

Continuously hot-dip zinc coated structural steels strip and sheet — Technical delivery conditions

The European Standard EN 10147:2000 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 10147:2000. It supersedes BS EN 10147:1992 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee ISE/10, Flat rolled steel products, to Subcommittee ISE/10/8, Coated steel flat rolled products, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Kontinuierlich Feuerverzinktes Band und Blech aus
Baustählen – Technische Lieferbedingungen

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Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard 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 supersedes EN 10147:1991.

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of an identical text or by endorsement, at the latest by October 2000, and conflicting national standards shall be withdrawn at the latest by October 2000.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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1 Scope

1.1 This European Standard specifies requirements for continuously hot-dip zinc coated flat products in thicknesses $\leq 3,0$ mm made of the steels given in Table 1. The thickness is the final thickness of the delivered product after zinc 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 types of coating, coating masses and coating finishes available, and surface qualities are given in Tables 2 to 4 (see also 7.2 to 7.4).

1.2 If agreed at the time of ordering, this European Standard may also be applied to continuously hot-dip zinc coated flat products in thicknesses $> 3,0$ mm. In this case, the mechanical property, adhesion of coating and surface condition requirements shall also be agreed at the time of ordering.

1.3 The products covered by this European Standard are suitable for applications where the minimum yield strength values and resistance to corrosion are of prime importance. Corrosion protection afforded by the coating is directly proportional to the mass of coating (see also 7.2.2).

1.4 This European Standard is not applicable to:

- continuously hot-dip zinc coated low carbon steel strip and sheet for cold forming (see EN 10142);
- electrolytically zinc coated cold rolled steel flat products (see EN 10152);
- continuously organic coated (coil coated) flat steel products (see EN 10169-1 and ENV 10169-2);
- continuously hot-dip coated strip and sheet of steels with higher yield strength for cold forming (see EN 10292).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10002-1, *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 and steel products*.

EN 10027-1, *Designation system for steel – Part 1: Steel names, principal symbols*.

EN 10027-2, *Designation systems for steels – Part 2: Numerical system*.

EN 10079, *Definition of steel products*.

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

EN 10204, *Metallic products – Types of inspection documents*.

CR 10260, *Designation systems for steel – Additional symbols*.

EURONORM 12¹⁾, *Bend test for steel sheet and strip less than 3 mm thick*.

3 Terms and definitions

For the purposes of this Standard the following terms and definitions apply in addition to the terms and definitions in EN 10020, EN 10021, EN 10079 and EN 10204 (see clause 2).

3.1

hot-dip zinc coating

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

In this case, the wide strip of steel is continuously hot-dip coated.

3.2

coating mass

total mass including both surfaces (expressed in grams per square metre)

4 Classification and designation

4.1 Classification

The steel grades according to this European Standard given in Table 1 are classified according to their increasing minimum yield strength (R_{eH}).

4.2 Designation

4.2.1 Steel names

For the steel grades covered by this European Standard, the steel names as given in Table 1 are allocated in accordance with EN 10027-1 and CR 10260.

¹⁾ Until it is transformed into European Standard, either EURONORM 12 or the corresponding national standard may be applied.

4.2.2 Steel numbers

For the steel grades covered by this European Standard, the steel numbers as given in Table 1 are allocated in accordance with EN 10027-2 and CR 10260.

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) the quantity to be delivered;
- b) the type of product (strip, sheet, cut length);
- c) the number of the dimensional standard (EN 10143)‘
- d) the nominal dimensions and the tolerances on dimensions and shape and, if applicable, letters denoting relevant special tolerances;
- e) the term “steel”;
- f) number of this standard (EN 10147);
- g) steel name or steel number and symbol for the type of hot-dip coating as given in Table 1;
- h) number designating the nominal mass of coating (e.g. 275 = 275 g/m² including both surfaces, see Tables 2, 3 and 4);
- i) letter denoting the coating finish (N, M or R; see Tables 2 and 3 and 7.3);
- j) letter denoting the surface quality (A, B or C; see Tables 2 and 3 and 7.4);
- k) letter denoting the surface treatment (C, O, CO, S, P or U, see 7.5).

