INTERNATIONAL STANDARD

ISO 16172

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Continuous hot-dip metallic-coated steel sheet for corrugated steel pipe

Tôles en acier revêtues en continu par immersion à chaud pour tuyaux d'acier strié

Reference number
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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.

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 16172 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

Continuous hot-dip metallic-coated steel sheet for corrugated steel pipe

1 Scope

This International Standard specifies the requirements for steel sheet used in the manufacture of corrugated steel pipe for storm sewers, culverts, drains, and similar uses.

The sheet is metallic coated by the continous hot-dip process.

Many metallic coated materials are covered in this International Standard. Users must determine which product best serves their needs. Four different metallic coatings are included:

— zinc coated;

— zinc-5 % aluminum-mischmetal alloy coating;

— 55 % aluminum-zinc alloy coated;

— Al-Si alloy coated.

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 1460, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 3497, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

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

3 Terms, definitions and abbreviations

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

3.1 Terms and definitions

3.1.1
fabricator
⟨for corrugated metal pipe⟩ the organization that produces the finished pipe

3.1.2
fabricator
⟨for structural plate pipe⟩ the organization that processes flat sheets and other items necessary for the field assembly of finished products

3.1.3
manufacturer
⟨for corrugated metal pipe⟩ the organization that produces the metal sheet from which pipe is made

3.1.4
purchaser
⟨for corrugated metal pipe⟩ the person or agency that purchases the finished pipe

NOTE With regard to this International Standard for sheet for corrugated steel pipe, the fabricator may also be considered as the purchaser of the sheet, where that term is used in this International Standard. Such an interpretation will not restrict the purchaser of finished pipe from enforcing any provisions of this specification.

3.1.5
normal spangle coating
coating formed as a result of the unrestricted growth of aluminium alloy crystals during normal solidification of the Zn-5Al-MM coating type

3.1.6
minimized spangle coating
a finer metallurgical coating formed as a result of treatment to restrict the formation of the normal coarse-grain coating structure of the Zn-5Al-MM coating type

3.2 Abbreviations

Al-Si: aluminium-silicon alloy
55Al-Zn: 55 % aluminium-zinc alloy
Zn: zinc
Zn-5Al-MM: zinc-5 % aluminium-mischmetal alloy

4 Requirements

4.1 Chemical composition

The chemical composition (heat analysis) of the base metal shall conform to the requirements of Table 1.

4.2 Mechanical properties

The metallic-coated sheet shall conform to the requirements listed in Table 2.

Table 1 — Chemical composition

Element	Heat analysis	Product analysis
Sulfur, max., %	0,05	0,06
Sum of carbon, manganese, phosphorus, sulfur and silicon, max., %	0,70	0,74

Table 2 — Mechanical requirements (properties of flat sheet prior to fabrication) [a]

Tensile strength [b], min., N/mm^2	310
Yield strength [b], min. N/mm^2	230
Elongation, in 50 mm [c], min., %	20

[a] To determine conformance with this specification, round each value for tensile strength and yield strength to the nearest 1 N/mm^2 and each value for elongation to the nearest 1 %.

[b] Yield strength and tensile strength are based on the thickness of the base metal. If tests are made after coating, determine the base metal thickness after stripping the coating from the ends of the specimen contacting the grips of the tension-testing machine prior to tensile testing.

[c] The elongation requirement does not apply to material tested after corrugating.

5 Coating requirements

5.1 Coating mass

The coating mass shall comply with the requirements listed in Table 3. The coating mass is the total amount of coating on both sides of the sheet, expressed in grams per square metre.

5.2 Coating adhesion

The adhesion of the coating shall be such that no peeling or flaking occurs while the coated sheet is being corrugated and formed into pipe.

5.3 Surface treatment

A chemical treatment may be applied to the metallic-coated sheet to minimize the hazard of wet storage stain 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.

