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# GB

NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA

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## GB/T 14291-2006

Replacing GB/T 14291-1993

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### Welded steel tubes for mine liquid service

矿山流体输送用电焊钢管

(ISO 559:1991 Steel tubes for water and sewage, NEQ)

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## Foreword

This Standard corresponds to ISO 559:1991 "Steel tubes for water and sewage" (English version); the consistent degree is not equivalent.

This Standard replaces GB/T 14291-1993 "Welded steel tubes for mine liquid service". Compared with GB/T 14291-1993, the main changes of this Standard are as follows:

- Modify the outer-diameter and wall-thickness series;
- Modify the permissible-deviation of outer-diameter and wall-thickness;
- Add the tube-end's cut-oblique requirements;
- Modify the coefficient of theoretical weight formula; add the weight permissible-deviation;
- Add the steel designations Q295A, Q295B, Q345A and Q345B; and their mechanical properties;
- Add the requirements of tube-end weld-seam's ultrasonic test, after hydraulic test;
- Modify the provision that non-destructive test replaces hydraulic test;
- Modify the bending test and flattening test provisions;
- Modify the group-batching rules.

This Standard was proposed by China Iron and Steel Association.

This Standard shall be under the jurisdiction of the National Steel Standardization Technical Committee.

Drafting organization of this Standard: Jinxi Steel Tube Co., Ltd.

Main drafters of this Standard: Qi Huijuan, Bi Jingdong, Zhu Xingwei, Xu Shoushan, Liu Shuochen.

This Standard was first-published in April 19, 1993.

# **Welded steel tubes for mine liquid service**

## **1 Scope**

This Standard specifies the dimension, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificate for welded steel tubes for mine liquid service.

This Standard applies to the straight-seam welded steel tubes that are used for mine pressured-air, drainage, drainage gas and slurry transportation.

## **2 Normative references**

The following normative documents contain the provisions which, through reference in this text, constitute the provisions of this Standard. For dated references, the subsequent amendments (excluding corrections) or revisions of these publications do not apply. However, the parties who enter into agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document applies.

GB/T 222 Permissible Tolerances for Chemical Composition of Steel Products

GB/T223.5 Steel and iron - Determination of acid-soluble silicon and total silicon content - Reduced molybdosilicate spectrophotometric method

GB/T 223.10 Methods for chemical analysis of iron, steel and alloy -The cupferron separation-chrome azurol S photometric method for the determination of aluminium content

GB/T 223.12 Methods for chemical analysis of iron, steel and alloy - The sodium carbonate separation-diphenyl carbazide photometric method for the determination of chromium content

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 223.16 Methods for chemical analysis of iron, steel and alloy - the chromotropic acid photometric method for the determination of titanium content

GB/T 223.19 Methods for chemical analysis of iron steel and alloy – The

neocuproine-chloroform extraction photometric method for the determination of copper content

GB/T 223.23 Methods for chemical analysis of iron, steel and alloy – The dimethylglyoxime spectrophotometric method for the determination of nickel content

GB/T 223.39 Methods for chemical analysis iron, steel and alloy - The sulphochlorophenol S photometric method for the determination of niobium content

GB/T 223.59 Methods for chemical analysis of iron, steel and alloy - The reduced molybdoantimonyl phosphoric acid photometric method for the determination of phosphorus content

GB/T 223.62 Methods for chemical analysis of iron, steel and alloy - The butyl acetate extraction photometric method for the determination of phosphorus 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

GB/T 223.69 Methods for chemical analysis of iron, steel and alloy - The gas-volumetric method after combustion in the pipe furnace for the determination of carbon content

GB/T 228 Metallic Materials - Method for Tensile Testing at Ambient Temperature (GB/T 228-2002, eqv ISO 6892:1998)

GB/T 241 Metal tubes - Hydrostatic pressure testing

GB/T 244 Metallic materials-Tube - Bend test (GB/T 244-2008, ISO 8491:1998, IDT)

GB/T 246 Metal materials - Tube - Flattening test (GB/T 246-2007, ISO 8492:1998, IDT)

GB/T 700 Carbon structural steels (GB/T 700-2006, ISO 630:1995, NEQ)

GB/T 1591 High strength low alloy structural steels GB/T 1591-1994, neq ISO 4950-1:1981, ISO 4950-2:1981, ISO 4951:1981)

