Continuously hot-dip coated strip and sheet of steels with high yield strength for cold forming — Technical delivery conditions

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ICS 77.140.50

British Standards

National foreword

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Continuously hot-dip coated strip and sheet of steels with high yield strength for cold forming - Technical delivery conditions

Bandes et tôles en aciers à haute limite d'élasticité revêtues en continu par immersion à chaud pour formage à froid - Conditions techniques de livraison

Kontinuierlich schmelztauchveredeltes Band und Blech aus Stählen mit hoher Streckgrenze zum Kaltumformen - Technische Lieferbedingungen

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Foreword

This document (EN 10292:2007) has been prepared by Technical Committee ECISS/TC 27 “Surface coated flat products – Qualities, dimensions, tolerances and specific tests”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2007, and conflicting national standards shall be withdrawn at the latest by September 2007.

This document supersedes EN 10292:2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies requirements for continuously hot-dip zinc (Z), zinc-iron alloy (ZF), zinc-aluminium alloy (ZA), aluminium-zinc alloy (AZ) and aluminium-silicon alloy (AS) coated flat products made of steels with high yield strength for cold forming (see Tables 1 and 3) with thicknesses up to and including 3,0 mm unless otherwise agreed. The thickness is the final thickness of the delivered product after coating.

This European Standard applies to strip of all widths and to sheets cut from it (≥ 600 mm width) and cut lengths (< 600 mm width).

The products covered by this European Standard are mainly used where cold formability and corrosion resistance for a defined minimum yield strength are the most important factors.

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.

EN 10002-1:2001, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

EN 10020, *Definition and classification of grades of steel*

EN 10021, *General technical delivery requirements for steel products*

EN 10079, *Definition of steel products*

EN 10143, *Continuously hot-dip coated steel sheet and strip — Tolerances on dimensions and shape*

EN 10204, *Metallic products — Types of inspection documents*

EN 10325, *Steel — Determination of yield strength increase by the effect of heat treatment (Bake-Hardening-Index)*

EN ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*

ISO 10113, *Metallic materials — Sheet and strip — Determination of plastic strain ratio*

ISO 10275, *Metallic materials — Sheet and strip — Determination of tensile strain hardening exponent*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020, EN 10021, EN 10079, EN 10204 and the following apply.

3.1

hot-dip zinc coating (Z)

application of a zinc coating by immersing the prepared products in a molten bath containing a zinc content of at least 99 %

3.2

hot-dip zinc-iron coating (ZF)

application of a zinc coating by immersing the prepared products in a molten bath containing a zinc content of at least 99 % ; subsequent annealing produces an iron-zinc coating with an iron content of normally 8 % to 12 % (see also 7.3.2.3)

3.3

hot-dip zinc-aluminium alloy coating (ZA)

application of a zinc-aluminium coating by immersing the prepared products in a molten bath which is composed of zinc, approximately 5 % aluminium and small amounts of misch metal

3.4

hot-dip aluminium-zinc alloy coating (AZ)

application of an aluminium-zinc coating by immersing the prepared products in a molten bath which is composed of 55 % aluminium, 1,6 % silicon and the balance zinc

3.5

hot-dip aluminium-silicon alloy coating (AS)

application of an aluminium-silicon coating by immersing the prepared products in a molten bath which is composed of aluminium and 8 % to 11 % silicon

NOTE In the present cases, the wide strip is continuously hot-dip coated in a bath the composition of which is given in 3.1 to 3.5.

3.6

coating mass

total mass of coating including both surfaces of the product (expressed in grams per square metre)

3.7

bake-hardening steel (B)

steel that demonstrates an increase in proof strength following heating in the region of 170 °C for 20 min

3.8

low alloy/micro-alloyed steel (LA)

steel containing one or more of alloys Nb, Ti and V to achieve required proof strength levels

3.9

interstitial free steel (Y)

steel whose composition is controlled to achieve improved r- and n-values

4 Classification and designation

4.1 Classification

The steel grades covered by this European Standard are alloy quality steels according to EN 10020. They are classified according to their minimum proof strength at room temperature.

4.2 Designation

4.2.1 Steel names

The steel names as given in Tables 1 and 3 are allocated in accordance with EN 10027-1.

4.2.2 Steel numbers

The steel numbers as given in Tables 1 and 3 are allocated in accordance with EN 10027-2.

5 Information to be supplied by the purchaser

5.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

a) quantity to be delivered,

b) type of product (strip, sheet, cut length),

c) number of the dimensional standard (EN 10143),

d) nominal dimensions and tolerances on dimensions and shape and, if applicable, letters denoting relevant special tolerances,

e) term ”steel“,

f) number of this European Standard, i.e. EN 10292,

g) steel name or steel number and symbol for the type of hot-dip coating as given in Tables 1 and 3,

h) number designating the nominal mass of coating (e.g. 080 = 80 g/m² including both surfaces, see Table 4),

i) in case of hot-dip zinc coated products, letter denoting the coating finish (N, M or R, see Tables 5 and 6 and 7.3.2),

j) letter denoting the surface quality (A, B or C, see 7.3.3) and

k) letter denoting the surface treatment (C, O, CO, S, P or U, see 7.3.4).

