INTERNATIONAL STANDARD

ISO 5000

Fourth edition
2011-01-15

Continuous hot-dip aluminium-silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities

Tôles en acier au carbone laminées à froid, revêtues par immersion à chaud en continu d'une couche d'aluminium-silicium, de qualité commerciale et pour emboutissage

Reference number
ISO 5000:2011(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Pages

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 5000 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This fourth edition cancels and replaces the third edition (ISO 5000:2005), which has been technically revised.

Continuous hot-dip aluminium-silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities

1 Scope

This International Standard specifies the characteristics of cold-reduced carbon steel sheet of commercial and drawing qualities coated by a continuous hot-dip aluminium-silicon alloy coating process.

Aluminium-silicon-coated steel sheets are used for heat-resisting applications and also where both corrosion and heat resistance are required.

The steel sheet is produced in a number of qualities, coating mass, grades, surface treatments and conditions designed to be compatible with differing application requirements.

Aluminium-silicon-coated steel sheet can be ordered in one of two ordering conditions:

a) Condition A): steel ordered to satisfy mechanical property requirements;

b) Condition B): steel ordered to make an identified part.

2 Normative references

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

ISO 6353 (all parts), *Reagents for chemical analysis*

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

ISO 7438, *Metallic materials — Bend test*

ISO 16163, *Continuously hot-dipped coated steel sheet products — Dimensional and shape tolerances*

3 Terms and definitions

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

3.1 Quality applications

3.1.1
commercial
intended for general fabricating purposes where sheet is used in the flat condition, or for bending or moderate forming

3.1.2
drawing
intended for parts where drawing or severe forming may be involved

3.1.3
deep drawing
intended for parts where severe forming or severe drawing may be involved

3.1.4
deep-drawing aluminium killed (non-ageing)
intended for fabricating parts where particularly severe drawing or forming may be involved or essential freedom from ageing is required

3.1.5
extra-deep drawing (stabilized)
intended for applications requiring interstitial free steel (IF) which is non-aging and has maximum formability

3.2
aluminium killed
steel which has been deoxidized with aluminium that is sufficient to prevent the evolution of gas during solidification

3.3
stabilized interstitial free steel
extra-low-carbon steel in which all interstitial elements are combined with titanium and/or equivalent elements

NOTE Stabilized steel is sometimes referred to as interstitial free steel.

3.4
skin pass
light cold-rolling of the product

NOTE The purpose of the skin pass is to produce a higher degree of surface smoothness and thereby improve the surface appearance. The skin pass also temporarily minimizes the occurrence of a surface condition known as stretcher strain (Lüders' lines) or fluting during the fabrication of finished parts. The skin pass also controls and improves flatness. Some increase in hardness and some loss of ductility will result from skin passing.

3.5
strain ageing
change in steel properties with the passage of time

NOTE Strain ageing may result in surface imperfections such as stretcher strain marks (Lüders' lines), fluting when the steel is formed, and a deterioration in ductility. To avoid these adverse outcomes, the period between final processing at the producing mill and fabrication needs to be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Effective roller-levelling immediately prior to fabrication can achieve reasonable freedom from stretcher strain marks.

3.6
lot
50 t or less of sheet of the same quality rolled to the same thickness and coating condition

4 Thickness

4.1 Aluminium-silicon-coated steel sheet is produced in thicknesses from 0,40 mm to 3,0 mm inclusive and in widths of 600 mm to 1 500 mm in coils and cut lengths. Aluminium-silicon-coated sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

4.2 The thickness of aluminium-silicon-coated steel sheet may be specified as a combination of the base metal and metallic coating, or as base metal alone. The purchaser shall indicate on the order which method of specifying is required. In the event that the purchaser does not indicate any preference, the thickness as a combination of the base metal and coating will be provided. Annex A describes the requirements for specifying the thickness as base metal alone.

5 Conditions of manufacture

5.1 Chemical composition

The chemical composition (heat analysis) shall not exceed the values given in Tables 1 and 2. On request, a report of the heat analysis shall be made to the purchaser.

A verification 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 steels) are not technologically suited for product analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering. The product analysis tolerances are shown in Table 3.

The processes used in making the steel and in manufacturing aluminium-silicon-coated sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steel-making process used.