GB/T 2102 Acceptance packing marking and quality certification of steel pipe

GB/T 2975 Steel and steel products - Location and preparation of test pieces for mechanical testing

GB/T 4336 Standard test method for spark discharge atomic emission spectrometric analysis of carbon and low-alloy steel (routine method)

GB/T 7735 Steel tubes - The inspection method on eddy current test (GB/T 7735-2004, ISO 9304:1989, MOD)

GB/T 18256 Welded steel tubes (except submerged arc-welded-ultrasonic testing for verification of hydraulic leak-tightness)

GB/T 20066 Steel and Iron - Sampling and preparation of samples for the determination of chemical composition (GB/T 20066-2006, ISO 14284:1996, IDT)

### 3 Ordering contents

The contract or order that is based on this Standard shall include the following contents:

- a) standard number;
- b) product name;
- c) steel designation;
- d) order quantity (total weight or total length);
- e) dimensions (outer-diameter × wall-thickness, in millimeters);
- f) delivery status;
- g) special requirements.

## 4 Dimension, shape and weight

### 4.1 Dimensions

#### 4.1.1 Outer-diameter and wall-thickness

Steel tubes' nominal outer-diameter (D) and nominal wall-thickness (S) shall comply with the requirements in Table 1. According to the demand-side's requirements, negotiated by both sides, and specified in the contract, it can supply the steel tubes of which the specifications are out of Table 1.

**Table 1 (Continued)**

| Outer-diameter (D)<br>/ mm | Nominal wall-<br>thickness<br>(S) / mm | Theoretical weight<br>/ (kg/m) | Test pressure / MPa |              |              |
|----------------------------|----------------------------------------|--------------------------------|---------------------|--------------|--------------|
|                            |                                        |                                | Q235A, Q235B        | Q295A, Q295B | Q345A, Q345B |
| 63.5                       | 4.5                                    | 6.55                           | 15.0                | 15.0         | 15.0         |
| 70                         | 2.5                                    | 4.16                           | 10.1                | 12.6         | 14.8         |
| 70                         | 3.0                                    | 4.96                           | 12.1                | 15.0         | 15.0         |
| 70                         | 3.5                                    | 5.74                           | 14.1                | 15.0         | 15.0         |
| 70                         | 4.0                                    | 6.51                           | 15.0                | 15.0         | 15.0         |
| 70                         | 4.5                                    | 7.27                           | 15.0                | 15.0         | 15.0         |
| 76.1                       | 2.5                                    | 4.54                           | 9.3                 | 11.6         | 13.6         |
| 76.1                       | 3.0                                    | 5.41                           | 11.1                | 14.0         | 15.0         |
| 76.1                       | 3.5                                    | 6.27                           | 13.0                | 15.0         | 15.0         |
| 76.1                       | 4.0                                    | 7.11                           | 14.8                | 15.0         | 15.0         |
| 76.1                       | 4.5                                    | 7.95                           | 15.0                | 15.0         | 15.0         |
| 88.9                       | 3.0                                    | 6.36                           | 9.5                 | 11.9         | 14.0         |
| 88.9                       | 3.5                                    | 7.37                           | 11.1                | 13.9         | 15.0         |
| 88.9                       | 4.0                                    | 8.38                           | 12.7                | 15.0         | 15.0         |
| 88.9                       | 4.5                                    | 9.37                           | 14.3                | 15.0         | 15.0         |
| 88.9                       | 5.0                                    | 10.35                          | 15.0                | 15.0         | 15.0         |
| 101.6                      | 3.0                                    | 7.29                           | 8.3                 | 10.5         | 12.2         |
| 101.6                      | 3.5                                    | 8.47                           | 9.7                 | 12.2         | 14.3         |
| 101.6                      | 4.0                                    | 9.63                           | 11.1                | 13.9         | 15.0         |
| 101.6                      | 4.5                                    | 10.78                          | 12.5                | 15.0         | 15.0         |
| 101.6                      | 5.0                                    | 11.91                          | 13.9                | 15.0         | 15.0         |
| 101.6                      | 5.5                                    | 13.03                          | 15.0                | 15.0         | 15.0         |
| 101.6                      | 6.0                                    | 14.15                          | 15.0                | 15.0         | 15.0         |
| 108                        | 3.0                                    | 7.77                           | 7.8                 | 9.8          | 11.5         |
| 108                        | 3.5                                    | 9.02                           | 9.1                 | 11.5         | 13.4         |
| 108                        | 4.0                                    | 10.26                          | 10.4                | 13.1         | 15.0         |
| 108                        | 4.5                                    | 11.49                          | 11.8                | 14.8         | 15.0         |
| 108                        | 5.0                                    | 12.70                          | 13.1                | 15.0         | 15.0         |
| 108                        | 5.5                                    | 13.90                          | 14.4                | 15.0         | 15.0         |
| 108                        | 6.0                                    | 15.09                          | 15.0                | 15.0         | 15.0         |
| 108                        | 6.5                                    | 16.27                          | 15.0                | 15.0         | 15.0         |
| 114.3                      | 3.5                                    | 9.56                           | 8.6                 | 10.8         | 12.7         |
| 114.3                      | 4.0                                    | 10.88                          | 9.9                 | 12.4         | 14.5         |
| 114.3                      | 4.5                                    | 12.19                          | 11.1                | 13.9         | 15.0         |