EXAMPLE 1 sheet, delivered with dimensional tolerances according to EN 10143 with a nominal thickness of 0,70 mm, ordered with special thickness tolerances (S), nominal width 1 200 mm, ordered with special width tolerances (S), nominal length 2 500 mm, ordered with special flatness tolerances (FS), made of steel HX300LAD (1.0932), aluminium-silicon coated (AS), coating mass 80 g/m^2 (080), best quality surface (C), chemically passivated and oiled (CO) according to EN 10292.

1 sheet – EN 10143 – 0,70Sx1200Sx2500FS – steel EN 10292 – HX300LAD+AS080 – C – CO

or

1 sheet – EN 10143 – 0,70Sx1200Sx2500FS – steel EN 10292 – 1.0932+AS080 – C – CO

5.2 Options

A number of options are specified in this European Standard and listed below. If the purchaser does not indicate his wish to implement one of these options, the products shall be supplied in accordance with the basis specification of this European Standard (see 5.1).

a) verification of the product analysis (see 7.1.2);

b) products suitable for the manufacture of a specific part (see 7.2.2);

c) coating masses different from those of Table 4 (see 7.3.1.2);

d) special requirements for different coating masses on each side (see 7.3.1.3);

e) hot-dip zinc coated products with pronounced spangle (see 7.3.2.2 a));

f) special requirements for a maximum Fe-Al-Si alloy layer mass occurring during hot-dip aluminium-silicon coating (see 7.3.2.6);

g) products supplied free from coil breaks (see 7.3.5);

h) maximum or minimum value for the coating mass on each product side (see 7.3.7.2);

i) determination of the tensile properties and/or the Bake-Hardening-Index BH_2 and/or the coating mass by calculation (see 8.1.4);

j) notification of which surface has been inspected (see 8.5.4);

k) testing for compliance with the requirements of this European Standard (see 8.1.1 and 8.1.2);

l) supply of an inspection document and type of document (see 8.7);

m) marking desired by branding of the products (see 9.2);

n) requirements for packing (see Clause 10).

6 Manufacturing process

The processes used in steelmaking and manufacture of the products are left to the discretion of the manufacturer.

7 Requirements

7.1 Chemical composition

7.1.1 Cast analysis

The chemical composition determined by cast analysis shall be in accordance with the requirements given in Table 1.

Table 1 — Chemical composition (cast analysis)

Designation			% by mass							
Steel name[a]	Steel number	Symbols for the type of the available hot-dip coatings	C max.	Si max.	Mn max.	P max.	S max.	Al min.	Ti max.	Nb max.
HX180YD	1.0921	+Z, +ZF, +ZA, +AZ, +AS	0,01	0,15	0,70	0,06	0,025	–	0,12	0,09
~~HX180BD~~	~~1.0914~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~0,1~~	~~0,50~~	~~0,70~~	~~0,06~~	~~0,025~~	~~0,015~~	~~0,12~~	~~0,09~~
~~HX220YD~~	~~1.0923~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~0,01~~	~~0,20~~	~~0,90~~	~~0,08~~	~~0,025~~	~~–~~	~~0,12~~	~~0,09~~
~~HX220BD~~	~~1.0919~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~0,1~~	~~0,50~~	~~0,70~~	~~0,08~~	~~0,025~~	~~0,015~~	~~0,12~~	~~0,09~~
~~HX260YD~~	~~1.0926~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~0,01~~	~~0,25~~	~~1,10~~	~~0,10~~	~~0,025~~	~~–~~	~~0,12~~	~~0,09~~
~~HX260BD~~	~~1.0924~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~0,1~~	~~0,50~~	~~0,80~~	~~0,10~~	~~0,025~~	~~0,015~~	~~0,12~~	~~0,09~~
HX260LAD	1.0929	+Z, +ZF, +ZA, +AZ, +AS	0,12	0,50	0,60	0,030	0,025	0,015	0,12	0,09
HX300YD	1.0927	+Z, +ZF, +ZA, +AZ, +AS	0,01	0,30	1,30	0,10	0,025	–	0,12	0,09
HX300BD	1.0930	+Z, +ZF, +ZA, +AZ, +AS	0,11	0,50	0,80	0,12	0,025	0,015	0,12	0,09
HX300LAD	1.0932	+Z, +ZF, +ZA, +AZ, +AS	0,11	0,50	1,00	0,030	0,025	0,015	0,15	0,09
HX340LAD	1.0933	+Z, +ZF, +ZA, +AZ, +AS	0,11	0,50	1,00	0,030	0,025	0,015	0,15	0,09
HX380LAD	1.0934	+Z, +ZF, +ZA, +AZ, +AS	0,11	0,50	1,40	0,030	0,025	0,015	0,15	0,09
HX420LAD	1.0935	+Z, +ZF, +ZA, +AZ, +AS	0,11	0,50	1,40	0,030	0,025	0,015	0,15	0,09

a **H** flat products of high strength for cold forming; **X** rolling condition (hot rolled or cold rolled) not specified; **nnn** minimum proof strength $R_{p0,2}$ in MPa; **B** bake-hardened; **Y** interstitial free; **LA** low alloy (micro-alloyed); **D** intended for hot-dip coating.

