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Continuously cold rolled high strength steel sheet and strip for automobile—Part 14: Low density steel

汽车用高强度冷连轧钢板及钢带 第14部分:低密度钢

(*English Translation*)

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Foreword

SAC/TC 183 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This document is drafted in accordance with the rules given in the GB/T 1.1—2020 *Directives for standardization—Part 1: Rules for the structure and drafting of standardizing documents*.

This is the fourteenth part of GB/T 20564 *Continuously cold rolled high strength steel sheet and strip for automobile*. GB/T 20564 consists of the following parts under the general title:

—Part 1: *Bake hardening steel*;

—Part 2: *Dual phase steel*;

—Part 3: *High strength interstitial free steel*;

—Part 4: *High strength low alloy steel*;

—Part 5: *Isotropic steel*;

—Part 6: *Transformation induced plasticity steel*;

—Part 7: *Martensitic steel*;

—Part 8: *Complex phase steel*;

—Part 9: *Quenching and partitioning steel*;

—Part 10: *Twinning induced plasticity steel*;

—Part 11: *Carbon manganese steel*;

—Part 12: *Dual phase steel with high formability*;

—Part 13: *Medium manganese steel*;

—Part 14: *Low density steel*.

Attention is drawn to the possibility that some of the elements of this document may be the subject

of patent rights. The issuing body of this document shall not be held responsible for identifying any or all such patent rights.

This document was proposed by China Iron and Steel Industry Association.

This document was prepared by SAC/TC 183 National Technical Committee on Steel of Standardization Administration of China.

Introduction

The purpose of GB/T 20564 is to standardize the designation and classification, ordering information, dimensions, shape, mass, technical requirements, test methods, inspection rules, packaging, marking and inspection certificate of cold rolled high strength steel sheet and strip for automobile.

GB/T 20564 consists of fourteen parts.

—Part 1: Bake hardening steel. The purpose is to determine the technical requirements for continuously cold rolled baking hardening high strength steel sheet and strip products with the nominal thickness from 0.50 mm to 3.00 mm, which are mainly used for manufacturing automotive external panels, internal panels and some structural parts.

—Part 2: Dual phase steel. The purpose is to determine the technical requirements for continuously cold rolled dual phase high strength steel sheet and strip products with the nominal thickness from 0.50 mm to 3.00 mm, which are mainly used for manufacturing automotive structural parts, reinforcement parts and some internal and external panels.

—Part 3: High strength interstitial free steel. The purpose is to determine the technical requirements for continuously cold rolled high strength interstitial free steel sheet and strip products with the nominal thickness from 0.50 mm to 3.00 mm, which are mainly used for manufacturing automotive external panels, internal panels and some structural parts.

—Part 4: High strength low alloy steel. The purpose is to determine the technical requirements for continuously cold rolled low alloy high strength steel sheet and strip products with the nominal thickness not more than 3.0 mm, which are mainly used for manufacturing automotive structural parts and reinforcement parts.

—Part 5: Isotropic steel. The purpose is to determine the technical requirements for continuously cold rolled isotropic high strength steel sheet and strip products with the nominal thickness not more than 2.5 mm, which are mainly used for making automotive external covering parts.

—Part 6: Transformation induced plasticity steel. The purpose is to determine the technical requirements for continuously cold rolled transformation induced plasticity high strength steel sheet and strip products with the nominal thickness from 0.50 mm to 2.5 mm, which are mainly used for manufacturing automotive structural parts and reinforcement parts.

—Part 7: Martensitic steel. The purpose is to determine the technical requirements for continuously cold rolled martensitic high strength steel sheet and strip products with the nominal thick-

ness from 0.50 mm to 2.1 mm, which are mainly used for manufacturing automotive structural parts, reinforcement parts and anti-collision parts.

—Part 8: Complex phase steel. The purpose is to determine the technical requirements for continuously cold rolled complex phase high strength steel sheet and strip products with the nominal thickness from 0.60 mm to 2.50 mm, which are mainly used for manufacturing automotive structural parts, reinforcement parts and some internal and external panels.

—Part 9: Quenching and partitioning steel. The purpose is to determine the technical requirements for continuously cold rolled quenching and partitioning high strength steel sheet and strip products with the nominal thickness from 0.8 mm to 2.5 mm, which are mainly used for manufacturing automotive structural parts and reinforcement parts.

