤ 1 200	+ 5
> 1 200 ≤ 1 500	+ 7
> 1 500	+ 9

Table 6 — Length tolerances for cut lengths, not resquared

Specified lengths mm	Tolerance (all plus)
≤ 3 000	+ 20 mm
> 3 000 ≤ 6 000	+ 30 mm
> 6 000	+ 0,5 % of length

Table 7 — Camber tolerances for coils and cut lengths, not resquared

Form	Tolerance
Coils	20 mm in any 5 000 mm length
Cut lengths	0,4 % of length
NOTE — Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge, see figure 1.	

Table 8 — Out-of-square tolerances for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1 % of width

Table 9 — Out-of-square tolerances for resquared material

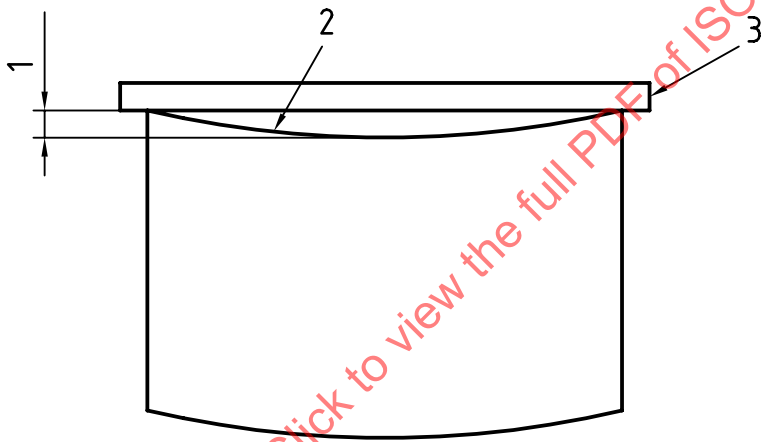
Dimensions and tolerances in millimetres

Specified lengths	Specified widths	Out-of-square tolerance (all plus)
$\leq 3\,000$	$\leq 1\,200$	+ 2
	$> 1\,200$	+ 3
$> 3\,000$	All widths	+ 3

NOTES

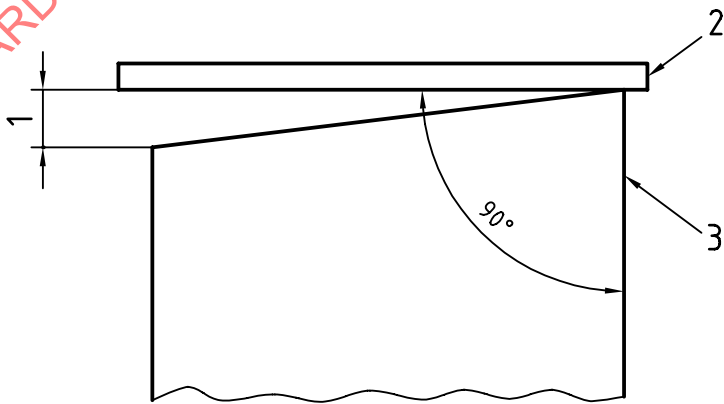
1 Out-of-square is the greatest deviation of an end edge from a straight line at right angles to a side and touching one corner, the measurement being taken as shown in figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.

2 When measuring material to resquared tolerances, consideration may have to be given to extreme variation in temperature.



- Key
- 1 Edge camber
 - 2 Side edge (concave side)
 - 3 Straightedge

Figure 1 — Measurement of camber



- Key
- 1 Out-of-square
 - 2 Straightedge
 - 3 Side edge

Figure 2 — Measurement of out-of square

7 Sampling

7.1 Hardness test sampling

One representative sample for the hardness test required in table 2 shall be taken from each lot of sheet for shipment. A lot consists of 50 t or less of sheet of the same designation rolled to the same thickness and condition.

7.2 Bend test sampling

One representative sample for the bend test shall be taken from each lot of sheet for shipment. A lot consists of all sheet of the same designation rolled to the same thickness and condition.

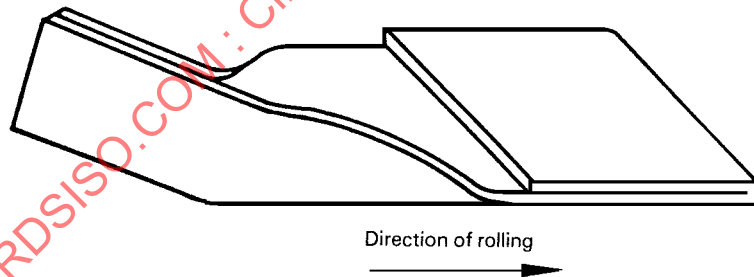
8 Tests

8.1 Hardness test requirements

Hardness test shall be carried out in accordance with ISO 6508 on test pieces taken midway between the centre and the edge of the sheet as rolled.