7.1.2 Product analysis

If a product analysis is agreed at the time of enquiry and order, the permitted deviations from the values of the cast analysis given in Table 1 shall be in accordance with the requirements in Table 2.

Table 2 — Permissible product analysis deviations from the values given in Table 1 for the cast analysis

Element	Specified limits according to the cast analysis % by mass	Permissible deviations from the limits of the cast analysis % by mass
C	≤ 0,12	+ 0,02
Si	≤ 0,50	+ 0,03
Mn	≤ 1,00	+ 0,05
	> 1,00 ≤ 1,40	+ 0,10
P	≤ 0,12	+ 0,01
S	≤ 0,025	+ 0,005
Al_{tot}	≥ 0,015	- 0,005
Ti	≤ 0,15	+ 0,02
Nb	≤ 0,09	+ 0,02

7.2 Mechanical properties

7.2.1 The products shall comply with requirements in Table 3.

7.2.2 If specially agreed at the time of enquiry and order, products with suitability for manufacturing a specific part may be supplied. In this case the values in Table 3 do not apply. The reject tolerances arising when the material is processed shall not exceed a specific proportion to be agreed upon at the time of enquiry and order.

7.2.3 If ordered in accordance with 7.2.1, the mechanical property values in Table 3 apply for a period of three months for bake-hardening grades and of six months for all other grades commencing from the date on which the products are made available by the works.

7.2.4 The values for the tensile test apply to the test piece cross section without coating.

7.2.5 The strain ratio r and the strain hardening exponent n shall be in the range of homogeneous deformation, within the strain range of 10 % to 20 %.

NOTE The uniform elongation of the material to be tested may be lower than 20 %. In this case an upper limit of the strain range of ≥ 15 % may be applied.

Table 3 — Mechanical properties (transverse direction) of continuously hot-dip coated steels with high yield strength for cold forming

Designation			0,2% proof strength [a]	Bake-Hardening-Index	Tensile strength	Elongation	Plastic strain ratio	Strain hardening exponent
Steel grade		Symbols for the type of the available hot-dip coatings	$R_{p0,2}$ MPa	BH_2 MPa	R_m MPa	A_{80} [b] [c] %	r_{90} [c]	n_{90}
Steel name	Steel number			min.		min.	min.	min.
~~HX180YD~~	~~1.0921~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~180 to 240~~	–	~~340 to 400~~	~~34~~	~~1,7~~ [d]	~~0,18~~
~~HX180BD~~	~~1.0914~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~180 to 240~~	~~35~~	~~280 to 360~~	~~34~~	~~1,5~~	~~0,16~~
~~HX220YD~~	~~1.0923~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~220 to 280~~	–	~~340 to 420~~	~~32~~	~~1,5~~ [d]	~~0,17~~
~~HX220BD~~	~~1.0919~~	~~+Z, +ZF, +ZA, +AZ, +AS~~	~~220 to 280~~	~~35~~	~~320 to 400~~	~~32~~	~~1,2~~	~~0,15~~
HX260YD	1.0926	+Z, +ZF, +ZA, +AZ, +AS	260 to 320	–	380 to 440	30	1,4 [d]	0,16
HX260BD	1.0924	+Z, +ZF, +ZA, +AZ, +AS	260 to 320	35	360 to 440	28	–	–
HX260LAD	1.0929	+Z, +ZF, +ZA, +AZ, +AS	260 to 330	–	350 to 430	26	–	–
HX300YD	1.0927	+Z, +ZF, +ZA, +AZ, +AS	300 to 360	–	390 to 470	27	1,3 [d]	0,15
HX300BD	1.0930	+Z, +ZF, +ZA, +AZ, +AS	300 to 360	35	400 to 480	26	–	–
HX300LAD	1.0932	+Z, +ZF, +ZA, +AZ, +AS	300 to 380	–	380 to 480	23	–	–
HX340LAD	1.0933	+Z, +ZF, +ZA, +AZ, +AS	340 to 420	–	410 to 510	21	–	–
HX380LAD	1.0934	+Z, +ZF, +ZA, +AZ, +AS	380 to 480	–	440 to 560	19	–	–
HX420LAD	1.0935	+Z, +ZF, +ZA, +AZ, +AS	420 to 520	–	470 to 590	17	–	–

a If the yield strength is pronounced, the values apply to the lower yield point (R_{eL}).

b Decreased minimum elongation values apply for thickness ≤ 0,5 mm (minus 4 units) and for thickness > 0,5 mm and ≤ 0,7 mm (minus 2 units).

c For AS-, AZ- and ZF-coatings, the A_{80} values are lowered by 2 units and the r_{90}-values are lowered by 0,2.

d For thicknesses > 1,5 mm the r_{90}-values are additionally lowered by 0,2.

