
**Cold-reduced carbon steel sheet of
commercial and drawing qualities**

*Tôles en acier au carbone laminées à froid de qualité commerciale et
pour emboutissage*

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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 3574 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 3574:1999), which has been technically revised.

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Cold-reduced carbon steel sheet of commercial and drawing qualities

1 Scope

1.1 This International Standard applies to cold-reduced carbon steel sheet of commercial and drawing qualities. It is suitable for applications where the surface is of prime importance.

1.2 Commercial quality sheet (CR1) is intended for general fabricating purposes where sheet is used in the flat condition or for bending, moderate forming, and welding operations. It is produced in thicknesses of 0,36 mm and thicker (commonly produced up to 4 mm) and in widths of 600 mm and over, in coils and cut lengths.

1.3 Drawing quality sheet (CR2, CR3, CR4, CR5) is intended for drawing or severe forming, including welding. It is produced in thicknesses of 0,36 mm and thicker (commonly produced up to 4 mm) and in widths of 600 mm and wider, in coils and cut lengths. Drawing quality sheet is furnished according to all the requirements of this International Standard, or, by agreement when ordered, to fabricate an identified part, in which case, the mechanical property requirements do not apply. Drawing qualities are identified as follows:

CR2 — Drawing quality

CR3 — Deep drawing quality

CR4 — Deep drawing quality aluminum killed (non-ageing)

CR5 — Extra deep drawing quality (stabilized interstitial free)

1.4 Interstitial free steel (IF steel) can be applied on orders of CR2, CR3 and CR4, provided that the customer is informed of the substitution and related shipping documents reflect the actual material shipped.

1.5 Cold-reduced sheet less than 600 mm wide can be slit from wide sheet and will be considered as sheet.

2 Normative references

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

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*

ISO 16162, *Continuously cold-rolled 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 cold-reduced steel sheet**
product obtained from hot-rolled descaled steel sheet by cold reducing to the required sheet thickness followed by annealing to recrystallize the grain structure.
- 3.2 skin pass**
final light cold rolling of cold-reduced and annealed sheet
- 3.3 camber**
greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straightedge
- 3.4 out-of-square**
greatest deviation of an end edge from a straight line at right angles to a side and touching one corner, the measurement being taken as described in ISO 16162, or measurable as one-half the difference between the diagonals of the cut-length sheet
- 3.5 stabilized interstitial free steel**
extra low carbon steel in which all interstitial elements are combined with titanium and/or equivalent elements

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4 Other information

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4.1 Cold-reduced steel sheet

This product is normally supplied skin passed (see 4.2) but may be supplied annealed last (i.e. without a skin pass), if specified by the purchaser on the order.

4.2 Skin passing

The purpose of skin passing is one or more of the following:

- to minimize temporarily the appearance of coil breaks, stretcher strains (Lüders lines) or fluting during fabrication of finished parts;
- to obtain the required surface finish suitable for ordinary decorative painting;
- to control the shape.

Some increase in hardness and some loss in ductility will result from skin passing.

4.3 Strain ageing

Cold-reduced sheet, in qualities CR1, CR2, and CR3 supplied in the skin-passed condition, tends to strain age and this may lead to the following:

- surface markings from stretcher strains (Lüders lines) or fluting when the steel is formed;
- deterioration in ductility.

Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Stocking of such steels for extended periods of time should be avoided; for optimum performance, the period should not exceed 6 weeks.

For skin-passed sheet in qualities CR1, CR2 and CR3, and with due regard to the foregoing precautions, reasonable freedom can be achieved by effective roller levelling immediately prior to fabrication at the purchaser's plant. Freedom from stretcher strain and fluting for a period of six months can be achieved by the supply of skin-passed non-ageing steels. Grades CR4 or CR5 shall be specified in such cases where Lüders lines are not acceptable and where roller levelling is not possible.

4.4 Surface condition

The CR1 product surface condition is supplied as specified in 11.1. Drawing quality products are supplied with either of the surface qualities A or B.

4.4.1 Surface quality A (unexposed)

Imperfections, such as pores, slight imperfections, small marks, minor scratches and slight coloring, which do not affect the formability or the application of surface coatings, are permitted.

4.4.2 Surface quality B (exposed)

The better surface shall be free of imperfections which might affect the uniform appearance of quality coating. The other surface shall at least conform to surface quality A.