EXAMPLE 1 sheet, delivered with dimensional tolerances according to EN 10143 with a nominal thickness of 0,80 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 S320GD+ZF (1.0250+ZF) according to EN 10147, coating mass 100 g/m² (100), coating finish regular (R), surface quality B, surface treatment oiled (O):

1 sheet EN 10143-0,80S×1200S×2500FS
steel EN 10147-S320GD+ZF100-R-B-O

or

1 sheet EN 10143-0,80S×1200S×2500FS
steel EN 10147-1.0250+ZF100-R-B-O

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 supplier shall supply in accordance with the basis specification of this European Standard (see 5.1):

- a) any coating masses different from those of Table 4 (see 7.2.2);
- b) any special requirements for different coating masses on each surface (see 7.2.3);
- c) any hot-dip zinc coated products with pronounced spangle (see 7.3.1);
- d) any products supplied free from coil breaks (see 7.6);
- e) any maximum or minimum value for the coating mass per product surface (see 7.7.2);
- f) notification of which surface has been inspected (see 7.9.1);
- g) any testing for compliance with the requirements of this standard (see 8.1.1 and 8.1.2);
- h) any supply of an inspection document and type of document (see 8.7);
- i) any marking desired by branding of the products (see 9.2);
- j) any 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 Mechanical properties

7.1.1 The products shall be supplied on the basis of the mechanical property requirements in Table 1.

7.1.2 The tensile test values shall apply to longitudinal samples and relate to the test piece cross-section without zinc-coating.

7.1.3 A reduction in the formability of all the hot-dip zinc coated products specified in this standard may occur by ageing. Therefore it is in the interest of the user to use the products as soon as possible after receiving them.

Table 1 - Steel grades and mechanical properties of steels (for thicknesses ≤ 3 mm)

Designation			0,2%-proof strength ^a	Tensile strength ^b	Elongation ^c
Steel grade					
Steel name	Steel number	Symbol for the type of hot-dip coating	$R_{p\ 0,2}$ N/mm ² min.	R_m N/mm ² min.	A_{80} % min.
S220GD	1.0241	+Z	220	300	20
S220GD	1.0241	+ZF			
S250GD	1.0242	+Z	250	330	19
S250GD	1.0242	+ZF			
S280GD	1.0244	+Z	280	360	18
S280GD	1.0244	+ZF			
S320GD	1.0250	+Z	320	390	17
S320GD	1.0250	+ZF			
S350GD	1.0529	+Z	350	420	16
S350GD	1.0529	+ZF			
S550GD	1.0531	+Z	550	560	-
S550GD	1.0531	+ZF			

^a If the yield point is pronounced, the values apply to the upper yield point (R_{eH}).

^b For all grades except S550GD+Z and S550GD+ZF a range of 140 N/mm² can be expected for tensile strength.

^c For product thicknesses $\leq 0,7$ mm (including zinc coating) the minimum elongation values (A_{80}) shall be reduced by 2 units.

7.2 Coatings

7.2.1 Zinc (Z) or zinc-iron alloy (ZF) coatings as given in Tables 2 and 3 are applicable for the products.

7.2.2 The available coating masses given in Tables 2 and 3 may be supplied. Other coating masses shall be agreed separately at the time of ordering.

Thicker zinc 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.

7.2.3 If agreed at the time of ordering, different coating masses on each surface may be supplied for the hot-dip zinc coated flat products. The two surfaces may have a different appearance as a result of the manufacturing process.

7.3 Coating finish (see Tables 2 and 3)

7.3.1 Normal spangle (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 ordering.

7.3.2 Minimized spangle (M)

This 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 specified if the normal spangle applicable (see 7.3.1) does not satisfy the surface appearance requirements.

7.3.3 Regular zinc-iron alloy coating (R)

This coating results from heat treatment in which iron diffuses through the zinc. The surface has a uniform matt grey appearance.

7.4 Surface quality (see Tables 2 and 3 and 7.9)

7.4.1 As coated surface (A)

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

7.4.2 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, spangle structure and zinc run-off marks and light passivations marks are permissible.

7.4.3 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 7.4.2).

Table 2 - Available coatings, finishes and surface qualities for zinc coatings (Z)

Steel grade	Coating designation ^{a, b}	Coating finish			
		N	M		
			Surface qualities ^b		
		A	A	B	C
All	100	X	X	X	X
	140	X	X	X	X
	200	X	X	X	X
	225	X	X	X	X
	275	X	X	X	X
	350	X	X	-	-
	(450)	(X)	-	-	-
	(600) ^c	(X)	-	-	-
^a See also 7.2.2. ^b The coatings and surface qualities given in brackets are available on agreement. ^c Not for steel grade S550GD+Z					

Table 3 - Available coatings, finishes and surface qualities for zinc-iron alloy coatings (ZF)

Steel grade	Coating designation ^a	Coating finish		
		R		
		Surface qualities		
		A	B	C
All	100	X	X	X
	140	X	X	-
^a See also 7.2.2.				

7.5 Surface treatment (surface protection)

7.5.1 General

Hot-dip zinc coated flat products generally receive surface protection at the producer's plant as specified in 7.5.2 to 7.5.6.