Table 3 — Coating mass requirements

Type	Coating mass		Equivalent coating thickness	
	total, both sides		total, both sides [a]	
	Triple spot, average, min. g/m^2	Single spot, min. g/m^2	Triple spot, average, min. µm	Single spot, min. µm
Zn	610	550	86	78
Zn-5Al-MM	640	550	93	80
55Al-Zn	210	180	56	48
Al-Si	305	275	95	86

[a] Coating thicknesses are approximate, for information only. Conversions are based on the following relationships: Zn coating: 1 g/m^2 = 0,141 5 µm; Zn-5Al-MM: 1 g/m^2 = 0,146 0 µm; 55Al-Zn coating: 1 g/m^2 = 0,266 36 µm; Al-Si coating: 1 g/m^2 = 0,331 28 µm.

6 Dimension and tolerances

6.1 Thickness

Sheet thickness shall conform to the dimensions specified in Table 4. The thickness of the sheet includes both the base metal and the coating.

6.2 Length

Permissible variations in the length of cut-length sheets, both flat and corrugated, shall be in accordance with ISO 16163.

6.3 Flat sheet

Permissible variations in the width and camber of flat material shall be in accordance with ISO 16163. The flatness tolerances are given in Table 5.

6.4 Corrugated sheet

6.4.1 Corrugations shall form smooth continuous curves and tangents. The dimensions of the corrugated sheet shall be in accordance with Table 6.

6.4.2 The covering width of corrugated sheet shall be in accordance with Table 7. The covering width is the distance between the crests of the extreme corrugations. The lip dimension of corrugated sheet shall be in accordance with Table 8 and is measured along the radial curvature from the crest of the corrugation to the edge of the sheet. There is no established tolerance for overall width, since the covering width and lip dimensions are the governing factors for the formed product.

Table 4 — Coated-steel-sheet thickness requirements

Specified thickness mm	Minimum thickness mm
1,0	0,9
1,3	1,2
1,6	1,5
2,0	1,8
2,8	2,6
3,5	3,3
4,3 [a]	4,0

[a] Aluminium-silicon-alloy-coated sheet is not available in these thicknesses.

NOTE Thickness is measured not less than 10 mm from an edge. On corrugated sheet, thickness is measured on the tangents of corrugations.

7 Sampling

7.1 Chemical composition

A heat analysis of each heat shall be made by the manufacturer to determine compliance with the requirements of Table 1.

7.2 Mechanical properties

One representative sample is used for the tensile test to determine conformance with the requirements of Table 2. Mechanical property tests shall be conducted on the sheet prior to corrugating or other fabrication, whenever possible. If the tests are made after corrugating, the specimens shall be taken on the tangents of corrugations and used for the determination of tensile and yield strength only.

7.3 Coating properties

7.3.1 Coating mass

Test specimens for coils shall be taken from a sample piece approximately 300 mm in length on the as-coated width. Three specimens are cut from the sample, one from the mid-width position and one from each side, not closer than 25 mm from the side edge. The minimum specimen area shall be 2 000 mm^2.

7.3.2 Triple-spot test

The triple-spot test result shall be the average coating mass found on the three specimens taken according to 7.3.1.

7.3.3 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.

8 Test methods

8.1 Tensile tests

The tests shall be conducted in accordance with the methods specified in ISO 6892.

8.2 Coating mass

The manufacturer shall conduct tests using methods deemed necessary to ensure that the material complies with the requirements shown in Table 3. Commonly used methods include those given in ISO 1460, ISO 3497 or ISO 2178. Coating mass is determined by converting coating thickness measurements made with magnetic gauges (ISO 2178) or by X-ray spectrometry (ISO 3497) using the relationship "100 g/m^2 ≡ 0,015 mm". The test methods in ISO 2178 and ISO 3497 may be used as a basis for acceptance but not for rejection. In cases of dispute, ISO 1460 shall be used as the referee method.

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 should be carried out as if they applied to a new lot.

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

10 Workmanship

The metallic-coated steel in corrugated cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that will be 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 in the cut-length product.

11 Inspection and acceptance

11.1 While not usually required for products covered by this International Standard, the purchaser may specify that inspection and tests for acceptance be observed prior to shipment from the manufacturer's works. In these cases, 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.

12 Certification

12.1 A manufacturer's certification shall be furnished to the purchaser when specified in the purchase order or contract. The certification shall be in accordance with, and make reference to, the provisions of this International Standard.