In the case of delivery of coil and slit coil, the percentage of defects may be greater than in the case of delivery in sheet or cut lengths. This should be taken into account by the purchaser, and the percentage of admissible surface defects may be agreed at the time of the enquiry and order. Unless otherwise agreed, a single surface of the product shall comply with the specified requirements. The other surface shall be such that during subsequent treatment it does not have a deleterious effect on the better surface.

4.5 Surface finish

Cold-reduced steel sheet is normally produced in a matte finish, dull in appearance, which is suitable for ordinary decorative painting but is not recommended for electroplating.

When cold-reduced steel sheet is deformed during fabrication, localized areas may roughen to some degree and such affected portions of the part may require hand finishing to prepare the surface for the intended application.

4.6 Oiling

As a deterrent to rusting, a coating of oil is usually applied to the product. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals. On request, the manufacturer shall advise the purchaser of which type of oil has been used. The product may be ordered not oiled, if required, in which case, the supplier has limited responsibility if oxidation occurs.

5 Conditions of manufacture

5.1 Steelmaking

The processes used in making the steel and in manufacturing cold-reduced sheet are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process being used.

5.2 Chemical composition

The chemical composition (heat analysis) shall not exceed the values given in Tables 1 and 2.

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

| Quality | | Carbon max. | Manganese max. | Phosphorus max. | Sulfur max. | Titanium ^a max. |
|-------------|--|----------------|-------------------|--------------------|----------------|-------------------------------|
| Designation | Name | | | | | |
| CR1 | Commercial | 0,15 | 0,60 | 0,050 | 0,035 | — |
| CR2 | Drawing ^b | 0,10 | 0,50 | 0,040 | 0,035 | — |
| CR3 | Deep drawing ^b | 0,08 | 0,45 | 0,030 | 0,03 | — |
| CR4 | Deep drawing aluminum killed ^b (non-ageing) | 0,06 | 0,45 | 0,030 | 0,03 | — |
| CR5 | Extra deep drawing ^c (stabilized interstitial free) | 0,02 | 0,25 | 0,020 | 0,02 | 0,15 |

^a Titanium may be replaced totally or partially by niobium or vanadium. Carbon and nitrogen shall be completely stabilized.

^b If interstitial free (IF steel) is to be applied to CR2, CR3 and CR4 orders, the values of 0,15 % maximum Ti, and 0,10 % maximum Nb and V, are acceptable to ensure that the carbon and nitrogen are fully stabilized.

^c By agreement, the manganese, phosphorus and sulfur maximums may be adjusted.

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Table 2 — Limits on additional chemical elements

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Mass fractions in percent

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

^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 For stabilized steels, the maximum for titanium is 0,15 %, and the maximum for each of niobium and vanadium is 0,10 %, to ensure that the carbon and nitrogen are fully stabilized.

5.3 Chemical analysis

5.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements given in Tables 1 and 2. When requested, this analysis shall be reported to the purchaser or his representative.

Each of the elements listed in Table 2 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 result may be reported as “< 0,02 %”.

5.3.2 Product analysis

A 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 suitable for verification analysis.

For killed steels, the sampling method shall be agreed between the manufacturer and the purchaser at the time of ordering. The product analysis tolerances shall be in accordance with Table 3.

Table 3 — Product analysis tolerances

| Element | Maximum of specified element % | Tolerance over maximum specified % |
|------------|-----------------------------------|---------------------------------------|
| Carbon | $\leq 0,15$ | 0,03 |
| Manganese | $\leq 0,60$ | 0,03 |
| Phosphorus | $\leq 0,05$ | 0,01 |
| Sulfur | $\leq 0,04$ | 0,01 |

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

5.4 Weldability

This product is normally suitable for welding if appropriate welding conditions are selected.

5.5 Application

It is desirable that cold-reduced steel sheet be identified for fabrication by the name of the part or by the intended application. Cold-reduced steel sheet of drawing qualities CR2, CR3, CR4 and CR5 may be produced to make an identified part within a properly established breakage allowance, which shall be previously agreed between the manufacturer and purchaser. In this case, the part name, the details of fabrication, and special requirements (i.e. exposed or unexposed, freedom from stretcher strain or fluting) shall be specified, and the mechanical properties of Table 4 do not apply.

5.6 Mechanical properties

Except when ordered according to an identified part as explained in 5.5, the mechanical properties shall be as given in Table 4 when they are determined on test pieces obtained in accordance with the requirements of Clause 8.

The values specified in Table 4 are applicable for the periods indicated in Table 5 from the time that the steel is available for shipment.