

ICS 77.140.01

CCS H46



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 41324-2022

Fire-resistant weathering steels for structures

耐火耐候结构钢

Issued on: March 9, 2022

Implemented on: October 1, 2022

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

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1 Scope

China's national standard for structural steels that are both fire-resistant and weathering. It specifies the terms and definitions, the designations and the requirements. The combination is unusual and useful. Weathering steel forms a stable adherent rust layer that protects the metal beneath, so a structure can be left unpainted for its life - which removes the maintenance that dominates the cost of a bridge or an exposed frame. Fire-resistant steel retains a defined fraction of its room temperature yield strength at 600 degrees C, achieved by molybdenum and niobium additions, which allows a structural member to survive a fire long enough for evacuation with less applied protection or none. Each property alone is established; combining them in one steel means satisfying two sets of compositional requirements that do not naturally coincide, and it produces a material for exposed structures where both painting and fireproofing would otherwise be needed.

This document specifies the size, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificates of fire-resistant weathering steels for structure. This document applies to hot-rolled steel plates and strips and hot-rolled section steels with fire resistance and atmospheric corrosion resistance for the manufacture of general structures and building structures.

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 version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 222, Permissible tolerances for chemical composition of steel products

GB/T 223.3, Methods for chemical analysis of iron, steel and alloy - The diantipyrylmethane phosphomolybdate gravimetric method for the determination of phosphorus content

GB/T 223.9, Iron, steel and alloy - Determination of aluminium content - Chrome azurol S photometric method

GB/T 223.11, Iron, steel and alloy - Determination of chromium content - Visual titration or potentiometric titration method

GB/T 223.14, Methods for chemical analysis of iron, steel and alloy - The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content

GB/T 223.17, Methods for chemical analysis of iron, steel and alloy - The diantipyrylmethane photometric method for the determination of titanium content

GB/T 223.18, Methods for chemical analysis of iron steel and alloy - The sodium thiosulfate separation iodometric method for the determination of copper content

GB/T 223.23, Iron, steel and alloy - Determination of nickel content - The dimethylglyoxime spectrophotometric method

GB/T 223.26, Iron, steel and alloy - Determination of molybdenum content - The thiocyanate spectrophotometric method

GB/T 223.40, Iron, steel and alloy - Determination of niobium content by the sulphochlorophenol S spectrophotometric method

GB/T 223.60, Methods for chemical analysis of iron, steel and alloy - The perchloric acid dehydration gravimetric method for the determination of silicon content

GB/T 223.63, Methods for chemical analysis of iron, steel and alloy - The sodium (potassium) periodate photometric method for the determination of manganese content

GB/T 223.68, Methods for chemical analysis of iron, steel and alloy - The potassium iodate titration method after combustion in the pipe furnace for the determination of sulfur content

3 Terms and definitions

The following terms and definitions are applicable to this document.

3.1 Fire-resistant weathering steels for structure Steels whose fire resistance and atmospheric corrosion resistance are improved by adding an appropriate amount of alloying elements such as molybdenum, copper, chromium, etc.

4 Designation representation

4.1 Fire-resistant weathering steels for structure are represented by designation plus quality grade. The designation of steels consists of three parts: the initial letter "Q" in Chinese pinyin "Qu" representing "yield strength", the specified minimum upper yield strength value, and the suffix "FRW" representing "fire-resistance weathering"; the quality grade code is represented by B, C, D, E.

7.6 Ultrasonic testing

7.6.1 When there are requirements for through-thickness characteristics, the steel plate shall be ultrasonically tested in accordance with GB/T 2970, and the section steel shall be ultrasonically tested in accordance with YB/T 4811, where the qualification grade shall be indicated in the contract.

7.6.2 When it is required by the buyer, other steels can also be subjected to ultrasonic testing. The test method and qualification grade shall be negotiated by the supplier and the buyer, and shall be indicated in the contract.

7.7.1 Steel plate

7.7.1.1 There shall be no harmful defects such as air bubbles, scabs, folds, inclusions, and iron oxide scale pressing on the surface of the steel plate that affect the use, and the steel plate shall not have visible delamination.

7.7.1.2 The surface of steel plate is allowed to have a thin layer of iron oxide scale, rust, and inconspicuous roughness, reticulation, pitting, scratches and other local defects caused by pressing into the iron oxide scale and rollers that do not affect the use, but the depth shall not be greater than one-half of the thickness tolerance of the steel plate, and the allowable minimum thickness of the steel plate shall be guaranteed.

7.7.1.3 The surface defects of steel plate are allowed to be removed by grinding and other methods. The cleaning place shall be smooth without edges and corners; the cleaning depth shall not be greater than the lower deviation of the thickness of the steel plate; the minimum allowable thickness of the steel shall be guaranteed.

7.7.1.4 After it is negotiated between the supplier and the buyer, and indicated in the contract, the surface quality of the steel plate may also meet the requirements of GB/T 14977.

7.7.2 Steel strip and its sheared steel plate

7.7.2.1 The surface of steel strip shall not have any harmful defects such as scabs, cracks, folds, inclusions, air bubbles and indentation of iron oxide scales that affect the use; the steel strip shall not have visible delamination.

7.7.2.2 The surface of steel strip is allowed to have local defects such as thin iron oxide scale, rust, slight pitting, and scratches that do not affect the use, but the depth or height shall not exceed one-half of the thickness tolerance of the steel strip, and the minimum allowable thickness of the steel strip shall be guaranteed.

7.7.2.3 The steel strip is allowed to be delivered with local defects, but the part with defects shall not exceed 6% of the total length of each coil of steel strip.

7.7.2.4 After it is negotiated between the supplier and the buyer, and indicated in the contract, the surface quality of the steel strip can also meet the requirements of GB/T 14977.

7.7.3 Section steel

7.7.3.1 The surface quality of hot-rolled section steel shall comply with the provisions of GB/T 706; the surface quality of hot rolled H section steel shall comply with the provisions of GB/T 11263.

7.7.3.2 After it is negotiated between the supplier and the buyer, and indicated in the contract, the surface quality of section steel can also meet the requirements of YB/T 4427.

7.8 Special requirements. After it is negotiated between the supplier and the buyer, and indicated in the contract, other special technical requirements, such as the maximum force total elongation A_{gt} and so on, can be put forward for the steel.

8 Test methods

8.1 The chemical composition analysis method of steel shall be carried out according to GB/T 4336, GB/T 20123, GB/T 20125 or general methods, and the arbitration shall be carried out according to GB/T 223.3, GB/T 223.9, GB/T 223.11, GB/T 223.14, GB/T 223.17, GB/T 223.18, GB/T 223.23, GB/T 223.26, GB/T 223.40, GB/T 223.60, GB/T 223.63, GB/T 223.68, GB/T 223.69, GB/T 223.79 and GB/T 20125.

8.2 The test methods for other inspection items of steel shall comply with the provisions in Table 10.

9.1 Batch rules

9.1.1 The steels shall be submitted for inspection and acceptance in batches, and each batch shall consist of steel plates, strips or section steels of the same designation, heat