—Part 10: Twinning induced plasticity steel. The purpose is to determine the technical requirements for continuously cold rolled twinning induced plasticity high strength steel sheet and strip products with the nominal thickness from 0.50 mm to 3.00 mm, which are mainly used for manufacturing complex shaped automotive structural parts and reinforcement parts.

—Part 11: Carbon manganese steel. The purpose is to determine the technical requirements for continuously cold rolled carbon manganese high strength steel sheet and strip products with the nominal thickness from 0.50 mm to 3.00 mm, which are mainly used for manufacturing automotive structural parts.

—Part 12: Dual phase steel with high formability. The purpose is to determine the technical requirements for continuously cold rolled high formability dual phase high strength steel sheet and strip products with the nominal thickness from 0.50 mm to 3.00 mm, which are mainly used for manufacturing complex shaped automotive structural parts and reinforcement parts.

—Part 13: Medium manganese steel. The purpose is to determine the technical requirements for continuously cold rolled medium manganese high strength steel sheet and strip products with the nominal thickness from 1.0 mm to 2.5 mm, which are mainly used for manufacturing automotive structural parts and reinforcement parts.

—Part 14: Low density steel. The purpose is to determine the technical requirements for continuously cold rolled low density high strength steel sheet and strip products with the nominal thickness from 0.6 mm to 3.0 mm, which are mainly used for manufacturing automotive structural parts and reinforcement parts.

Continuously cold rolled high strength steel sheet and strip for automobile— Part 14：Low density steel

1 Scope

This document specifies designation and classification，ordering information，dimensions，shape，mass，technical requirements，test methods，inspection rules，packaging，marking and inspection certificate of the continuously cold rolled high strength low density steel sheet and strip.

This document is applicable to the continuously cold rolled high strength low density steel sheet and strip used for making automotive structural parts and reinforcement parts with the nominal thickness from 0.6 mm to 3.0 mm（hereinafter referred to as steel sheet and strip）.

2 Normative references

The contents in the following documents constitute the essential clauses of this document through normative references in the text. For dated references，only the edition cited applies. For undated references，the latest edition of the referenced document（including any amendments）applies.

GB/T 223.4，*Alloyed steel—Determination of manganese content—Potentiometric or visual titration method*

GB/T 223.5，*Steel and iron—Determination of acid-soluble silicon and total silicon content —Reduced molybdosilicate spectrophotometric method*

GB/T 223.9，*Iron，steel and alloy—Determination of aluminium content—Chrom azurol S photometric method*

GB/T 223.40，*Iron，steel and alloy—Determination of niobium content—The sulphochlorophenol S spectrophotometric method*

GB/T 223.59，*Iron，steel and alloy—Determination of phosphorus content—Bismuth phosphomolybdate blue spectrophotometric method and antimony phosphomolybdate blue spectrophotometric method*

GB/T 223.76，*Methods for chemical analysis iron，steel and alloy —The flame atomic absorption*

spectrometric method for the determination of vanadium content

GB/T 223.84，*Steel and iron—Determination of titanium content—Diantipyrylmethane spectrophotometric method*

GB/T 223.85，*Steel and iron—Determination of sulfur content—Infrared absorption method after combustion in an induction furnace*

GB/T 223.86，*Steel and iron —Determination of total carbon content—Infrared absorption method after combustion in an induction furnace*

GB/T 228.1—2021，*Metallic materials—Tensile testing—Part 1：Method of test at room temperature*

GB/T 247，*General rule of package，mark and certification for steel plates（sheets）and strips*

GB/T 708，*Dimension，shape，weight and tolerance for cold-rolled steel strip and sheet*

GB/T 2523，*Measuring method of surface roughness and peak count for cold-rolled metal sheet（strip）*

GB/T 2975，*Steel and steel products—Location and preparation of samples and test pieces for mechanical testing*

GB/T 8170，*Rules of rounding off for numerical values & expression and judgement of limiting values*

GB/T 17505，*Steel and steel products—General technical delivery requirements*

GB/T 20066，*Steel and iron—Sampling and preparation of samples for the determination of chemical composition*

3 Terms and definitions

For the purposes of this document，the following terms and definitions apply.

