INTERNATIONAL STANDARD

# ISO 4998

Sixth edition
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# Continuous hot-dip zinc-coated and zinc-iron alloy-coated carbon steel sheet of structural quality

*Tôles en acier au carbone revêtues de zinc ou d'un alliage zinc-fer en continu par immersion à chaud, de qualité destinée à la construction*



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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.



This sixth edition cancels and replaces the fifth edition (ISO 4998:2011), which has been technically revised.

 

# Continuous hot-dip zinc-coated and zinc-iron alloy-coated carbon steel sheet of structural quality

## 1 Scope

**1.1** This International Standard specifies continuous hot-dip zinc-coated and zinc-iron alloy-coated carbon steel sheet of structural quality.

**1.2** The product is intended for applications where resistance to corrosion is of prime importance.

**1.3** The steel sheet is produced in a number of grades, coating masses, ordering conditions, and surface treatments.

**1.4** This International Standard does not cover steels designated as commercial quality, or drawing quality, which are covered in ISO 3575[2].

## 2 Normative references



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



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

ISO 7438, *Metallic materials — Bend test*

ISO 16163:2012, *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**
**continuous hot-dip zinc-coated steel sheet**
product obtained by hot-dip coating of cold-reduced sheet coils or hot-rolled descaled sheet coils on a continuous zinc-coating line

**3.2**
**normal coating**
coating formed as a result of unrestricted growth of zinc crystals during normal solidification

Note 1 to entry: This coating has a metallic lustre and is of the type normally furnished for a wide variety of applications. It can be furnished as S or N; however, it can be variable in appearance and is not suitable for decorative painting.

 

**3.3**
**minimized spangle coating**
coating obtained by restricting normal spangle formation during the solidification of the zinc

Note 1 to entry: This product can have some lack of uniformity in surface appearance within a coil, or from coil to coil.

**3.4**
**smooth finish**
smooth coating produced by skin-passing the coated material in order to achieve an improved surface condition as compared with the normal as-coated product

**3.5**
**zinc-iron alloy coating**
coating produced by processing the zinc-coated steel sheet so that the coating formed on the base metal is composed of zinc-iron alloys

Note 1 to entry: This product, designated ZF, is not spangled, is normally dull in appearance, and, for some applications, can be suitable for immediate painting without further treatment, except normal cleaning. Zinc-iron alloy coatings can powder during severe forming.

**3.6**
**differential coating**
coating having a specified coating mass designation on one surface, and a different coating mass designation on the other surface



**3.7**
**skin pass**
light cold-rolling of the zinc-coated steel sheet



Note 1 to entry: 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 (Luder's Lines) or fluting during the fabrication of finished parts. The skin pass also controls and improves flatness. Some increase in hardness and loss of ductility will result from skin passing.

**3.8**
**lot**
50 t or less of sheet of the same grade rolled to the same thickness and coating condition

## 4 Dimensions

**4.1** Zinc-coated or zinc-iron alloy-coated structural-quality sheet is produced in thicknesses from 0,25 mm to 5 mm after zinc coating, and in widths of 600 mm and over in coils and cut lengths. Zinc-coated or zinc-iron alloy-coated sheet less than 600 mm wide can be slit from wide sheet and will be considered as sheet.

NOTE Thicknesses less than 0,4 mm might not be available in grades 220, 250, 280, and 320.

**4.2** The thickness of zinc- and zinc-iron alloy-coated sheet steel can be specified as a combination of the base metal and metallic coating, or base metal alone. The purchaser shall indicate on the order which method of specifying thickness 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 (product analysis) can be made by the purchaser to verify the specified analysis of the semi-finished or finished steel, and shall take into consideration any normal heterogeneity. The sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering.

The product analysis tolerances shall be in accordance with Tables 2 and 3.

The processes used in making the steel and in manufacturing zinc-coated sheet of structural quality are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steelmaking process being used.

**Table 1 — Chemical composition (heat analysis)**

Mass fractions as a percentage (%)

| Element | Maximum of specified element |
|---|---|
| C | 0,25 |
| Mn | 1,70 |
| P[a] | 0,05 |
| S | 0,035 |

[a] Grades 250 and 280: P – 0,10 % max.; grade 350: P – 0,20 % max.



**Table 2 — Limits on additional chemical elements**

Mass fractions as a percentage (%)

| Element | Cu[a] max. | Ni[a] max. | Cr[ab] max. | Mo[ab] 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 |

NOTE 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 %, the analysis can be reported as <0,02 %.

[a] The sum of copper, nickel, chromium, and molybdenum shall not exceed 0,50 % on heat analysis. When one or more of these elements are specified, the sum does not apply, in which case only the individual limits on the remaining elements will apply.

[b] The sum of chromium and molybdenum shall not exceed 0,16 % on heat analysis. When one or more of these elements are specified, the sum does not apply, in which case only the individual limits on the remaining elements will apply.

[c] Heat analysis greater than 0,008 % can be supplied after agreement between the producer and purchaser.

