

# Shanghai Enterprise Standard

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## SL SERIES UPWARD CONTINUOUS CASTING SYSTEM FOR OXYGEN-FREE COPPER MATERIAL PRODUCTION

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issued



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## Introduction

At present, there are no corresponding national standards, industrial standards and local standards for this product. In order to strictly manage and ensure product quality, this document is made.

The format of this document is formulated according to GB/T 1.1-2020 Standardization Guidelines Part 1: Structure and Drafting Rules of Standardization Documents.

Please note that some of the content of this document may involve patents. The issuer of this document is not responsible for identifying the patent.

This document refers to GB/T 24337 -- 2009 "power quality between public grid harmonics", GB/T 1576-2018 "Industrial boiler water quality", GB 7251.12 -- 2013 "low-voltage switchgear and control equipment", GB/T 3952 -- 2016 "copper wire billet for electrical engineering", GB/T 467-2010 Cathode Copper and relevant requirements of CE certification passed by this unit.

This document is amended by Q31/0115000622C002-2020, mainly as follows:

1. The reference standard number has been updated.
2. The terms "enhanced" and "reverse thrust" were added.
3. Added the number of specifications: 24, 28, 32, 36, 40, 48.
4. The annual output has been increased by 15000 tons, 18000 tons, 20000 tons and 25000 tons.
5. Major changes have been made to type and meaning item 4.
6. Due to the addition of the "enhanced" unit, the pressure of the enhanced cooler and the cooling water supply system is adjusted to no less than 0.75Mpa, and the water supply pipe is provided with seamless water pipe.

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This is the eighth revision.



# SL SERIES UPWARD CONTINUOUS CASTING SYSTEM

## 1 Scope

This document specifies the terms, main characteristics, product classification, technical requirements, test methods, inspection rules, delivery methods, marks and document requirements of the SL series upward continuous casting system.

This document is applicable to SL series upward continuous casting system (hereinafter referred to as the product), which adopts upward continuous casting process and is dedicated to producing large-length bright oxygen-free copper. It is specially used for the production of long length bright copper alloy materials.

## 2 Normative reference document

The following documents are essential for the application of this document. For dated references, the date-only version applies to this document. For undated references, the latest version (including all amendment orders) applies to this document.

GB/T 3952-2016 Copper wire billet for electrical purposes

## 3 Terms and definitions

### 3.1 Machine

Adopting the upward continuous casting process, it is specially used to produce large length bright oxygen free copper and alloy copper. It is mainly composed of power frequency induction cored electric furnace, continuous casting machine, wire coiling machine and electronic control equipment.

### 3.2 Power frequency induction core furnace

It is the use of electromagnetic induction principle, so that in the alternating magnetic field (frequency of 50Hz, 60Hz) in the secondary coil (that is, the copper ring), melting under the action of induction current, so as to constantly generate heat, to melt the furnace charge or make liquid copper heat preservation a kind of electric heating equipment. The melting furnace, holding furnace and combination furnace of different types of units are power frequency induction core electric furnace.

Power frequency induction furnace for melting electrolytic copper.

#### 3.2.1 Melting furnace

#### 3.2.2 Holding furnace

Power frequency induction furnace which can keep copper liquid constant temperature for continuous casting.

#### 3.2.3 Combination furnace

It is a power frequency induction furnace which integrates melting furnace and holding furnace.

#### 3.2.4 Copper ring

Key parts of power frequency induction cored electric furnace.

The low voltage coil made of pure copper is equivalent to the secondary side of the transformer. After melting in the furnace body, the corresponding furnace cavity is generated, which is the source of heat of the furnace charge.

### 3.3 Continuous casting machine

It is a device for continuously cooling copper liquid into casting billet and conveying it, including cooler, traction and transmission system, liquid level tracking and transmission system, etc.

#### 3.3.1 Cooler, enhanced type

3.3.1.1 A device for cooling copper liquid into casting billets, including a cooler (called a cooler in China), a graphite dies, insulation cup, etc. (Optional graphite dies for brass rods.)