3.1
low density steel

high strength steel which shows excellent mechanical properties and a density reduction not less than 4% by adding different contents of elements such as Al，Mn and Si for light weight.

4 Designation and classification

4.1 Designation

The designation of steel sheet and strip shall be indicated with the initial capital letter "CR" of "Cold Rolled", the specified minimum yield strength/specified minimum tensile strength, and the initial capital letter "LD" of "Low Density".

EXAMPLE CR400/980LD

where

CR the initial capital letter of "Cold Rolled";

400/980 the specified minimum yield strength is 400, and the specified minimum tensile strength is 980, in megapascals (MPa);

LD the initial capital letter of "Low Density".

4.2 Classification

4.2.1 For classification of steel sheet and strip in grade and recommended application, see Table 1.

Table 1—Grade and recommended application

Steel grade	Recommended application
CR340/590LD	Structural parts, reinforcement parts
CR370/780LD、CR420/780LD	
CR400/980LD	

4.2.2 For classification of steel sheet and strip in accordance with surface quality, see Table 2.

Table 2—Surface quality classification

Surface quality	Symbol
Normal surface	FB
Improved surface	FC

4.2.3 For classification of steel sheet and strip in accordance with surface finish, see Table 3.

Table 3—Surface finish classification

Surface finish	Symbol
Dull	D
Bright	B

5 Order information

5.1 The contract or order covered by this document shall include the following information:

a) product type (sheet or strip);

b) the number of this document;

c) steel grade;

d) specification, dimensions and flatness tolerances;

e) surface quality;

f) surface finish;

g) edge condition;

h) packaging type;

i) mass;

j) application;

k) other special requirements.

5.2 In case where the requirements for tolerances on dimensions and flatness, surface quality, surface finish, edge condition and packaging type are not indicated in the contract, the product shall be supplied in normal dimensions and flatness tolerances, normal surface quality (FB), dull surface finish (D), cut edge condition, and the packaging type provided by the supplier.

6 Dimensions, shape and mass

The dimensions, shape, mass and tolerances shall be in accordance with GB/T 708.

7 Technical requirements

7.1 Chemical composition

For the referenced chemical composition (heat analysis), see Annex A. When requested at the

time of ordering, the chemical composition shall be agreed between the manufacturer and purchaser.

7.2 Steelmaking process

The steel shall be made by Basic Oxygen Furnace (BOF) or Electrical Arc Furnace (EAF). Unless otherwise agreed, the steelmaking processes shall be at the manufacturer's option.

7.3 Delivery condition

7.3.1 The steel sheet and strip are supplied in annealed and skin-passed condition.

7.3.2 The steel sheet and strip should be delivered in oiled condition. The layer of oil shall be capable of being removed by alkaline solutions or usual solvents. The manufacturer ensures that under normal conditions of packaging, transportation, handling and storing, the products show no corrosion for up to six months from the date on which the products are made available at the manufacturer's work. If the purchaser does not require the surface to be oiled, this shall be agreed at the time of ordering.

NOTE The product delivered in unoiled condition can show corrosion and light scratches during transportation, handling, storage and application.

7.4 Mechanical properties

Within six months from the date on which the products are made available at the manufacturer's work, the mechanical properties of steel sheet and strip shall be as specified in Table 4. If there is a requirement for the strain hardening index (*n* value), it shall be agreed at the time of order.

Table 4—Mechanical properties

Steel grade	Tensile test		
	Lower yield strength[a] (R_{eL}) MPa	Tensile strength (R_m) MPa	Elongation after fracture ($A_{80\,mm}$) %
	not less than		
CR340/590LD	340	590	21
CR370/780LD	370	780	15
CR420/780LD	420	780	13
CR400/980LD	400	980	10
No. P6 test piece specified in GB/T 228.1—2021 and taken in longitudinaldirection apply			
[a] When the yield phenomenon is not obvious, $R_{P0.2}$ apply.			

7.5 Weldability

Due to the special welding performance of low density steel, the welding process should be determined according to the chemical composition and strength grade, and the appropriate welding process should be determined by the manufacturer and purchaser.

