
**Continuous hot-dip zinc-coated carbon
steel sheet of structural quality**

*Tôles en acier au carbone galvanisées en continu par immersion à
chaud, de qualité destinée à la construction*

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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 4998 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This fourth edition cancels and replaces the third edition (ISO 4998:1996), which has been technically revised.

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Continuous hot-dip zinc-coated carbon steel sheet of structural quality

1 Scope

This International Standard applies to continuous hot-dip zinc- and zinc-iron-alloy-coated carbon steel sheet of structural quality.

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

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

Zinc-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 sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

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

The thickness of zinc and zinc-iron alloy coated sheet steel may 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.

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 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 1460:1992, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 2178:1982, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 3497:2000, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods*

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

ISO 7438:2005, *Metallic materials — Bend test*

ISO 16160:2005, *Continuously hot-rolled steel sheet products — Dimensional and shape tolerances*

ISO 16162:2005, *Continuously cold-rolled steel sheet products — Dimensional and shape tolerances*

ISO 16163:2005, *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 This coating has a metallic lustre and is the type normally furnished for a wide variety of applications. It may be furnished as S or N; however, it may 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 This product may 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 This product, designated ZF, is not spangled, is normally dull in appearance, and, for some applications, may be suitable for immediate painting without further treatment, except normal cleaning. Zinc-iron alloy coatings may 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 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.

4 Requirements

4.1 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) may 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. Non-killed steels, such as rimmed or capped, are not technologically suited for verification analysis.

The product analysis tolerances are shown in Table 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 steel-making process being used.

Table 1 — Chemical composition (heat analysis)

Element	% max.
Carbon	0,25
Manganese	1,70
Phosphorus ^a	0,05
Sulfur	0,035
^a Grades 250 and 280: phosphorus – 0,10 % max. Grade 350: phosphorus – 0,20 % max.	

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Table 2 — Limits on additional chemical elements, %

Element	Cu ^a max.	Ni ^a max.	Cr ^{a, b} max.	Mo ^{a, b} max.	Nb max.	V ^c max.	Ti max.
Heat analysis	0,20	0,20	0,15	0,06	0,008	0,008	0,008
Product analysis	0,23	0,23	0,19	0,07	0,018	0,018	0,018

Each of the elements listed in this table shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 %, the analysis may be reported as < 0,02 %.

^a The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % on the 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 % may be supplied after agreement between the producer and purchaser.

Table 3 — Product analysis tolerances, %

Element	Maximum of specified element	Tolerance over maximum specified
Carbon	0,25	0,04
Manganese	1,70	0,14
Phosphorus	0,05	0,01
Sulfur	0,035	0,01

NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis.

4.2 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 N/mm ² ^b	R_m N/mm ²	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 stress

R_m = tensile strength (for information only)

A = percentage elongation after fracture

L_o = gauge length on test piece

^a The yield stress specified in this table shall be the lower yield stress (R_{eL}). The values can also be measured by 0,5 % total elongation proof stress (proof stress under load) or by 0,2 % offset when a definite yield phenomenon is not present. When upper yield stress (R_{eH} is specified), the values shall be 20 N/mm² above the R_{eL} values for each grade.

^b 1 N/mm² = 1 MPa

^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.

4.3 Coating

4.3.1 Coating mass

The coating mass shall conform to the limits for the coating designations shown in Table 5. The coating mass is the total amount of zinc on both surfaces of the sheet, expressed in grams per square metre (g/m²) of sheet. The coating mass of differentially coated material shall be agreed upon between the interested parties. 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/m ² (of sheet)	Single spot test g/m ² (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

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 The coating thickness may 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 designation 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.

4.3.2 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.