International Standard ISO 5952

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance

Tôles en acier de construction laminées à chaud en continu à résistance améliorée à la corrosion atmosphérique

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5952 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in March 1982.

It has been approved by the member bodies of the following countries :

Australia	Italy	Sri Lanka
Austria	Japan	Sweden
Belgium	Korea, Dem. P. Rep. of	Switzerland
Brazil	Korea, Rep. of	Thailand
China	Mexico	Turkey
Czechoslovakia	Netherlands	United Kingdom
Egypt, Arab Rep. of	New Zealand	USA
Germany, F.R.	Poland	USSR
India	Romania	
Iran	South Africa, Rep. of	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

France
Spain

Printed in Switzerland

Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance

1 Scope and field of application

1.1 This International Standard applies to continuously hot-rolled steel sheet (see 3.2) of structural quality having improved atmospheric corrosion resistance. It is also known as weather-resistant structural steel. It is produced in the grades and classes listed in tables 1 and 2. The product is intended for applications where requirements are for mechanical properties and increased resistance to atmospheric corrosion. The atmospheric corrosion resistance of HSA 355W1 is greater than that of HSA 235W or HSA 355W2 (see 3.1 and 4.7). It is generally used in the delivered condition and is intended for bolted, riveted or welded structures.

1.2 This product is commonly produced in the range of thicknesses 1,6 mm and thicker and widths of 600 mm and over, in coils and cut lengths.

1.3 Hot-rolled sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

NOTE — Hot-rolled sheet up to but not including 3 mm in thickness is commonly known as sheet. Hot-rolled sheet 3 mm and over in thickness is commonly known as either "sheet" or "plate".

1.4 This International Standard does not cover steels intended for boilers or pressure vessels, or steels designated as commercial quality or drawing qualities (ISO 3573), or steels produced on reversing mills and designated as improved atmospheric corrosion resistance (ISO 4952), or steels to be rerolled to cold-reduced products (ISO 3576), or steels designated as structural quality (ISO 4995), or high yield strength structural quality (ISO 4996), or steels designated as higher yield strength with improved formability (ISO 5951).

2 References

ISO 82, *Steel — Tensile testing.*

ISO/R 85, *Bend test for steel.*

ISO 86, *Steel — Tensile testing of sheet and strip less than* 3 mm *and not less than* 0,5 mm *thick.*

ISO/R 87, *Simple bend testing of steel sheet and strip less than* 3 mm *thick.*

ISO 148, *Steel — Charpy impact test (V-notch).*

IIS/IIW 382-71, *Guide to the welding and weldability of C-Mn steels and C-Mn microalloyed steels.*

3 Definitions and other information

3.1 improved atmospheric corrosion resistance : A characteristic achieved by intentional addition of a certain number of alloying elements such as P, Cu, Cr, Ni, Mo, etc., providing a chemical composition which promotes the formation of a protective oxide layer on the product. The degree of corrosion resistance is based on data acceptable to the purchaser.

3.2 hot-rolled steel sheet : A product obtained by rolling heated steel through a continuous-type or reversing-type wide strip mill to the required sheet thickness. The product has a surface covered with oxide or scale resulting from the hot rolling operation.

3.3 hot-rolled descaled steel sheet : Oxide or scale on hot-rolled steel sheet is commonly removed by pickling in an acid solution. Descaling may also be performed by mechanical means such as grit blasting. Some change in properties may result from descaling.

As a deterrent to rusting, a coating of oil is usually applied to hot-rolled descaled steel sheet but sheet may be furnished not oiled, if required. The oil is not intended as a forming lubricant and shall be easily removable with degreasing chemicals. When requested, the manufacturer shall advise the purchaser which type of oil has been used.

3.4 mill edge : Normal side edge produced in hot rolling. Mill edges may contain some irregularities such as cracked or torn edges or thin (feathered) edges.

3.5 edge trimmed : Normal edge obtained by shearing, slitting or trimming a mill edge product.

3.6 surface condition : Oxide or scale on hot-rolled steel sheet is subject to variations in thickness, adherence and colour. Removal of the oxide or scale by pickling or blast cleaning may disclose surface imperfections not readily visible prior to this operation.

4 Conditions of manufacture

4.1 Steelmaking

Unless otherwise agreed upon, the processes used in making the steel and in manufacturing hot-rolled sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steelmaking process being used.

4.2 Chemical composition

4.2.1 The chemical composition (cast analysis) shall conform to table 1, unless otherwise agreed between the interested parties.

4.2.2 When selecting the grade or chemical composition to be used, attention should be directed to the appropriate welding procedure to be followed (see 4.4).