Table 1 — Chemical composition, % (mass fraction)

Quality		C % max.	Mn % max.	P % max.	S % max.	Ti % max.
Designation	**Name**					
01	Commercial	0,15	0,60	0,05	0,035	—
02	Drawing	0,10	0,50	0,04	0,035	—
03	Deep drawing	0,08	0,45	0,03	0,03	—
04	Deep drawing aluminium killed	0,06	0,45	0,03	0,03	—
05	Extra-deep drawing (stabilized interstitial free)	0,02	0,25	0,02	0,02	0,15
For interstitial free steels only, the values of 0,15 % maximum for titanium and 0,10 % maximum for niobium and vanadium are acceptable to ensure that the carbon and nitrogen are fully stabilized. By agreement, the levels of manganese, phosphorus, sulfur and titanium may be adjusted.						

Table 2 — Limits on additional chemical elements, % (mass fraction)

Element	Cu[a] % max.	Ni[a] % max.	Cr[a,b] % max.	Mo[a,b] % max.	Nb % max.	V[c] % max.	Ti % max.
Heat analysis	0,20	0,20	0,15	0,06	0,008	0,008	0,008
Product analysis	0,23	0,23	0,19	0,07	0,018	0,018	0,018
Each of the elements listed in this table shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 % (mass fraction), the analysis result may be reported as $< 0{,}02$ %.							
[a] The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % (mass fraction) on heat analysis. When one or more of these elements is specified, the sum does not apply, in which case only the individual limits on the remaining elements apply. [b] The sum of chromium and molybdenum shall not exceed 0,16 % (mass fraction) on heat analysis. When one or more of these elements is specified, the sum does not apply, in which case, only the individual limits on the remaining elements apply. [c] Heat analysis greater than 0,008 % (mass fraction) may be supplied after agreement between producer and purchaser.							

Table 3 — Product analysis tolerances, % (mass fraction)

Element	Maximum %	Tolerance over maximum specified %
C	0,15	0,03
Mn	0,60	0,03
P	0,05	0,01
S	0,05	0,01

NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis. For example: for designation 02, the following product analysis values are within these tolerances: C 0,15, Mn 0,53, P 0,05, S 0,05.

5.2 Mechanical properties

5.2.1 Aluminium-silicon-coated steel sheet ordered to satisfy mechanical properties (ordering condition A) shall, at the time of shipment, satisfy the applicable requirements of Table 4.

5.2.2 Aluminium-silicon-coated steel sheet ordered to make an identified part (ordering condition B) shall be supplied with a commitment to satisfactory performance within a properly established breakage allowance, which shall be previously agreed upon by the interested parties. This ordering condition applies to steel sheet qualities 02, 03, 04 and 05. In these cases, the part name, details of fabrication and special requirements shall be specified.

NOTE Prolonged storing of the sheet can result in a change in mechanical properties (increase in hardness and decrease in elongation) leading to a decrease in formability. To minimize this effect, qualities 04 and 05 should be specified.

5.2.3 Aluminium-silicon-coated steel sheet is available in several fabrication qualities.

— Commercial: intended for general fabrication purposes where sheet is used in the flat state or for bending or moderate forming.

— Drawing: intended for fabricating parts where drawing or severe forming may be involved.

— Deep drawing: intended for fabricating parts where severe drawing or severe forming may be involved.

— Deep-drawing aluminium killed (non-ageing): intended for fabricating parts where particularly severe drawing or forming may be involved or essential freedom from ageing is required.

— Extra-deep drawing (stabilized interstitial free): intended for applications requiring interstitial free steel (IF), which is non-ageing and has maximum formability.

5.3 Coating

5.3.1 Silicon content

The aluminium-silicon alloy used for coating normally has between 5 % and 11 % silicon added to promote better adherence and heat resistance.

5.3.2 Coating mass

The coating mass shall conform to the limits for the quality designations listed in Table 5. The coating mass is the total amount of coating on both sides of the sheet, expressed in grams per square metre. See Annex B for determination of coating mass.