7.3 Requirements for coatings

7.3.1 Types of coatings

7.3.1.1 The products shall be supplied with coatings of zinc (Z) or zinc-iron alloy (ZF) or zinc-aluminium alloy (ZA) or aluminium-zinc alloy (AZ) or aluminium-silicon alloy (AS) as given in Table 4.

7.3.1.2 The available coating masses are also given in Table 4.

Coating masses different from those of Table 4 can be supplied by agreement at the time of enquiry and order. Thicker coatings limit the formability and weldability of the products. Therefore, the forming and weldability requirements should be taken into account when ordering the coating mass.

7.3.1.3 If agreed at the time of enquiry and order, different coating masses on each side may be supplied. The two sides may have a different appearance as a result of the manufacturing process.

Table 4 — Coating mass

Coating designation [a]	Minimum total coating mass, g/m² both sides	
	Triple spot test [b]	Single spot test [b]
	Zinc coating masses (Z) [c]	
Z100	100	85
Z140	140	120
Z200	200	170
Z225	225	195
Z275	275	235
	Zinc-iron alloy coating masses (ZF) [e]	
ZF100	100	85
ZF120	120	100
	Zinc-aluminium alloy coating masses (ZA) [d]	
ZA095	95	80
ZA130	130	110
ZA185	185	155
ZA200	200	170
ZA255	255	215
	Aluminium-zinc alloy coating mass (AZ) [e]	
AZ100	100	85
AZ150	150	130
AZ185	185	160
	Aluminium-silicon alloy coating masses (AS) [f]	
AS060	60	45
AS080	80	60

a See also 7.3.1.2.

b See 8.4.3 and 8.5.5.

c A coating mass of 100 g/m² corresponds to a coating thickness of approximately 7,1 µm on each side.

d A coating mass of 95 g/m² corresponds to a coating thickness of approximately 7,2 µm on each side.

e A coating mass of 100 g/m² corresponds to a coating thickness of approximately 13,3 µm on each side.

f A coating mass of 100 g/m² on both sides corresponds to a coating thickness of approximately 17 µm on each side.

7.3.2 Coating finish

7.3.2.1 General

Depending on the galvanizing conditions, crystals of different sizes and brightness arise. The coating properties are not affected by this.

7.3.2.2 Zinc coated products (see Table 5)

a) Normal finish (N)

The finish is obtained when the zinc coating is left to solidify normally. Either no spangle or zinc crystals of different sizes and brightness appear depending on the galvanizing conditions. The quality of the coating is not affected by this.

If a pronounced spangle is desired, this shall be indicated specially at the time of enquiry and order.

Table 5 — Available coatings, finishes and surface qualities for zinc coatings (Z)

Coating designation [ab]	Coating finish			
	N	M		
	Surface qualities [b]			
	A	A	B	C
Z100	x	x	x	x
Z140	x	x	x	x
Z200	x	x	x	x
(Z225)	x	x	x	(x)
(Z275)	x	x	x	(x)

a See also 7.3.1.2.

b The coatings and surface qualities given in brackets are available on agreement.

b) Minimized spangle (M)

The finish is obtained by influencing the solidification process in a specific way. The surface will have reduced spangles, in some cases, not visible to the unaided eye. The finish may be ordered if the normal spangle (see 7.3.2.2 a)) does not satisfy the surface appearance requirements.

7.3.2.3 Zinc-iron alloy coated products (see Table 6)

The regular zinc-iron alloy coating (R) results from heat treatment in which iron diffuses through the zinc. The surface has a uniform matt grey appearance.

Table 6 — Available coatings, finishes and surface qualities for zinc-iron alloy coatings (ZF)

Coating designation [a]	Coating finish R Surface qualities		
	A	B	C
ZF100	x	x	x
ZF120	x	x	x

a See also 7.3.1.2.

7.3.2.4 Zinc-aluminium coated products (see Table 7)

The normal coating finish has a metallic lustre, which is the result of unrestricted growth of the zinc-aluminium crystals during normal solidification. Crystals of different sizes and brightness may appear depending on the manufacturing conditions. The quality of the coating is not affected by this.

7.3.2.5 Aluminium-zinc coated products (see Table 7)

The products are supplied with a normal spangle.

Normal spangle is a coating finish, having a metallic lustre, which is the result of unrestricted growth of the aluminium-zinc crystals during normal solidification.

7.3.2.6 Aluminium-silicon coated products (see Table 7)

During hot-dip aluminium-silicon alloy coating (AS) a Fe-Al-Si alloy layer forms over the base material and its thickness depends on the chemical composition and the metallurgical properties of the base material. If a maximum value for the mass of this layer is required, this shall be specially agreed upon at the time of enquiry and order. The test method is described in Annex C.