3.3.1.2 Enhanced type: Cooler and graphite die with connection thread lengthened, or choose taper connection; Water supply pressure increases.

#### 3.3.2 Traction and transmission system

#### 3.3.3 Turn and stop ratio, reverse push

The traction wheel rotates intermittently by using motor and other power, so as to realize a transmission device of upward continuous casting. Rotation/stop ratio: The ratio of rotation to stop in traction wheel clearance motion.

#### 3.3.4 Level tracking and transmission system

A device that can make the mounting plate of the continuous casting machine move up and down automatically with the liquid level, so as to keep the position of the cooler and the liquid level of the copper liquid relatively unchanged. Reverse thrust: The reverse operation of the traction wheel in the rotation stop motion.

### 3.4 Coiling machine

A coiling device for receiving casting billet comprises a traction drive device and a coiling frame.

### 3.5 Electrical control system

A complete set of electric control devices required for the unit to implement the upward continuous casting process.

Including control of melting furnace holding furnace pressure regulating cabinet; Capacitor compensation cabinet; Continuous casting machine lifting; Control table for traction casting billet;

Cooling system control box; Temperature measuring device for copper liquid temperature and cooling water temperature; Take-up control panel; Take-up automatic tracking control box; Solenoid valve control box, etc.

It includes a three-phase balancing device, which is not configured for standard universal units. If a three-phase balancing device is required, it must be indicated in the Technical Specification Book.

Since the effective component of AC power network is the single frequency of power frequency, any component different from the power frequency can be called harmonic. Because the sinusoidal voltage is pressurized against the nonlinear load, the fundamental current distorts to produce harmonics.

### 3.7 Three-phase balancing device

When the load of the three-phase power supply is seriously unbalanced, a device that makes the three-phase load relatively balanced.

### 3.8 Cooling water

Water for heat exchange in the production process of the unit.

#### 4 Main characteristics of unit

- 4.1 According to the annual output is divided into: 1000 tons, 2000 tons, 3000 tons, 4000 tons, 5000 tons, 6000 tons, 8000 tons, 10000 tons, 12000 tons, 15000 tons, 18000 tons, 20000 tons, 25000 tons.
- 4.2 According to the material is divided into: in addition to pure copper, but also can produce brass, silver copper, magnesium copper, phosphorus copper, tin bronze and other alloy copper.
- 4.3 According to the shape is divided into: round rod, round tube, flat billet, profile, etc.
- 4.4 According to the number of rod is divided into: 4 ~ 48 strands. Single continuous casting machine: 4-24 strands, more than 28 strands choose 2 continuous casting machines, the maximum number of 48 strands (24 strands of continuous casting machine 2 sets).

#### 5 Product classification

##### 5.1 Model and meaning

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Annual production, or the number of holes in the W-shaped copper ring. Generally omitted, but when the furnace style is the same and the output is different and difficult to distinguish, it must be marked. For example, Q11.0, Q11.2, QW-2, and QW-3 etc.

Furnace Style Q- Combination furnace, different styles plus notes, Such as: QB, QE, QH, QI, QW, etc.

Continuous casting machine style IV - four column

continuous casting machine, I - single column

continuous casting machine. Product code (S- upward,

L- continuous casting)

##### 5.1.2 specification

Billet specification, number of strand, furnace type, annual output.