Table 4 — Mechanical properties

Base-metal quality[a]		R_{eL}[b] MPa[g] max.	R_m[c] MPa max.	A, %[d] min.		$\bar{r}$[e,f,h] min.	$\bar{n}$[e,f,h] min.
Designation	Name			$L_0 = 80$ mm	$L_0 = 50$ mm		
01	Commercial	—	—	—	—	—	—
02	Drawing	340	430	30	31	—	—
03	Deep drawing	300	410	34	35	—	—
04	Deep drawing aluminium killed	270	410	36	37	—	—
05	Extra-deep drawing (stabilized interstitial free)	250	380	38	38	1,4	0,17

R_{eL} yield stress

R_m tensile stress

A percentage elongation after fracture

L_0 gauge length of test piece

r index of drawability of the product

n index of stretchability of the product

a All qualities are available with a normal spangle or smooth finish.

b The yield values apply to 0,2 % proof stress if the yield point is not pronounced, otherwise to the lower yield point (σ_{el}).

c The minimum tensile strength for qualities 02, 03 and 04 would normally be expected to be 270 MPa. For design purposes, the lower limit for R_{eL} may be assumed to be 140 MPa for grades 01, 02, 03, 04, and 120 MPa for grade 05.

d For materials of thickness up to and including 0,6 mm, the elongation percentages in this table shall be reduced by 2.

e $\bar{r}$ and $\bar{n}$ values are only applicable to thickness $\geqslant$ 0,5 mm. For thickness $>$ 2,0 mm, the $\bar{r}$ value is reduced by 0,2.

f $\bar{r}$ can also be written as r-bar and $\bar{n}$ can also be written as n-bar.

g 1 MPa = 1 N/mm^2.

h $\bar{r}$ and $\bar{n}$ values may be modified or excluded from this specification, by agreement between the producer and the purchaser.

NOTE 1 Duration of applicability of values stated in this table:

Designation	Time period
01	—
02	8 days
03	30 days
04	6 months
05	6 months

NOTE 2 For product produced to performance criteria (ordering condition B), the typical mechanical properties presented here are not mandatory. For products ordered according to specific mechanical properties (ordering condition A), the purchaser may negotiate with the supplier if a specific range of values or a more restrictive range is required for the application. Therefore, these values can be specified by agreement.

NOTE 3 These typical mechanical properties apply to the full range of steel sheet thickness. The yield stress tends to increase and some of the formability tends to decrease as the sheet thickness decreases.

5.3.3 Coating adherence

The coated sheet shall be capable of being bent in any direction, in accordance with the mandrel diameter requirements of Table 6, without flaking on the outside of the bend. Flaking of the coating within 7 mm from the edge of test piece shall not be cause for rejection.

Table 5 — Mass of coating (total both sides)

Qualities for mass of coating	Coating designation	Coating mass g/m^2 (of sheet) min.	
		Triple-spot test check	Single-spot test check
Commercial	AS200	200	150
	AS300	300	240
Commercial and drawing	AS040	40	30
	AS060	60	45
	AS080	80	60
	AS100	100	75
	AS120	120	90
	AS150	150	115

NOTE 1 Because of the many variables and changing conditions that are characteristic of continuous aluminium-silicon coating, the mass of coating is not always evenly divided between the two surfaces of an aluminium-silicon-coated sheet; neither is the aluminium-silicon coating evenly distributed from edge to edge. However, it can normally be expected that not less than 40 % of the single-spot check limit will be found on either surface.

NOTE 2 The coating thickness can be estimated from the coating mass by using the following relationship:

For a coating mass of 100 $g \cdot m^2$ total both sides, coating thickness = 0,033 mm.

Table 6 — Coating adherence — Mandrel diameter for 180° bend test

Base-metal quality	Coating designation					
	Up to AS120	AS150	AS200 AS300	Up to AS120	AS150	AS200 AS300
	Mandrel diameter					
	$t < 1{,}25$			$t \geqslant 1{,}25$		
Commercial	$1 \times t$	$2 \times t$	$2 \times t$	$2 \times t$	$3 \times t$	$3 \times t$
Drawing	$1 \times t$	$2 \times t$	—	$3 \times t$	$3 \times t$	—

t = thickness of steel, in millimetres

5.4 Weldability

The product is suitable for welding if appropriate welding conditions are selected with special attention to the heavier coatings.

5.5 Mill passivation

A chemical treatment may be applied to aluminium-silicon-coated steel sheet to minimize the hazard of wet-storage stains during shipment and storage. However, the inhibiting characteristics of the treatment are limited and if a shipment is received wet, the material shall be used immediately or dried.

5.6 Oiling

Oiling of the aluminium-silicon-coated steel sheet prevents marring and scratching of the soft surface during handling and shipping, and helps to minimize the hazard of wet-storage stains. Sheet which is not oiled shall be subject to an agreement between the producer and purchaser.