12.2 The test results, including chemical composition, mechanical properties, coating type, and coating mass for each heat and coating lot, shall be maintained by the manufacturer for seven years without regard to whether a certification was furnished. The test results shall be made available to the fabricator and purchaser upon request.

13 Marking

13.1 Each 0,5 to 1,5 m of sheet in coils or cut lengths shall be identified by showing the following:

Name of manufacturer
Brand name (if appropriate)
Specified thickness

Coating type (Zn, Zn-5Al-MM, 55Al-Zn, Al-Si)
Specified coating mass
Identifying symbols relating to a specific heat number and coating lot number
Applicable ISO designation number

13.2 The above marking shall be removed or obliterated, or the sheet remarked “nonspecification” on each 0,5 to 1,5 m of sheet in a coating lot or heat for which control tests, as prescribed herein, show nonconformance to this International Standard.

14 Information to be supplied by the purchaser

14.1 All sheet, both flat and formed, covered by this International Standard shall be ordered only according to the specified thicknesses in Table 4 on coated-steel-sheet thickness requirements.

14.2 All material furnished in accordance with this International Standard shall be chemically treated, unless otherwise specified in the purchaser order.

14.3 To specify requirements adequately using this International Standard, enquiries and orders shall include the following information:

a) a reference to this International Standard;

b) name of material used;

c) coating type and, where appropriate, class;

d) dimensions; for cut lengths, thickness; width; either flat or overall corrugated; length; pitch; and depth of corrugations, if corrugated; for coils, thickness; width; coil requirements (maximum outside diameter, acceptable inside diameter);

e) certification, if required.

NOTE 1 Abbreviations may be used to describe the coating type.

NOTE 2 A typical ordering description is as follows: steel sheet for corrugated pipe in accordance with ISO 16172, aluminum-silicon alloy coating, 45,000 kg, 2,77 by 700 mm by coil, 1 500 mm max. outside diameter, 600 mm inside diameter, 7 000 kg max., certified.

Table 5 — Flatness tolerances (cut lengths only)

Specified thickness mm	Specified width mm	Flatness tolerance (Maximum deviation from a horizontal flat surface) mm
1,6 and thicker	up to 1 500, inclusive	13
1,3 and thinner	up to 900, inclusive	13
	over 900 to 1 500, inclusive	19
NOTE This table also applies to sheets cut to length from coils by the fabricator when adequate flattening measures are performed.		

Table 6 — Corrugation size

Nominal size mm	Maximum pitch [a] mm	Minimum depth [b]	Radius of curvature mm	
			nominal	minimum
68 by 13	73	12	17	13
75 by 25	83	24	14	13
125 by 25	135	24	40	36

[a] Pitch is measured from the crest of corrugations, at 90° to the direction of the corrugations.

[b] Depth is measured as the vertical distance from a straight edge resting on the corrugation crests to the bottom of the intervening valley.

Table 7 — Covering width tolerance for corrugated sheet

Covering width mm	Tolerance over and under mm
up to 600	6
over 600 to 900	10
over 900 to 1200	13

Table 8 — Lip dimension of corrugated sheet

Nominal-corrugation-size pipe mm	For riveted pipe construction mm	For spot-welded construction mm
68 by 13	19	11
75 by 25	22	13
125 by 25	22	13

Bibliography

[1] ISO 3575, *Continuous hot-dip zinc-coated carbon steel sheet of commercial and drawing qualities*

[2] ISO 4998, *Continuous hot-dip zinc-coated carbon steel sheet of structural quality*

[3] ISO 5000, *Continuous hot-dip aluminium-silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities*

[4] ISO 9364, *Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities*

[5] ISO 14788:1998, *Continuous hot-dip zinc-5 %/aluminium alloy coated steel sheets and coils*

[6] ASTM A929/A929M, *Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe*[1)]

1) This standard may be reviewed for comparison with this International Standard. The relationship between the standards may only be approximate; therefore, the respective standards should be consulted for actual requirements. Those who use these standards must determine which specifications address their needs.

ICS 77.140.50

Price based on 9 pages