**Table 1 (Continued)**

| Outer-diameter (D)<br>/ mm | Nominal wall-<br>thickness<br>(S) / mm | Theoretical weight<br>/ (kg/m) | Test pressure / MPa |              |              |
|----------------------------|----------------------------------------|--------------------------------|---------------------|--------------|--------------|
|                            |                                        |                                | Q235A, Q235B        | Q295A, Q295B | Q345A, Q345B |
| 152.4                      | 5.0                                    | 18.18                          | 9.3                 | 11.6         | 13.6         |
| 152.4                      | 5.5                                    | 19.93                          | 10.2                | 12.8         | 14.9         |
| 152.4                      | 6.0                                    | 21.66                          | 11.1                | 13.9         | 15.0         |
| 152.4                      | 6.5                                    | 23.39                          | 12.0                | 15.0         | 15.0         |
| 152.4                      | 7.0                                    | 25.10                          | 13.0                | 15.0         | 15.0         |
| 159                        | 4.0                                    | 15.29                          | 7.1                 | 8.9          | 10.4         |
| 159                        | 4.5                                    | 17.15                          | 8.0                 | 10.0         | 11.7         |
| 159                        | 5.0                                    | 18.99                          | 8.9                 | 11.1         | 13.0         |
| 159                        | 5.5                                    | 20.82                          | 9.8                 | 12.2         | 14.3         |
| 159                        | 6.0                                    | 22.64                          | 10.6                | 13.4         | 15.0         |
| 159                        | 6.5                                    | 24.45                          | 11.5                | 14.5         | 15.0         |
| 159                        | 7.0                                    | 26.24                          | 12.4                | 15.0         | 15.0         |
| 159                        | 8.0                                    | 29.79                          | 14.2                | 15.0         | 15.0         |
| 159                        | 9.0                                    | 33.29                          | 15.0                | 15.0         | 15.0         |
| 168.3                      | 4.5                                    | 18.18                          | 7.5                 | 9.5          | 11.1         |
| 168.3                      | 5.0                                    | 20.14                          | 8.4                 | 10.5         | 12.3         |
| 168.3                      | 5.5                                    | 22.08                          | 9.2                 | 11.6         | 13.5         |
| 168.3                      | 6.0                                    | 24.02                          | 10.1                | 12.6         | 14.8         |
| 168.3                      | 6.5                                    | 25.94                          | 10.9                | 13.7         | 15.0         |
| 168.3                      | 7.0                                    | 27.85                          | 11.7                | 14.7         | 15.0         |
| 168.3                      | 8.0                                    | 31.63                          | 13.4                | 15.0         | 15.0         |
| 168.3                      | 9.0                                    | 35.36                          | 15.0                | 15.0         | 15.0         |
| 177.8                      | 4.5                                    | 19.23                          | 7.1                 | 9.0          | 10.5         |
| 177.8                      | 5.0                                    | 21.31                          | 7.9                 | 10.0         | 11.6         |
| 177.8                      | 5.5                                    | 23.37                          | 8.7                 | 11.0         | 12.8         |
| 177.8                      | 6.0                                    | 25.42                          | 9.5                 | 11.9         | 14.0         |
| 177.8                      | 6.5                                    | 27.46                          | 10.3                | 12.9         | 15.0         |
| 177.8                      | 7.0                                    | 29.49                          | 11.1                | 13.9         | 15.0         |
| 177.8                      | 8.0                                    | 33.50                          | 12.7                | 15.0         | 15.0         |
| 177.8                      | 9.0                                    | 37.47                          | 14.3                | 15.0         | 15.0         |
| 193.7                      | 5.0                                    | 23.27                          | 7.3                 | 9.1          | 10.7         |
| 193.7                      | 5.5                                    | 25.53                          | 8.0                 | 10.1         | 11.8         |
| 193.7                      | 6.0                                    | 27.77                          | 8.7                 | 11.0         | 12.8         |
| 193.7                      | 6.5                                    | 30.01                          | 9.5                 | 11.9         | 13.9         |