5.7 Dimensional and shape tolerances

Dimensional tolerances applicable to aluminium-silicon-coated steel sheet shall be as given in ISO 16163. The tolerances apply to the coated sheet. In the case of sheet ordered to base metal alone, the tolerances apply to the average coated-product thickness (see Annex A).

6 Sampling

6.1 Chemical composition

The manufacturer shall test each heat to determine compliance with the requirements of Tables 1 and 2.

6.2 Tensile test

When required, one representative transverse sample from each lot for shipment shall be taken for the tensile test to verify conformance to the requirements of Table 4. Transverse test pieces shall be taken midway between the centre and the edge of the sheet as-rolled.

6.3 Coating tests

6.3.1 Coating mass

The producer shall develop a testing plan with a frequency sufficient to adequately characterize the lot of material and ensure conformance with specification requirements.

The purchaser may conduct verification tests by securing a sample piece approximately 300 mm in length by the as-coated width, and cutting three test specimens, one from the mid-width position and one from each side, not closer than 25 mm to the side edge. The minimum area of each specimen shall be 1 200 mm^2.

6.3.2 Triple-spot test

The triple-spot test result shall be the average coating mass found on the three specimens taken in accordance with 5.3.1.

6.3.3 Single-spot test

The single-spot test result shall be the minimum coating mass found on any one of the three specimens used for the triple-spot test. Material that has been slit from wide coil shall be subject to a single-spot test only.

6.3.4 Coating adherence

One representative sample for the coating adherence bend test shall be taken from each lot of sheet for shipment. The specimens for the coated sheet bend test shall not be taken closer than 25 mm from the side edge. The minimum width of the test specimen shall be 50 mm.

6.4 Retest

If a test result does not satisfy the specified requirements, two or more test pieces shall be taken at random from the same lot. Both retests shall conform to the requirements of this International Standard; otherwise the lot shall be rejected.

7 Test methods

7.1 Tensile test

The tests shall be conducted in accordance with the methods specified in ISO 6892-1. The base-metal thickness shall be used to calculate the cross-sectional area needed for the tensile test. However, for orders specifying thickness “as base metal only”, there are two permissible methods for determining the base-metal thickness:

a) Option A — Determination of the actual base-metal thickness through direct measurement of the substrate of a specimen whose coating has been removed.

b) Option B — Calculation of the base-metal thickness, by subtraction of the average coating thickness for the appropriate coating designation included in Annex A from the actual coated thickness of the test specimen.

7.2 Coating properties

7.2.1 Coating mass

Determination of coating mass shall be conducted in accordance with either one of the two methods described in Annex B.

7.2.2 Coating adherence

Bend tests for coating adherence shall be conducted in accordance with the methods specified in ISO 7438, using the test mandrel specified in Table 6.

8 Designation system

The as-produced hot-dip aluminium-silicon coatings are designated as AS (aluminium-silicon). The coating mass designation, for which three spaces are allocated, follows the letters AS. If only two spaces are required, such as for designation 80, then the two digits are preceded by a zero and the coating designation is shown as, for example, 080. The coating condition designation then follows. Since this product is normally skin-passed, the designation S is used. For the base-metal quality, the numbers 01, 02, 03, 04 and 05 indicate the qualities of commercial, drawing, deep drawing, deep-drawing special-killed and extra-deep drawing (stabilized interstitial free), respectively.

EXAMPLE The complete designation for the coated steel sheet, AS080S01, including coating type, coating mass, coating condition and base-metal quality, is composed by combining the following:

AS aluminium-silicon coating

080 mass designation

S skin-passed

01 commercial quality

9 Resubmission

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

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 aluminium-silicon-coated steel sheet in cut lengths shall be free from 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 done on 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 supplier shall be notified in order that he/she may properly investigate.

12 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) the number of this International Standard, i.e. ISO 5000:2011;

c) the designation (coating, coating mass, coating condition and base-metal quality);

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

13 Information to be supplied by the purchaser

To specify requirements adequately in accordance with this International Standard, enquiries and orders shall include the following information:

a) a reference to this International Standard, i.e. ISO 5000:2011;

b) the name and designation of the product (for example, aluminium-silicon-coated steel sheet, commercial quality) (see 3.1.1 and 5.2.3);

c) dimensions:

   — for cut lengths: thickness (combination of base metal and coating or base metal alone), width, length and bundle mass, and the total quantity required;

   — for coils: thickness (combination of base metal and coating or base metal alone), width, minimum or range of inside diameter, outside diameter, and maximum coil mass, and the quantity required.