Table 7 — Available coatings and surface qualities for zinc-aluminium coatings (ZA), aluminium-zinc coatings (AZ) and aluminium-silicon coatings (AS)

Coating designation [a]	Surface qualities								
	ZA			AZ			AS		
	A	B	C	A	B	C	A	B	C
ZA60/AZ60/AS60	–	–	–	–	–	–	x	x	x
ZA80/AZ80/AS80	–	–	–	–	–	–	x	x	x
ZA95/AZ95/AS95	x	x	x	–	–	–	–	–	–
ZA100/AZ100/AS100	–	–	–	x	x	x	–	–	–
ZA130/AZ130/AS130	x	x	x	–	–	–	–	–	–
ZA150/AZ150/AS150	–	–	–	x	x	–	–	–	–
ZA185/AZ185/AS185	x	x	x	x	–	–	–	–	–
ZA200/AZ200/AS200	x	x	x	–	–	–	–	–	–
ZA255/AZ255/AS255	x	x	x	–	–	–	–	–	

a See also 7.3.1.2.

7.3.3 Surface quality

7.3.3.1 General

The product surface shall comply with requirements in 7.3.3.2 to 7.3.3.4 for the ordered surface quality.

When supplying strip in coils, there is greater risk of surface defects than if sheet and cut lengths are supplied as it is not possible for the manufacturer to eliminate all the defects in a coil. This shall be taken into account by the purchaser when evaluating the products.

7.3.3.2 As coated surface (A)

Imperfections such as small pits, variations in surface appearance, dark spots, stripe marks and light passivation stains are permissible. Stretch levelling breaks or run-off marks may appear.

7.3.3.3 Improved surface (B)

Surface quality B is obtained by skin passing.

With this surface quality, small imperfections such as stretch levelling breaks, skin pass marks, scratches, indentations, surface structure and run-off marks and light passivation marks are permissible.

7.3.3.4 Best quality surface (C)

Surface quality C is obtained by skin passing.

The better surface shall not impair the uniform appearance of a high-class paint finish. The other surface shall have at least the characteristics of surface quality B (see 7.3.3.3).

7.3.4 Surface treatment (surface protection)

7.3.4.1 General

At the time of enquiry and order one of the following surface treatment conditions (see 7.3.4.2 to 7.3.4.6) shall be agreed.

- chemically passivated C
- oiled O
- chemically passivated and oiled CO
- phosphated P
- phosphated and oiled PO
- sealed S

Hot-dip coated flat products are only supplied without surface treatment (untreated (U)) if expressively desired by the purchaser on his own responsibility. In this case, there is increased risk of formation of corrosion products on the surface during storage and transportation.

The period of protection afforded depends on the atmospheric and storage conditions.

7.3.4.2 Chemical passivation (C)

Chemical passivation protects the surface against humidity and reduces the risk of formation of corrosion products during transportation and storage. Local discolouring as a result of this treatment is permissible and does not impair the quality.

7.3.4.3 Oiling (O)

This treatment reduces the risk of formation of corrosion products. If specially agreed, prelubes, which improve formability, may be used.

It shall be possible to remove the oil layer with a suitable degreasing solvent which does not adversely affect the coating.

The corrosion protection oil applied to at the works is not a drawing oil.

7.3.4.4 Chemical passivation and oiling (CO)

Agreement may be reached on this combination of surface treatment if increased protection against the formation of corrosion products is required.

7.3.4.5 Phosphating (P)

This treatment improves the adherence and protective effect of a coating applied by the processor. It also reduces the risk of corrosion occurring during transport and storage. Phosphating in conjunction with a suitable lubricating agent may improve workability.

7.3.4.6 Phosphating and oiling (PO)

This combined surface treatment may improve formability.

7.3.4.7 Sealing (S)

Application of a transparent organic film coating of masses about 1 g/m^2.

This treatment offers additional corrosion protection, especially the protection against fingerprints, it may improve the sliding characteristics during forming operations and can be used as a priming coat for subsequent varnishing.

7.3.5 Freedom from coil breaks

If the products are to be delivered with freedom from coil breaks (fluting), this shall be specially indicated at the time of enquiry and order.

7.3.6 Stretcher strains

Products with surface condition B and C are free from stretcher strains for a period of three months for bake-hardening grades and of six months for all other grades commencing from the agreed date on which they are made available.

7.3.7 Coating mass

7.3.7.1 The coating mass shall correspond to the data in Table 4. The values apply for the total mass of the coating on both surfaces for the triple spot test and the single spot test (see 8.4.3 and 8.5.5).

The coating mass is not always equally distributed on both the product surfaces. However, it may be assumed that a coating mass of at least 40 % of the value given in Table 4 for the single spot test exists on each surface of the product.