4.3 Chemical analysis

4.3.1 Cast analysis

A cast analysis of each cast of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulphur plus other elements responsible for obtaining the specified mechanical properties and atmospheric corrosion resistance. When requested, this analysis shall be reported to the purchaser or his representative.

4.3.2 *Verification analysis*

A verification analysis may be made by the purchaser to verify the specified analysis of the semi-finished or finished steel and shall take into consideration any normal heterogeneity. The sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering.

4.4 Weldability

Appropriate welding conditions should be selected, such as the recommendations given in IIS/IIW 382/71.

4.5 Application

It is desirable that hot-rolled steel sheet be identified for fabrication by name of the part or by the intended application which shall be compatible with the chemical composition and mechanical properties of this International Standard.

4.6 *Mechanical properties*

At the time that the steel is made available for shipment, the mechanical properties shall be as stated in table 2 when they are determined on test pieces obtained according to the requirements of clause 7. Any additional property requirements specified or required are subject to agreement before ordering. Such additional requirements may include characterizations or prescribed values for properties such as impact for sheet over 6 mm in thickness (see 7.3).

4.7 Corrosion resistance

The resistance of these steels to atmospheric corrosion is due to the formation of a protective oxide layer. The formation of this protective layer depends not only on chemical composition such as the distinctive differences between the analyses of HSA 235W, HSA 355W1 and HSA 355W2, but also on a number of factors such as surrounding atmosphere, design, etc., over which the steel producer has no control. When requested, the producer shall supply representative data of atmospheric corrosion resistance in accordance with the grade specified at the time the order is placed. For applications or installations, it is advisable to obtain from the producer more specific information.

5 Dimensional tolerances

5.1 Dimensional tolerances applicable to hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance shall be as given in tables 3 to 10, inclusive.

6 Sampling

6.1 Tensile test

One representative sample for the tensile 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 grade and class rolled to the same thickness and condition.

6.2 Bend test

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 grade and class rolled to the same thickness and condition.

7 Mechanical property tests

7.1 Tensile test

The tensile test shall be carried out in accordance with ISO 82 and ISO 86. Transverse test pieces shall be taken midway between the centre and the edge of the sheet as rolled.

Table 1 — Chemical composition (cast analysis)[1)]
(Normal standard compositions, see 4.2)

Grade	Class[2)]	Method of deoxidation[3)]	Carbon %	Manganese %	Silicon %	Phosphorus %	Sulphur %	Copper %	Nickel %	Chromium %	Molybdenum %	Zirconium %
HSA 235W	B	NE	0,13 max.	0,20/ 0,60	0,10/ 0,40	0,050 max.	0,035 max.	0,20/ 0,50	0,65 max.	0,40/ 0,80		
	D	CS				0,040 max.						
HSA 355W1	A	NE	0,12 max.	1,00 max.	0,20/ 0,75	0,06/ 0,15	0,050 max.	0,25/ 0,55	0,65 max.	0,30/ 1,25		
	D	CS					0,040 max.					
HSA 355W2	C	NE	0,19 max.	0,50/ 1,50	0,50 max.	0,040 max.	0,050 max.	0,20/ 0,55	0,65 max.	0,40/ 0,80	0,30 max.	0,15 max.
	D	CS					0,040 max.					

1) Each grade may contain one or more microalloying elements such as vanadium, titanium, niobium, etc.

2) Class A steels satisfy only moderate conditions of service.

Class B steels are intended for use in welded structures or structural parts, subjected to normal loading conditions.

Class C steels are to be used in cases where, owing to loading conditions and the general design of the structure, some resistance to brittle fracture is necessary.

Class D steels are to be used for structures or structural parts where, owing to loading conditions and the general design of the structure, a high resistance to brittle fracture is necessary.

3) NE = Non-rimming
CS = Special killed

Table 2 — Mechanical properties[1)]

Grade	Class	R_e[2)] min. N/mm²	R_m min. Information only N/mm²	A min.[3)5)]				180°[4)5)] bend mandrel diameter
				e < 3 mm		3 ≤ e ≤ 6 mm		
				L_o = 50 mm	L_o = 80 mm	$L_o = 5{,}65\sqrt{S_o}$	L_o = 50 mm	
HSA 235W	B and D	235	330	20	18	23	22	2 a
HSA 355W1	A and D	355	450	15	13	19	19	3 a
HSA 355W2	C and D	355	430	18	16	22	22	2 a

1) R_e = yield strength
R_m = tensile strength
A = percentage elongation after fracture
L_o = gauge length on test piece
S_o = original cross sectional area of gauge length
a = thickness of bend test piece
e = thickness of steel sheet, in millimetres
1 N/mm² = 1 MPa

2) The yield strength can be measured either by 0,5 % total elongation proof stress $R_{t0,5}$ (proof stress under load) or by 0,2 % offset $R_{p0,2}$ when a definite yield phenomenon is not present.