**Table 1 (Continued)**

| Outer-diameter (D)<br>/ mm | Nominal wall-<br>thickness<br>(S) / mm | Theoretical weight<br>/ (kg/m) | Test pressure / MPa |              |              |
|----------------------------|----------------------------------------|--------------------------------|---------------------|--------------|--------------|
|                            |                                        |                                | Q235A, Q235B        | Q295A, Q295B | Q345A, Q345B |
| 355.6                      | 6.5                                    | 55.96                          | 5.2                 | 6.5          | 7.6          |
| 355.6                      | 7.0                                    | 60.18                          | 5.6                 | 7.0          | 8.1          |
| 355.6                      | 8.0                                    | 68.58                          | 6.3                 | 8.0          | 9.3          |
| 355.6                      | 9.0                                    | 76.93                          | 7.1                 | 9.0          | 10.5         |
| 355.6                      | 10.0                                   | 85.23                          | 7.9                 | 10.0         | 11.6         |
| 355.6                      | 11.0                                   | 93.48                          | 8.7                 | 11.0         | 12.8         |
| 355.6                      | 12.5                                   | 105.77                         | 9.9                 | 12.4         | 14.6         |
| 377                        | 6.0                                    | 54.90                          | 4.5                 | 5.6          | 6.6          |
| 377                        | 6.5                                    | 59.39                          | 4.9                 | 6.1          | 7.1          |
| 377                        | 7.0                                    | 63.87                          | 5.2                 | 6.6          | 7.7          |
| 377                        | 8.0                                    | 72.80                          | 6.0                 | 7.5          | 8.8          |
| 377                        | 9.0                                    | 81.68                          | 6.7                 | 8.5          | 9.9          |
| 377                        | 10.0                                   | 90.51                          | 7.5                 | 9.4          | 11.0         |
| 377                        | 11.0                                   | 99.29                          | 8.2                 | 10.3         | 12.1         |
| 377                        | 12.5                                   | 112.36                         | 9.4                 | 11.7         | 13.7         |
| 406.4                      | 6.0                                    | 59.25                          | 4.2                 | 5.2          | 6.1          |
| 406.4                      | 6.5                                    | 64.10                          | 4.5                 | 5.7          | 6.6          |
| 406.4                      | 7.0                                    | 68.95                          | 4.9                 | 6.1          | 7.1          |
| 406.4                      | 8.0                                    | 78.60                          | 5.6                 | 7.0          | 8.1          |
| 406.4                      | 9.0                                    | 88.20                          | 6.2                 | 7.8          | 9.2          |
| 406.4                      | 10.0                                   | 97.76                          | 6.9                 | 8.7          | 10.2         |
| 406.4                      | 11.0                                   | 107.26                         | 7.6                 | 9.6          | 11.2         |
| 406.4                      | 12.5                                   | 121.43                         | 8.7                 | 10.9         | 12.7         |
| 426                        | 6.0                                    | 62.15                          | 4.0                 | 5.0          | 5.8          |
| 426                        | 6.5                                    | 67.25                          | 4.3                 | 5.4          | 6.3          |
| 426                        | 7.0                                    | 72.33                          | 4.6                 | 5.8          | 6.8          |
| 426                        | 8.0                                    | 82.47                          | 5.3                 | 6.6          | 7.8          |
| 426                        | 9.0                                    | 92.55                          | 6.0                 | 7.5          | 8.7          |
| 426                        | 10.0                                   | 102.59                         | 6.6                 | 8.3          | 9.7          |
| 426                        | 11.0                                   | 112.58                         | 7.3                 | 9.1          | 10.7         |
| 426                        | 12.5                                   | 127.47                         | 8.3                 | 10.4         | 12.1         |
| 457                        | 6.0                                    | 66.73                          | 3.7                 | 4.6          | 5.4          |
| 457                        | 6.5                                    | 72.22                          | 4.0                 | 5.0          | 5.9          |
| 457                        | 7.0                                    | 77.68                          | 4.3                 | 5.4          | 6.3          |

D - outer-diameter, in mm.