7.3.7.2 A maximum or minimum value for the coating mass may be agreed upon per surface of the product (single spot test) for each coating given in Table 4.

7.3.8 Adhesion of coating

The adhesion of the coating shall be tested by using an appropriate method. The selection of the test method is left to the discretion of the manufacturer.

7.4 Tolerances on dimensions and shape

The requirements of EN 10143 shall apply.

7.5 Suitability for further processing

7.5.1 The products according to this European Standard are suitable for welding using welding methods corresponding to the specified steel grades, their chemical composition and strength level and to the coating masses. With heavier coating masses, special measures shall be taken for welding, as appropriate.

7.5.2 Products complying with the requirements of this European Standard are suitable for bonding together.

7.5.3 All steel grades and surface qualities are suitable for organic coating. The appearance after this treatment depends on the surface quality ordered (see 7.3.3).

NOTE Application of surface coatings requires corresponding pre-treatment at the processor's works.

8 Testing

8.1 General

8.1.1 The products may be supplied with or without testing for compliance with the requirements of this European Standard.

8.1.2 If testing is required, the purchaser shall give the following information at the time of enquiry and order:

type of test (specific or non-specific test, see EN 10021),

type of inspection document (see EN 10204 and 8.7).

8.1.3 Specific tests shall be carried out in accordance with the requirements in 8.2 to 8.6.

8.1.4 By agreement at the time of enquiry and order, the manufacturer may determine the tensile properties and/or the Bake-Hardening-Index BH_2 and/or the coating mass by calculation in accordance with an approved method.

8.2 Test units

The test unit consists of 20 t or a fraction of 20 t of hot-dip coated flat products of the same grade, nominal thickness, coating mass and surface condition. In the case of strip, a coil weighing more than 20 t shall be regarded as one test unit.

8.3 Number of tests

One series of tests shall be carried out per test unit as specified in 8.2 to determine

the mechanical properties (see 8.5.1),

the r- and n-values if specified in Table 3 (see 8.5.2),

the Bake-Hardening-Index (BH_2) (see 8.5.3) and

the coating mass (see 8.5.5).

The number of tests for the determination of the alloy layer in case of hot-dip aluminium-silicon alloy coatings (see 7.3.2.6) shall - if required - be agreed at the time of enquiry and order.

8.4 Sampling

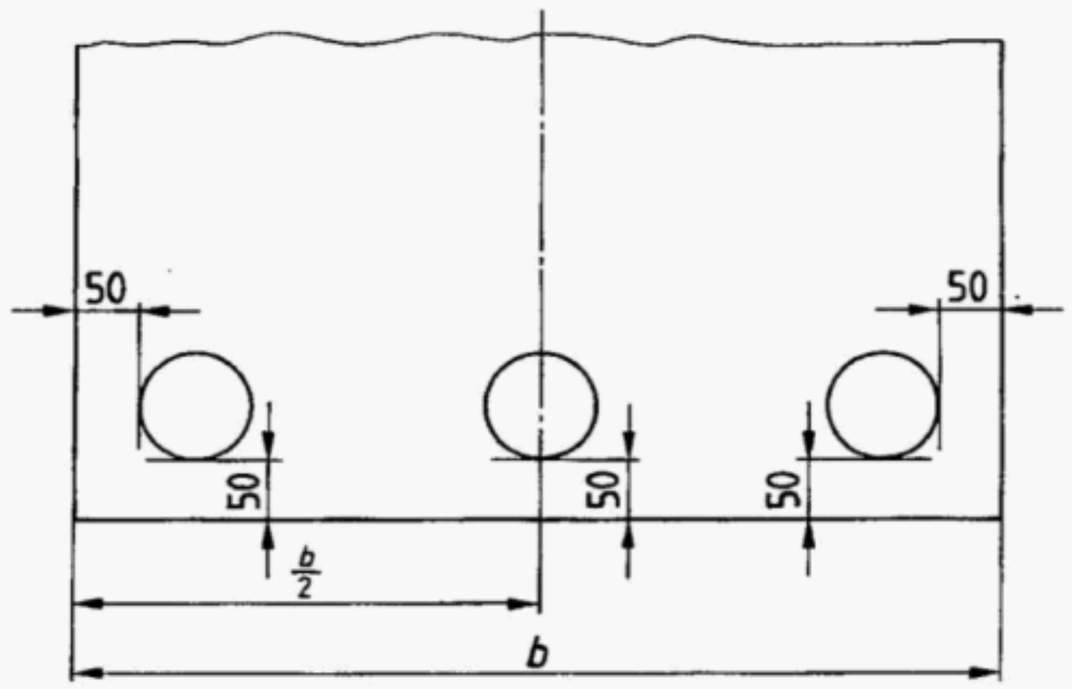
8.4.1 In the case of strip, the samples shall be taken from the beginning or the end of the coil. In the case of sheet and cut lengths, the selection of the sample shall be left to the discretion of the inspector supplier.