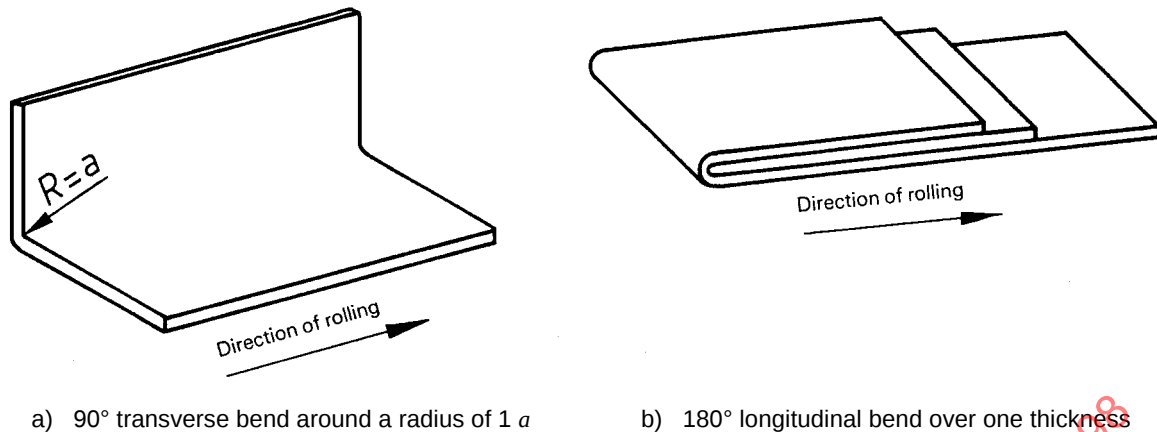
8.2 Bend test requirements

Because of the different hardness ranges each designation is subject to different bend tests. Small cracks on the edges of the test pieces and cracks which require magnification to be visible shall be disregarded. See figures 3 to 5.



180° flat bend in either longitudinal or transverse direction

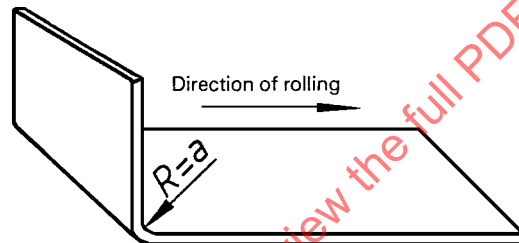
Figure 3 — Bend test piece for CRH-50

a) 90° transverse bend around a radius of 1 a

b) 180° longitudinal bend over one thickness

Key

a	Thickness of test piece
R	Radius of bend

Figure 4 — Bend test piece for CRH-6090° longitudinal bend around a radius of 1 a **Key**

a	Thickness of test piece
R	Radius of bend

Figure 5 — Bend test piece for CRH-70**9 Retests****9.1 Flaws**

If any test piece shows defective areas, it shall be discarded and another piece substituted.

9.2 Additional tests

If a test does not give the specified results, two more tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this International Standard, otherwise the lot may be rejected.

10 Resubmission

The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection due to unsatisfactory properties, after he has subjected them to a suitable treatment (selection, heat treatment), which, on request, shall be indicated to the purchaser.

In this case, the tests shall be carried out as if they applied to a new lot.

The manufacturer has the right to present the rejected products to a new examination for compliance with the requirements for another designation.

11 Workmanship

The surface condition should be that normally obtained in a cold-reduced product. The steel sheet in cut lengths shall be free from any laminations, surface flaws and other imperfections that are detrimental to the final product or to subsequent appropriate processing.

Processing for shipment in coils does not afford the manufacturer the opportunity of readily observing or removing defective portions as would be the case on the cut length product.

12 Inspection and acceptance

12.1 While not usually required for products covered by this International Standard, when the purchaser specifies that inspection and tests for acceptance be observed prior to shipment from the manufacturer's works, the manufacturer shall afford the purchaser's inspector all reasonable facilities to determine that the steel is being furnished in accordance with this International Standard.

12.2 Steel that is reported to be defective after arrival at the user's works shall be set aside, properly and correctly identified and adequately protected. The supplier shall be notified in order that he may properly investigate.

13 Coil size

When cold-reduced steel sheet is ordered in coils, a minimum or range of acceptable inside diameter (ID) shall be specified. In addition, the maximum outside diameter (OD) and maximum acceptable coil mass shall be specified.

14 Marking

Unless otherwise stated, the following minimum requirements for identifying the steel shall be legibly stencilled on the top of each lift or shown on a tag attached to each coil or shipping unit:

- a) manufacturer's name or identifying brand;
- b) reference to this International Standard, i.e. ISO 5954;
- c) the quality designation;
- d) the order number;
- e) the product dimensions;
- f) the lot number;
- g) the mass.

15 Information to be provided by the purchaser

To adequately specify the requirements under this International Standard, inquiries and orders shall include the following information:

- a) reference to this International Standard, i.e. ISO 5954;