   When the base metal alone is specified, see Annex A for determining thickness.

   When the method of specifying thickness is not indicated, the combination of base metal and coating shall be provided.

d) the intended application (name of part), if possible;

e) ordering condition A or B (see 5.2.1 and 5.2.2);

f) for drawing qualities (02, 03, 04, 05), whether ordered according to mechanical properties (see 5.2.1) or to fabricate an identified part (see 5.2.2);

g) mill-passivated, if required (see 5.5);

h) not oiled, if required (see 5.6);

i) report of the heat analysis, if required (see 5.1);

j) details of fabrication or special requirements (fluting or coating performance);

k) inspection and tests for acceptance prior to shipment from the producer's works, if required (see Clause 9).

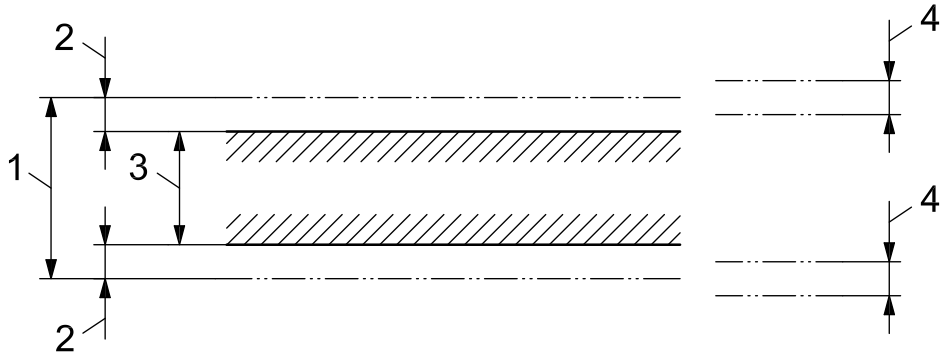
EXAMPLE A typical ordering description is as follows:

International Standard ISO 5000:2011, aluminium-silicon-coated steel sheet, drawing quality, designation AS120S02, ordering condition A, 1,0 (base metal alone) × 1,200 mm × coil, 20 000 kg, exhaust pipe tubing, #6201.

Annex A
(normative)

Specification of thickness

When specified by the purchaser, the ordered thickness shall be the base-metal thickness. In these cases, the average coated-product thickness shall be calculated as the base-metal thickness + average thickness for each surface (see Table A.1) of the coating, as indicated in Figure A.1. Thickness tolerance tables apply to the average coated-product thickness.



Key

1 average coated-product thickness
2 average coating thickness
3 base-metal thickness
4 thickness tolerances

Figure A.1 — Calculation of the average coated-product thickness

Table A.1 — Average coating thickness

Coating designation	Average coating thickness[a] for calculation mm
AS040	0,022
AS060	0,033
AS080	0,044
AS100	0,056
AS120	0,067
AS150	0,083
AS200	0,111
AS300	0,167

[a] Coating data derived from actual production results.

Annex B
(normative)

Determination of mass of coating on aluminium-silicon-coated steel sheet

B.1 General

B.1.1 This annex covers the determination of the mass of aluminium-silicon coating on the surface of a steel sheet specimen by measuring the mass of the specimen before and after removal of the coating. Two procedures are described as follows:

a) Procedure A: stripping with hydrochloric acid.

b) Procedure B: stripping with inhibited hydrochloric acid.

B.1.2 To strip the coating, use either the hydrochloric acid method (procedure A), or the inhibited hydrochloric acid method (procedure B).

B.2 Procedure A – stripping with hydrochloric acid

B.2.1 Apparatus

B.2.1.1 Analytical balance, capable of measuring to the nearest 0,001 g.

B.2.2 Reagents

B.2.2.1 Hydrochloric acid, ρ = 1,19 g/ml.

B.2.2.2 Sodium hydroxide, 20 % (mass fraction) solution.

Dissolve sodium hydroxide (ISO 6353, R34) in water, in the proportion of 2 g of sodium hydroxide in 8 ml of water.