The period of protection afforded depends on the atmospheric conditions.

7.5.2 Chemical passivation (C)

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

7.5.3 Oiling (O)

This treatment also reduces the risk of corrosion of the surface.

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

7.5.4 Chemical passivation and oiling (CO)

Agreement may be reached on this combination of surface treatment if increased protection against the formation of “white rust” is required.

7.5.5 Sealed (S)

Application of a transparent organic film coating of masses about 1 g/m².

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

7.5.6 Phosphated (P)

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

7.5.7 Untreated (U)

Hot-dip zinc coated flat products complying with the requirements of this standard are only supplied without surface treatment if expressly desired by the purchaser on his own responsibility. In this case, there is increased risk of corrosion.

7.6 Freedom from coil breaks

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

7.7 Coating mass

7.7.1 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 8.4.4 and 8.5.3).

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.

Table 4 - Coating masses

Coating designation ^a	Minimum coating mass in g/m ² including both surfaces ^b	
	Triple spot test ^c	Single spot test ^c
100	100	85
140	140	120
200	200	170
225	225	195
275	275	235
350	350	300
450	450	385
600	600	510
^a The coatings available for the individual steel grades are given in Tables 2 and 3. ^b The coating mass of 100 mg/m ² (including both surfaces) corresponds to a coating thickness of 7,1 µm per surface. ^c See 8.4.4 and 8.5.3.		

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

7.8 Adhesion of coating

The adhesion of the coating shall be tested using the method specified in 8.5.2. After bending, the coating shall shown no signs of flaking, but an area of 6 mm from each edge of the specimen shall be disregarded in order to exclude the effect of the cutting. Crazing and roughening are permissible, as is dusting of zinc-iron alloy (ZF) coatings.

7.9 Surface condition

7.9.1 The surface shall comply with the requirements in 7.3 to 7.5. Unless otherwise agreed at the time of ordering, 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.

7.9.2 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.

7.10 Tolerances on dimensions and shape

The requirements of EN 10143 shall apply.

7.11 Suitability for further processing

7.11.1 Products complying with the requirements of this standard, with the exception of grades S550GD+Z and S550GD+ZF, are suitable for welding using normal welding methods appropriate for the steel grade and coating mass.

7.11.2 Products complying with the requirements of this standard are suitable for bonding together.

7.11.3 All steel grades and surface qualities are suitable for organic coating. The appearance after this treatment depends on the surface quality ordered (see 7.4).

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 desired, the purchaser shall give the following information at the time of ordering:

- type of test (specific or non-specific test, see EN 10021);
- type of inspection document (see 8.7).

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

8.2 Test units

The test unit consists of 20 t or a fraction of 20 t of hot-dip zinc coated flat products of the same grade and nominal thickness, coating finish and surface appearance. In the case of strip, a coil weighing more than 20 t is 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 adhesion of the coating (see 8.5.2); and
- the coating mass (see 8.5.3).

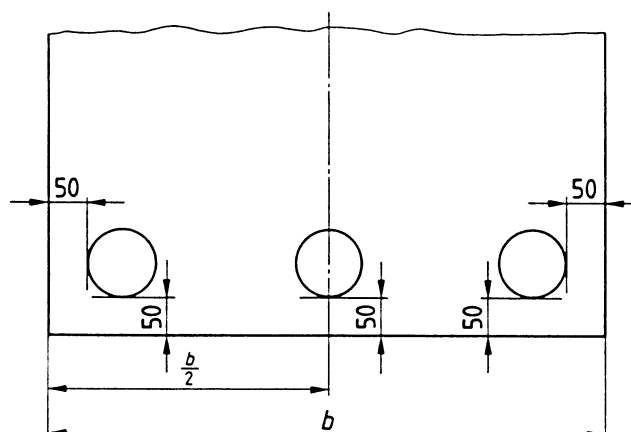
8.4 Sampling

8.4.1 In the case of strip the samples shall be taken from the beginning or 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 carrying out the inspection tests.

8.4.2 The samples for the tensile test (see 8.5.1) shall be taken in the longitudinal direction at a distance of at least 50 mm from the edges of the product.

8.4.3 The sample for the bend test to determine the adhesion of the coating (see 8.5.2) may be taken in any direction. The distance from the product edges shall be at least 50 mm. The size of the sample shall be such that the length of the folded edge is at least 100 mm.

8.4.4 The three samples for testing the coating mass (see 8.5.3) shall be taken as shown in Figure 1 if the product width is adequate. The samples may be round or square and each individual sample shall be at least 5 000 mm² in area.



b = Strip or sheet width

**Figure 1 - Position of the samples for determining the zinc coating mass
(dimensions in millimetres)**

If sampling as shown in Figure 1 is not possible because the products 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.