3) For thicknesses up to 3 mm, use either L_o = 50 mm or L_o = 80 mm. For thicknesses 3 mm incl. to 6 mm incl., use $L_o = 5{,}65\sqrt{S_o}$ or L_o = 50 mm. In case of dispute, however, only the results obtained on a proportional test piece will be valid for material 3 mm and over in thickness.

4) The bend mandrel diameters in table 2 are for test pieces prepared for laboratory testing. Conditions during fabrication may be more severe and may not simulate those during laboratory testing.

5) For material over 6 mm in thickness, values for bend and elongation are subject to agreement between the manufacturer and purchaser.

7.2 Bend test

The transverse bend test piece shall withstand being bent in the direction as shown in figure 1 through 180° without cracking on the outside of the bent portion around an inside diameter as shown in table 2. The bend test shall be carried out at ambient temperature and as described in ISO/R 85 and ISO/R 87.

Small cracks on the edges of test pieces and cracks which require magnification to be visible shall be disregarded.

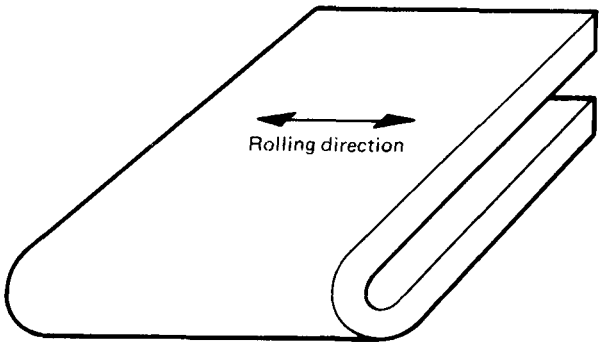

Figure 1 — Transverse bend test piece (after bending)

7.3 Impact test

While not usually specified, if so agreed at the time of ordering, impact tests may be specified for material 6 mm and over in thickness. The test pieces shall be in the longitudinal direction and the test shall be carried out in accordance with ISO 148 for the Charpy V-notch test.

8 Retests

8.1 Machining and flaws

If any test piece shows defective machining or develops flaws, it shall be discarded and another specimen substituted.

8.2 Elongation

If the percentage of elongation of any tested piece is less than that specified in table 2 and any part of the fracture is outside the middle half of the gauge length as scribed before the test, the test shall be discarded and a retest shall be conducted.

8.3 Additional tests

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

9 Resubmission

9.1 The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a suitable treatment (selection, heat treatment) which, on request, will be indicated to the purchaser. In this case, the tests shall be carried out as if they applied to a new batch.

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

10 Workmanship

The surface condition shall be that normally obtained in a hot-rolled or hot-rolled descaled product. The steel sheet in cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing. Processing for shipment in coils does not afford the manufacturer the opportunity to observe readily or to remove defective portions as can be carried out on the cut length product.

11 Inspection and acceptance

11.1 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.

11.2 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 manufacturer shall be notified in order that he may properly investigate.

12 Coil size

When hot-rolled steel sheet is ordered in coils, a minimum or range of acceptable inside diameter (I.D.) shall be specified. In addition, the maximum outside diameter (O.D.) and the maximum acceptable coil mass shall be specified.

13 Marking

Unless otherwise stated, the minimum requirements for identifying the steel shall be the following :

- manufacturer's name or identifying brand,
- number of this International Standard,
- grade designation number,
- order number,

— product dimensions,

— lot number,

— mass,

legibly stencilled on the top of each lift or shown on a tag attached to each coil or shipping unit.

14 Information to be supplied by the purchaser

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

a) number of this International Standard;

b) name, quality, grade and class of material (for example, *hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance, grade HSA 355W1, Class A*);

c) dimensions of product and quantity required;

d) application (name of part) if possible (see 4.4 and 4.5);

e) pickling (or descaling by grit or shot blasting), if required (material so specified will be oiled unless ordered not oiled) (see 3.3);

f) type of edge (see 3.4 and 3.5);

g) *ends cropped, if required;*

h) if required, report of mechanical properties and/or cast analysis (see 4.6 and 4.3.1);

j) if necessary, additional requirements (see 4.6);

k) limitations on mass and dimensions of individual coils and bundles, if applicable (see clause 12);

m) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see 11.1).

NOTE — Typical ordering description is as follows :

ISO 5952 hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance, grade HSA 355W1, Class A, 3 × 1 200 × 2 440 mm, 40 000 kg, for Part No. 32154, formed channels for outdoor parking garage.