B.2.3 Sampling

Test pieces shall not be smaller than 1 200 mm^2.

B.2.4 Procedure

Weigh the test piece, then immerse it in the sodium hydroxide solution (B.2.2.2) that has been heated to not less than 85 °C until the reaction ceases. Remove the test piece, scrub it under water, blot with a towel to remove most of the water and immerse it for 2 s to 3 s in cold hydrochloric acid (B.2.2.1). Remove the test piece again, scrub it under water, and reimmerse it in the sodium hydroxide solution until reaction again ceases. Repeat this cycle until immersion in the sodium hydroxide solution shows no visible reaction. Remove, scrub, dry and reweigh the test piece.

B.2.5 Expression of results

The mass of coating m_c, in grams per square metre of sheet (total for both sides), is given by the formula

$$m_c = \frac{m_0 - m_1}{A} \times 10^6$$

where

m_0 is the mass, in grams, of the test piece before stripping;

m_1 is the mass, in grams, of the test piece after stripping;

A is the area of the test piece used, in square millimetres.

EXAMPLE For a test piece of 40 mm × 40 mm, $m_c = 625(m_0 - m_1)$

B.3 Procedure B – stripping with inhibited hydrochloric acid

B.3.1 Principle

This method is for determining the amount of aluminium-silicon coating on the surface of a steel sheet specimen by measuring the mass of the specimen before and after removal of the coating.

B.3.2 Apparatus

B.3.2.1 Analytical balance, capable of measuring to the nearest 0,001 g.

B.3.3 Reagents

B.3.3.1 Hexamethylenetetramine-hydrochloric acid.

Dissolve 3.5 g of hexamethylenetetramine in 500 ml of hydrochloric acid ($\rho = 1{,}19$ g/ml) and dilute with water to 1 litre.

B.3.3.2 Sodium hydroxide, 20 % (mass fraction) solution.

Dissolve sodium hydroxide (ISO 6353, R34) in water, in the proportion of 2 g of sodium hydroxide in 8 ml of water.

B.3.4 Sampling

Test pieces shall not be smaller than 1 200 mm^2.

B.3.5 Procedure

B.3.5.1 Using an organic (but not chlorine-based) solvent or other suitable method, remove oil and other soils from the test piece, dry completely, then weigh to the nearest 0,001 g.

B.3.5.2 Weigh the test piece, then immerse it in the sodium hydroxide solution (B.3.3.2) that has been heated to not less than 85 °C until the reaction ceases. After confirming termination of active hydrogen gas generation and the subsequent generation of small bubbles from the test piece, remove it from the solution and wash with tap water.

B.3.5.3 Immediately submerge the wet test piece in the hexamethylenetetramine-hydrochloric acid solution (B.3.3.1). After confirming termination of active hydrogen gas generation and the subsequent generation of small bubbles from the test piece, remove it from the solution, wash with tap water, and dry completely.

B.3.5.4 Reweigh the dry test piece to the nearest 0,001 g.

B.3.6 Expression of results

The mass of coating, m_c, in grams per square metre of sheet (total for both sides), is given by the formula:

$$m_c = \frac{m_0 - m_1}{A} \times 10^6$$

where

m_0 is the mass, in grams, of the test piece before stripping;

m_1 is the mass, in grams, of the test piece after stripping;

A is the area of the test piece used, in square millimetres.

EXAMPLE For a test piece of 40 mm × 40 mm, $m_c = 625(m_0 - m_1)$.

Bibliography

[1] ISO 16160, *Continuously hot-rolled steel sheet products — Dimensional and shape tolerances*

[2] ISO 16162, *Continuously cold-rolled steel sheet products — Dimensional and shape tolerances*

[3] ASTM A463/A463M, *Standard Specification for Steel Sheet, Aluminium-Coated, by the Hot-Dip Process*[1)]

[4] JIS G 3314 *Hot-dip aluminium-coated steel sheets and coils*[1)]

[5] EN 10346, *Continuously hot-dip coated steel flat products — Technical delivery conditions*[1)]

1) This document is recognized by ISO/TC 17/SC 12 to cover a subject similar to that of this International Standard. This information is given for the convenience of users of this International Standard and constitutes neither an endorsement of the document by TC 17/SC 12 or ISO, nor a statement regarding its degree of equivalence with this International Standard.

ICS 77.140.50

Price based on 15 pages