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.

8.5 Test methods

8.5.1 The tensile test shall be carried out as described in EN 10002-1 using type 2 test pieces (initial gauge length $L_0 = 80$ mm, width $b = 20$ mm) as described in EN 10002-1 (see also 7.1.2).

8.5.2 The bend test to determine the adhesion of the coating (see also 7.8 and 8.4.3) shall be carried out as described in EURONORM 12.

The diameters D of the mandrel or bending roll given in Table 5 shall be used. The angle of bend shall be 180° in all cases.

When pressing together with the two legs of the test piece, care shall be taken that the coating is not damaged.

**Table 5 - Bend test for determining adhesion of the coating
(for product thicknesses ≤ 3 mm)**

Coating designation ^a	Bending mandrel diameter D ^b for steel grades		
	S220GD (1.0241) S250GD (1.0242)	S280GD (1.0244)	S320GD (1.0250) S350GD (1.0529) ^c
100 to 450	1a	2a	3a
600	2a	3a	4a
^a ZF-coatings are available for coating designations of 100 and 140 only (see Tables 2 and 3). ^b a = Product thickness. ^c Bending mandrel diameter = 4a for product thicknesses > 1,5 mm.			

8.5.3 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 samples as shown in 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.

However, other methods, e. g. non-destructive tests, may be used for continuous checks at the manufacturer's works.

In cases of dispute, the method described in annex A of this standard shall be used.

8.6 Retests

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

8.7 Inspection documents

If agreed at the time of ordering, 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 and shall contain 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.

9.2 Marking of the products by branding may be agreed upon at the time of ordering.

10 Packing

The packing requirements for the product shall be agreed at the time of ordering.

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 zinc coated flat products, may lead to the formation of matt grey to white deposits (white rust). The possible types of surface protection are given 7.5. However, if there is lengthy contact with moisture, the corrosion protection may be reduced locally. As a precaution, the product should be transported and stored dry and protected from moisture.

11.2 During transportation, dark spots may appear on the hot-dip zinc coated surfaces as a result of friction. Generally, they only impair the appearance. Friction is reduced by oiling the products. However, the following precautionary measures should be taken: secure packing, laid flat, no local pressure spots.

12 Disputes

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

Annex A **(normative)**

Reference method for determination of the 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 zinc mass in grams per square metre of product, including both sides.

A.2 Reagents and preparation of the solution

Reagent:

- Hydrochloric acid (HCl, $\rho_{20} = 1,19 \text{ g/cm}^3$)
- Hexamethylenetetramine

Preparation of the solution:

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

This prepared solution is equally suitable for a zinc coating or zinc-iron alloy coating and 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 0,01 g. For the test, use a take-off device.

A.4 Procedure

The following operations are applied to each sample:

- if necessary, degrease the test piece with an organic solvent which will not attack the zinc, then dry the sample;
- weigh the sample to an accuracy of 0,01 g;
- place the sample in the solution specified in 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;

- 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;
- weight the sample again to an accuracy of 0,01 g;
- 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 (informative)

List of corresponding former designations

The following Table B.1 comprises the former designations according to EN 10147:1991 and the new designations according to EN 10027-1, CR 10260 and EN 10027-2.

Table B.1 - List of corresponding designations

Designation according to EN 10147:2000			Designation according to EN 10147:1991
Steel name	Steel number	Symbol for the type of hot-dip coating	Steel name
S220GD	1.0241	+Z	Fe E 220 G Z
S220GD	1.0241	+ZF	Fe E 220 G ZF
S250GD	1.0242	+Z	Fe E 250 G Z
S250GD	1.0242	+ZF	Fe E 250 G ZF
S280GD	1.0244	+Z	Fe E 280 G Z
S280GD	1.0244	+ZF	Fe E 280 G ZF
S320GD	1.0250	+Z	Fe E 320 G Z
S320GD	1.0250	+ZF	Fe E 320 G ZF
S350GD	1.0529	+Z	Fe E 350 G Z
S350GD	1.0529	+ZF	Fe E 350 G ZF
S550GD	1.0531	+Z	Fe E 550 G Z
S550GD	1.0531	+ZF	Fe E 550 G ZF

Bibliography

EN 10142, *Continuously hot-dip zinc coated low carbon steel strip and sheet for cold forming – Technical delivery conditions.*

EN 10152, *Electrolytically zinc coated cold rolled steel flat products – Technical delivery conditions.*

EN 10169-1, *Continuously organic coated (coil coated) steel flat products – Part 1: General information (definitions, materials, tolerances, test methods).*

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