S - wall-thickness, in mm;

R – 60% of specified lower-yield strength, in MPa.

After the hydraulic test, the weld-seams that are within 300 mm from the tube-end shall be subjected to ultrasonic test. Ultrasonic test shall comply with GB/T 18256. Negotiated by both sides, and specified in the contract, for tube-end of which the outer-diameter is not more than 114.3 mm, it may be exempted from ultrasonic test.

Negotiated by both sides, and specified in the contract, it may use ultrasonic test or eddy current test to replace hydraulic test. Steel-tube's ultrasonic test shall comply with the provisions of GB/T 18256; eddy current test shall comply with the provisions of GB/T 7735; compared with the sample-tube, the artificial defects (holes) shall be grade-A.

### 5.6 Bending test

For steel-tubes of which the outer-diameter is not more than 60.3 mm, bending test shall be conducted. 1 piece of bending specimen shall be respectively taken from the head-end of steel-tube that is manufactured from each-batch's first-roll steel-strip AND tail-end of steel-tube that is manufactured from each-batch's last-roll steel-strip [Translator: total 2 pieces]. During the test, the specimen shall be bent without filler; bending radius shall be 6 times of the nominal steel-tube's outer-diameter; bending angle is 90°; the weld-seam and bending-plane form 90°. After the test, it does not allow crack-seams or cracks on the specimen.

### 5.7 Flattening test

For steel-tubes of which the outer-diameter is more than 60.3 mm, flattening test shall be conducted. 2 piece of bending specimens shall be respectively taken from the head-end of first steel-tube AND tail-end of last steel-tube that are manufactured from each-roll steel-strip [Translator: total 4 pieces]. During the test, the weld-seams of 2 specimens of head-end AND 2 specimens of tail-end shall form 90° and 0° with the exerting-force's direction respectively [Translator: total 2 pieces]; if there is stop-welding phenomenon, it shall take 1 specimen from the front and back of stop-welding respectively [Translator: total 2 pieces]. Weld-seam of specimen shall form 90° with the exerting-force's direction. The test of specimens that are taken from the front and back of stop-welding can replace the flattening test that the weld-seams of head-end and tail-end specimens are placed at 0°.

During the test, when the distance between the plates is 2/3 of steel-tube's outer-diameter, crack-seam or crack is not allowed to appear at weld-seam; when the distance between the plates is 1/3 of steel-tube's outer-diameter, crack-seam or crack is not allowed to appear at parts other than weld-seam; continue to flatten until relative tube-walls are contacted. In the entire flattening process, stratification or metal over-

|   |                 |          |                |
|---|-----------------|----------|----------------|
| 7 | Flattening test | GB/T 246 | 4 piece / roll |
|---|-----------------|----------|----------------|

## 7 Inspection rules

### 7.1 Inspection and Acceptance

Steel-tube's inspection and acceptance shall be conducted by the supplier's quality-technical supervision department.

### 7.2 Group-batching rules

Steel-tube shall be inspected and accepted by batch; each batch of steel-tube shall be consisted of the same furnace (tank) number, same designation, same specification and same heat treatment system. Quantity of each batch steel-tubes shall not exceed the following provisions:

- a) For outer-diameter  $\leq 60.3$  mm: 500 pieces;
- b) For outer-diameter  $> 60.3$  mm  $\sim 114.3$  mm: 400 pieces;
- c) For outer-diameter  $> 114.3$  mm  $\sim 273.1$  mm: 300 pieces;
- d) For the outer-diameter  $> 273.1$  mm: 200 pieces.

## 8 Re-inspection and judgment rules

Steel-tube's re-inspection and judgment shall comply with the provisions of GB/T 2102.

## 9 Packaging, marking and quality certificate

Steel-tube's packaging, marking and quality certificate shall comply with the provisions of GB/T 2102.

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