8.4.2 The sample for the tensile test (see 8.5.1) shall be taken at a distance of at least 50 mm from the edge of the product.

8.4.3 The three samples for testing the coating mass (see 8.5.5) shall be taken as shown in Figure 1 if the product width permits. The samples may be round or square and the individual sample shall be at least 5 000 mm² in area.

If sampling as shown in Figure 1 is not possible because the product width is too small, only one sample shall be taken with an area of at least 5 000 mm². The coating mass determined from it shall comply with the requirements for the single spot test as specified in Table 4.

Dimensions in millimetres



Key

b strip or sheet width

Figure 1 — Position of the samples for determining the coating mass

8.4.4 If it is agreed to determine the thickness of the alloy layer (see 7.3.2.6) special agreement shall be made for sampling.

8.4.5 All the samples shall be taken and machined, if necessary, in such a way that the results of the tests are not affected.

8.4.6 If verification of chemical composition according to product analysis is agreed at the time of enquiry and order, sampling and sample preparation shall be in accordance with the requirements of EN ISO 14284.

8.5 Test methods

8.5.1 Tensile test

The tensile test shall be carried out according to EN 10002-1 using type 2 test pieces (initial gauge length L_o = 80 mm, width b = 20 mm) according to Annex B in EN 10002-1:2001 (see also 7.2.4).

8.5.2 Plastic strain ratio and hardening exponent

The determination of the plastic strain ratio r and the strain hardening exponent n shall be carried out in accordance with ISO 10113 and ISO 10275.

8.5.3 Bake-Hardening-Index

The determination of the yield strength increase by the effect of heat treatment (Bake-Hardening-Index BH_2) shall be carried out in accordance with EN 10325.

8.5.4 Surface inspection

The product surface shall be visually inspected for verification of conformance with the requirements in 7.3.2 to 7.3.4.

Unless otherwise agreed at the time of enquiry and order, only one surface shall be inspected at the manufacturer's works. If requested, the supplier shall inform the purchaser whether the inspected surface is the top surface or the bottom surface.

Small edge cracks which may occur in the case of uncut edges are not justification for rejection.

8.5.5 Coating mass

8.5.5.1 General method

The coating mass shall be determined from the difference in mass of the samples before and after the coating has been removed chemically. In the test with specimens according to 8.4.3 and Figure 1, the triple spot test value is the arithmetic mean of the three test results. Each individual result shall meet the requirements of the single spot test as given in Table 4.

Other methods – e.g. non-destructive tests – may be used for continuous checks at the discretion of the manufacturer.

In cases of dispute, the methods described in Annex A (Z, ZF, ZA and AZ) or Annex B (AS) shall be used.

8.5.5.2 Special method for determination of the mass of the Fe-Al-Si alloy layer

If it is agreed to determine the mass of the Fe-Al-Si alloy layer resulting from hot-dip aluminium-silicon alloy (AS) coating (see 7.3.2.6) the method for its determination given in Annex C shall be applied.

8.6 Retests

The requirements of EN 10021 shall apply. In the case of coils, the retest specimens shall be taken from a distance of at least one lap away, but with a maximum of 20 m from the end of the coil.

8.7 Inspection documents

If agreed at the time of enquiry and order, one of the inspection documents specified in EN 10204 shall be supplied (see 8.1.2).

9 Marking

9.1 A label shall be attached to each coil or bundle containing at least the following information:

a) name or mark of the manufacturer‘s works;

b) designation (consisting of 5.1 b) and 5.1 f) to 5.1 k));

c) nominal dimensions of the product;

d) identification number;

e) order number;

f) mass of the coil or bundle.

Bar coding according to EN 606 can supplement marking, when the above mentioned minimum information is also given in clear text.

9.2 Marking of the products by branding may be agreed upon at the time of enquiry and order.

10 Packing

The packing requirements for the product shall be agreed at the time of enquiry and order.

11 Storage and transportation

11.1 Moisture, in particular condensation between the sheets, laps of the coil or other adjacent parts made of hot-dip coated flat products can lead to the formation of corrosion products. The possible types of surface protection are given in 7.3.4. As a precaution, the products should be transported and stored dry and protected from moisture.

11.2 During transportation, dark spots may appear in the coated surfaces as a result of friction. Generally, they only impair the appearance. Friction is reduced by oiling the products. The products shall be adequately packed, transported and stored in order to avoid damage on appropriate transport.

12 Disputes

EN 10021 is applicable to disputes after delivery and their settlement.

Annex A

(normative)

Reference method for determination of the zinc, zinc-iron, zinc-aluminium and aluminium-zinc coating mass

A.1 Principle

The sample shall be at least 5 000 mm² in area. Using a sample with a surface area of 5 000 mm², the loss of mass in grams when the coating is dissolved, multiplied by 200, will represent the coating mass in grams per square metre of the product, including both sides.