**Table 3 — Product analysis tolerances**

Mass fractions as a percentage (%)

| Element | Maximum of specified element | Tolerance over maximum specified |
|---|---|---|
| C | 0,25 | 0,04 |
| Mn | 1,70 | 0,05 |
| P | 0,05 | 0,01 |
| S | 0,035 | 0,01 |
| NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis. | | |

## 5.2 Mechanical properties

Structural quality grades shall satisfy the mechanical properties shown in Table 4. On request, a report of the mechanical properties shall be made to the purchaser.

**Table 4 — Mechanical properties**

| Grade | $R_{eL}$ min.[a] MPa[b] | $R_m$ MPa | $A$ min. %[c] | |
|---|---|---|---|---|
| | | | $L_o$ = 50 mm | $L_o$ = 80 mm |
| 220 | 220 | 310 | 20 | 18 |
| 250 | 250 | 360 | 18 | 16 |
| 280 | 280 | 380 | 16 | 14 |
| 320 | 320 | 430 | 14 | 12 |
| 350 | 350 | 450 | 12 | 10 |
| 380 | 380 | 540 | 12 | 10 |
| 550 | 550 | 570 | — | — |

$R_{eL}$ = lower yield strength

$R_m$ = tensile strength (for information only)

$A$ = percentage elongation after fracture

$L_o$ = gauge length on test piece

[a] The yield strength specified in this table shall be the lower yield strength ($R_{eL}$). The values can also be measured by 0,5 % total elongation proof strength (proof strength under load) or by 0,2 % offset when a definite yield phenomenon is not present. When the upper yield strength ($R_{eH}$) is specified, the values shall be 20 MPa above the $R_{eL}$ values for each grade.

[b] 1 MPa = 1 N/mm$^2$.

[c] Use either $L_o$ = 50 mm or $L_o$ = 80 mm to measure elongation. For material up to and including 0,6 mm in thickness, the elongation values in this table shall be reduced by 2.



## 5.3 Coating

### 5.3.1 Coating mass

The coating mass limits shall conform to the limits for the designations shown in Table 5. The coating mass is the total amount of coating on both sides of the sheet, expressed in grams per square metre. The interested parties shall agree upon the coating mass of differentially coated product. If a maximum coating mass is required, the manufacturer shall be notified at the time of ordering.

**Table 5 — Mass of coating (total both sides)**

| Coating designation | Minimum check limit | |
|---|---|---|
| | **Triple-spot test** g/m² (of sheet) | **Single-spot test** g/m² (of sheet) |
| Z001 | No minimum[b] | No minimum[b] |
| Z100 | 100 | 85 |
| Z180 | 180 | 150 |
| Z200 | 200 | 170 |
| Z275 | 275 | 235 |
| Z350 | 350 | 300 |
| Z450[a] | 450 | 385 |
| Z600[a] | 600 | 510 |
| Z700[a] | 700 | 585 |
| ZF001 | No minimum[b] | No minimum[b] |
| ZF100 | 100 | 85 |
| ZF180 | 180 | 150 |

NOTE 1 The amount of coating for each coating designation is not always evenly divided between the two surfaces of a zinc-coated sheet, nor is the zinc 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: 100 g/m² total both sides = 0,014 mm total both sides.

[a] Coating masses corresponding to the designations Z450, Z600, and Z700 are not available for steels with minimum yield stresses of 320 N/mm², 350 N/mm², 380 N/mm², and 550 N/mm².

[b] "No minimum" means that there are no established minimum check limits for triple- and single-spot tests.



### 5.3.2 Coating adherence

The zinc-coated sheet shall be capable of being bent in any direction, in accordance with the mandrel diameter requirements for the coating designations included in Table 6. Flaking of the coating within 7 mm from the edge of the test piece shall not be cause for rejection. The bend-test requirements of Table 6 do not apply to zinc-iron alloy coating.

**Table 6 — Coating bend-test requirements**

| Grade | 180° bend-mandrel diameter | | | | | |
|---|---|---|---|---|---|---|
| | $e < 3$ mm | | | $e \geq 3$ mm | | |
| | Coating designation | | | | | |
| | Up to Z350 | Z450 Z600 | Z700 | Up to Z450 | Z600 | Z700 |
| 220 | 1*a* | 2*a* | 3*a* | 2*a* | 3*a* | 4*a* |
| 250 | 1*a* | 2*a* | 3*a* | 2*a* | 3*a* | 4*a* |
| 280 | 2*a* | 2*a* | 3*a* | 3*a* | 3*a* | 4*a* |
| 320 | 3*a* | 3*a* | 3*a* | 3*a* | 3*a* | 4*a* |
| 350 | 3*a* | 3*a* | 3*a* | 3*a* | 3*a* | 4*a* |
| 380 | 3*a* | 3*a* | 3*a* | 3*a* | 3*a* | 4*a* |

*e* = thickness of sheet, in millimetres

*a* = thickness of bend test piece