7.6 Surface quality

7.6.1 The surface of steel sheet and strip shall be free from scabs, cracks, inclusions and other defects that are detrimental to practical use. Lamination of sheet and strip is not permitted.

7.6.2 The surface quality characteristics of steel sheet and strip shall be as specified in Table 5.

Table 5—Surface quality characteristics

Surface quality	Symbol	Characteristics
Normal surface	FB	Imperfections such as minor scratches, slight indentation, small pits and roll marks, and slight coloring which do not affect formability or the application of surface coatings, are permitted
Improved surface	FC	The better surface shall be free from apparent visible imperfections, while the other surface shall at least conform to surface quality FB

7.6.3 The steel strip may be supplied with defects since there is no chance to remove them during continuous production. The total length of the defect parts shall not exceed 6% of the total length of the strip.

7.7 Surface finish

The surface finish of steel sheet and strip shall be as specified in Table 6. If the purchaser has special requirements for roughness, it shall be agreed at the time of ordering.

Table 6—Surface finish

Surface finish	Symbol	Average surface roughness(Ra) μm
Dull	D	＞0.6 to 1.9
Bright	B	≤0.9

8 Test methods

8.1 The test for the determination of chemical composition should be carried out in accordance with GB/T 4336, GB/T 20123, GB/T 20125 or general chemical composition analysis methods. In case

of arbitration, arbitration shall be conducted in accordance with GB/T 223.4, GB/T 223.5, GB/T 223.9, GB/T 223.40, GB/T 223.59, GB/T 223.76, GB/T 223.84, GB/T 223.85, and GB/T 223.86.

8.2 The test item and test method of steel sheet and strip shall be as specified in Table 7.

Table 7—Test item, sampling quantity, sampling method and test method of steel sheet and strip

No.	Test item	Sampling quantity	Sampling method	Test method
1	Chemical composition	1 per heat	GB/T 20066	See 8.1
2	Tensile test	1 per test unit	GB/T 2975	Method B in GB/T 228.1—2021
3	Surface roughness	—	—	GB/T 2523
4	Dimensions, shape	—	—	Suitable measuring gauge
5	Surface quality	each sheet/each coil	—	Visual inspection

9 Inspection rules

9.1 The steel sheet and strip shall be inspected and accepted by the supplier's quality supervision department.

9.2 The steel sheet and strip shall be accepted in test unit. Each test unit shall consist of a maximum of 30 t steel sheet or strip of the same steel grade, dimension, and cold rolling process. In the case of strip, a coil weighing more than 30 t shall be regarded as one test unit.

9.3 The sampling number and sampling method of steel sheet and strip shall be in accordance with Table 7.

9.4 The re-testing and acceptance rules shall be in accordance with GB/T 17505.

9.5 The test results of mechanical properties and chemical composition shall be rounded off according to the stipulations of rounding value comparison method, and the rounding rules shall be in accordance with GB/T 8170.

10 Packaging, marking and inspection certificate

If there are no special requirements, the packaging, marking and inspection certificate shall be in accordance with GB/T 247.

Annex A
（informative）
Reference value of chemical composition（Heat analysis）of steel

For the referenced chemical composition of steel（heat analysis），see Table A. 1.

Table A. 1—Reference value of chemical composition（Heat analysis）of steel

Steel grade	Chemical composition[a]（Mass fraction） %					
	C	Si	Mn	P	S	Al_t
	no more than					no less than
CR340/590LD	0. 22	1. 00	2. 00	0. 035	0. 030	3. 00
CR370/780LD	0. 42	1. 00	2. 50	0. 035	0. 030	3. 00
CR420/780LD	0. 42	1. 00	2. 80	0. 035	0. 030	3. 00
CR400/980LD	0. 42	1. 00	3. 00	0. 035	0. 030	3. 00
[a] Other alloy elements can be added，such as Ti，Nb，and V.						

Bibliography

[1] GB/T 4336, *Carbon and low-alloy steel-Determination of multi-element contents-Spark discharge atomic emission spectrometric method (routine method)*

[2] GB/T 20123, *Steel and iron-Determination of total carbon and sulfur content-Infrared absorption method after combustion in an induction furnace (routine method)*

[3] GB/T 20125, *Low-alloy steel-Determination of multi-element contents-Inductively coupled plasma atomic emission spectrometric method*