A.2 Reagent and preparation of the solution

Reagent:

hydrochloric acid (HCl ρ_{20} = 1,19 g/ml);

hexamethylenetetramine ($C_6H_{12}N_4$).

Preparation of the solution:

The hydrochloric acid is diluted with de-ionized or distilled water in the ratio one part pure HCl to one part water (50 % dilution). Hexamethylenetetramine is then added, stirring, in the ratio of 3,5 g per litre of diluted hydrochloric acid solution.

This prepared solution permits the execution of numerous successive dissolutions under satisfactory conditions of attack of the coating, both from the point of view of speed and accuracy.

A.3 Apparatus

Balance capable of weighing samples to an accuracy of 0,001 g. For the test, use a take-off device.

A.4 Procedure

The following operations are applied to each sample:

a) if necessary, degrease the sample with an organic solvent which will not attack the coating, then dry the sample;

b) weigh the sample to an accuracy of 0,001 g;

c) place the sample in the hydrochloric acid solution with hexamethylenetetramine inhibitor (see A.2) at ambient temperature (20 °C to 25 °C). Leave the sample immersed in the solution until the release of hydrogen ceases or only a few bubbles are released;

d) after the attack, the sample is washed and brushed under running water, dried with a cloth and then by heating to around 100 °C and cooled or dried by blowing with warm air;

e) weigh the sample again to an accuracy of 0,001 g;

f) determine the difference between the mass of the coated sample and that of the sample without its coating. This difference, calculated in grams, represents the mass m of the coating.

Annex B

(normative)

Reference method for determination of the aluminium-silicon coating mass

B.1 Scope

The method described below is used for determining the coating mass of hot-dip aluminium-silicon coated flat products. The samples are weighed before and after the coating has been removed.

B.2 Reagents

Hydrochloric acid (ρ_{20} = 1,19 g/ml).

20 % sodium hydroxide solution made by dissolving 20 g sodium hydroxide in 80 ml of water.

B.3 Procedure

B.3.1 Samples

The samples are taken from the product in accordance with 8.4.3.

The samples shall be clean. If necessary, they are to be washed firstly with suitable solvents, which will not attack the coating, then secondly in alcohol. Finally, they are thoroughly dried.

B.3.2 Method

After washing as specified in B.3.1, the samples are weighed to an accuracy of 0,001 g and then placed in the hot sodium hydroxide solution until the reaction ceases. Then the test samples are taken out of this solution, rubbed under water, roughly dried off with a cloth and placed in cold hydrochloric acid for 2 s to 3 s.

The samples are then rinsed under water and again immersed in the sodium hydroxide solution until no further reaction can be established. This process is to be repeated until no reaction is visible when the sample is dipped into the sodium hydroxide solution. The samples are then washed, dried and re-weighed (accuracy 0,001 g).

B.4 Evaluation

The coating mass in grams per square metre of the product (on both sides) is obtained from the following equation:

$$\frac{(m_0 - m_1 \quad 10^6}{A}).$$

where

m_0 is the mass of the sample before the coating is stripped off, in grams,

m_1 is the mass of the sample after the coating has been removed, in grams,

A is the area of the sample used in square millimetres.

Annex C

(normative)

Methods for determination of the mass of the Fe-Al-Si alloy layer

C.1 Scope

The method described below is used for determining the mass of the alloy layer on samples of hot-dip aluminium-silicon coated flat products. Firstly, the so-called non-alloy layer and secondly the alloy layer are removed, according to the method in Annex B. The method is based on the reaction of tin (II) chloride solution with aluminium to form metallic tin (sponge); this solution does not react with the alloy or with the iron base material. The samples are weighed before and after removal of the alloy layer.

C.2 Reagents

C.2.1 Tin (II) chloride solution

C.2.1.1 To produce the stock solution, 1 000 g $SnCl_2 \cdot H_2O$ are dissolved in 500 ml of diluted hydrochloric acid (1:1). Make up to 1 000 ml adding 5 g to 10 g metallic tin. Heat until the solution is clear.

C.2.1.2 To produce the test solution, 20 ml of stock solution are added to 200 ml H_2O immediately prior to use.

C.3 Procedure

C.3.1 Removal of the non-alloy layer

The samples, taken in accordance with 8.4.3 are cleaned with petroleum ether and immersed in 200 ml of test solution (see C.2.1.2) until the reaction ceases. Once the test samples have been removed from the solution, the sponge tin is scraped off with a small spatula. The process is repeated until no further reaction takes place. The samples are then washed and dried.

C.3.2 Determination of alloy layer

The test samples prepared in accordance with C.3.1 are treated as described in B.3.2.

C.4 Evaluation

The mass of the alloy layer is calculated using the equation in B.4, from the difference in mass of the samples before and after the test.

Bibliography

[1] EN 606, *Bar coding — Transport and handling labels for steel products*

[2] EN 10027-1, *Designation systems for steels — Part 1: Steel names*

[3] EN 10027-2, *Designation systems for steels — Part 2: Numerical system*

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