Table 3 — Hot-rolled steel sheet (including descaled sheet), coils[1] and cut lengths — Thickness tolerances, structural quality with improved corrosion resistance (Grade HSA 235W)

(For Grades HSA 355W1 and HSA 355W2, the values in this table should be increased by 10 %.)

Values in millimetres

Specified width	Thickness tolerance [2] over and under, for specified thicknesses								
	< 2,0	> 2,0 < 2,5	> 2,5 < 3,0	> 3,0 < 4,0	> 4,0 < 5,0	> 5,0 < 6,0	> 6,0 < 8,0	> 8,0 < 10,0	> 10,0 < 12,5
> 600 < 1 200	0,17	0,18	0,20	0,22	0,24	0,26	0,29	0,32	0,35
> 1 200 < 1 500	0,19	0,21	0,22	0,24	0,26	0,28	0,30	0,33	0,36
> 1 500 < 1 800	0,21	0,23	0,24	0,26	0,28	0,29	0,31	0,34	0,37
> 1 800	—	0,25	0,26	0,27	0,29	0,31	0,35	0,40	0,45

1) The values specified do not apply to the uncropped ends for a length "*l*" of a mill edge coil. The length "*l*" would be calculated using the following formula :

$$\text{length } "l" \text{ in metres} = \frac{90}{\text{Thickness in mm}}$$

provided that the result was not greater than 20 m, inclusive of both ends.

2) Thickness is measured at any point on the sheet not less than 40 mm from a side edge. Measurement on an untrimmed edge sheet nearer to an edge than 40 mm and on a trimmed edge sheet nearer to an edge than 25 mm and values of tolerances are subject to negotiation.

Table 4 — Hot-rolled sheet (including descaled sheet), mill edge, coils and cut lengths — Width tolerances, structural quality with improved corrosion resistance

Values in millimetres

Specified width	Tolerances[1] over specified width (No tolerance under)
Up to and including 1 200	30
Over 1 200 up to and including 1 500	35
Over 1 500 up to and including 1 800	40
Over 1 800	50

1) The values specified do not apply to the uncropped ends for a length "*l*" of a mill edge coil. Length "*l*" would be calculated using the following formula :

$$\text{Length } "l" \text{ in metres} = \frac{90}{\text{Thickness in mm}}$$

provided that the result was not greater than 20 m, inclusive of both ends.

Table 5 — Hot-rolled steel sheet (including descaled sheet), cut edge, not resquared, coils and cut lengths — Width tolerances, structural quality with improved corrosion resistance

Values in millimetres

Specified width	Tolerances over specified width (No tolerance under)
Up to and including 1 200	6
Over 1 200 up to and including 1 500	8
Over 1 500	10

Table 6 — Hot-rolled steel sheet (including descaled sheet), not resquared — Length tolerances, structural quality with improved corrosion resistance

Values in millimetres

Specified length	Tolerances over specified length (No tolerance under)
Up to and including 3 000	20
Over 3 000 up to and including 6 000	30
Over 6 000	0,5 % × length

Table 7 — Hot-rolled steel sheet (including descaled sheet), not resquared — Camber[1] tolerances, structural quality with improved corrosion resistance

Values in millimetres

Form	*Maximum tolerance*[2]
Coils	25 in any 5 000 length
Cut lengths	0,5 % × length

1) See figure 2.

2) The values do not apply to the uncropped ends of mill edge coil within 7 m inclusive of both ends.

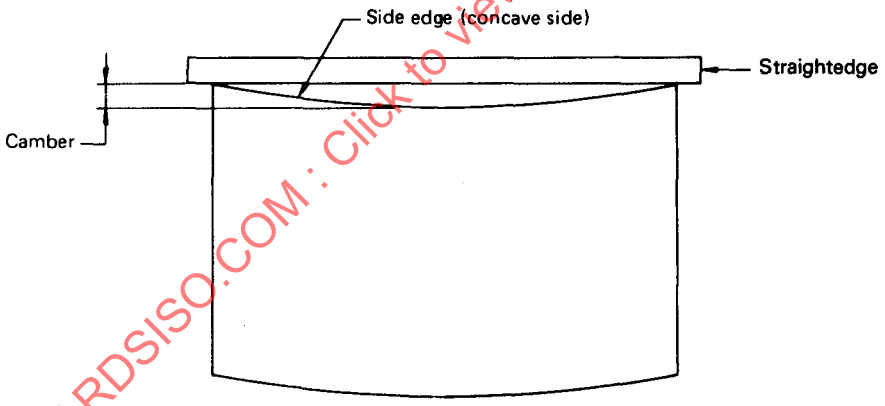

Figure 2 — Measurement of camber

Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straightedge.