##### 5.2 classification

##### 5.2.1 Units can be divided into furnaces

- a) Single furnace set
- b) One melting furnace and one holding furnace unit
- c) Combined furnace set

##### 5.2.2 The unit can be divided into according to the traction mode

- a) Servo motor traction
- b) Mechanical traction

##### 5.2.3 The unit can be divided into continuous casting type

- a) Four column continuous casting machine
- b) Single column continuous casting machine

##### 5.2.4 Unit is divided into annual output type

1000 tons ~ 25000 tons



### 5.3 Basic parameter

Basic parameters (see Table 1)

Table 1 Basic parameters

NO	ITEMS	Basic parameters
1	Number of billets	4、6、8、10、12、14、16、18、20、24、28、32、36、40、48。
2	Billet diameter (mm)	Φ8 ~ Φ60
3	Thickness and width of billet(mm)	width : 50 ~ 630, thickness: 6 ~ 25
4	Annual production (tons)	1000 ~ 25000
5	Traction speed(mm/min)	10 ~ 3500, Arbitrary adjustable, special cases up to 4000
6	Traction pitch(mm)	Type S is adjustable: 1 ~ 6, adjustable J type fixed: 5, 5.5, can also be determined.
7	Turn-to-stop ratio ( % )	adjustable
8	Reverse thrust	adjustable

### 5.4 Unit performance

#### 5.4.1 Product conformity

The copper rod produced by the unit shall meet the requirements of GB/T 3952-2016 "Copper billet for Electrical " or "Technical Specification".

#### 5.4.2 Furnace time

The life cycle from the start of the furnace to the end of the furnace production.

### 6 Technical requirement

6.1 Units shall conform to the requirements of this standard and be manufactured in accordance with drawings and technical documents approved by the prescribed procedures.

#### 6.2 Unit appearance

6.2.1 The machined surface of the unit should be coated with anti-rust oil or blackening treatment, and the remaining exposed surface should be painted. The coating layer should have strong adhesion and be firmly combined. 6.2.2 The electroplated parts of the unit must be smooth, fine and uniform in color.

6.2.3 The signs and various scale values are clear, neatly installed, firmly installed and in accordance with the usage requirements.

#### 6.3 Power frequency induction furnace

6.3.1 The welding place is smooth and firm.

6.3.2 holding furnace, melting furnace in the cold furnace condition, the inside of the core insulation resistance, furnace shell and the sensor shell of the insulation resistance shall be not less than 0.5 MΩ.

6.3.3 When the induction furnace is in working condition, the temperature of the inductor shell shall not exceed 250℃.

6.4.1 Level tracking device

The moving parts rotate flexibly, no stuck phenomenon, continuous casting machine mounting plate (or upper and lower frame) for up and down the movement is stable, sensitive response.

6.4.2 Traction and transmission device

Tractive action is correct and smooth, no abnormal phenomenon.

6.4.3 Coolers

It should be able to withstand 0.75Mpa water pressure, and pressure stability, no leakage phenomenon.

6.4.4 The cylinder pressing mechanism works correctly.

6.5 Coiling machine

6.5.1 The traction wheel and frame device of the coiling machine shall rotate flexibly without jamming.

6.5.2 The wiring mechanism of the automatic wiring rewinding machine operates correctly and stably, and the switch operates with sensitive response. Cylinder pressing action is correct, no stuck phenomenon.

6.6 Electrical System

6.6.1 The product design of the electronic control equipment supporting the unit must meet the requirements of testing, convenient maintenance, safe and reliable, economical and reasonable, practical and beautiful.

6.6.2 Operation handles and buttons of all operating mechanisms shall be flexible, and auxiliary switch contacts shall be closed correctly and reliably.

6.6.3 The electrical components in the electronic control equipment shall meet the relevant requirements and maintain their electrical clearance and creepage distance under normal operating conditions.

6.6.4 Meters, relays, electrical equipment, terminal blocks and connecting wires of all secondary circuits shall be labeled. Labels shall be complete, clear and in accordance with the requirements of the drawings.

6.6.5 The tracking speed of the automatic tracking system shall be synchronized with the traction speed of the motor.

6.7 Coil and water sleeve water cooling system should be able to withstand 0.25MPa water pressure; The water cooling system of the ordinary cooler should be able to withstand 0.45MPa water pressure, and the water cooling system of the enhanced cooler should be able to withstand 0.75MPa water pressure. And the pressure is stable, no leakage phenomenon.

6.8 When the water pressure and copper liquid temperature exceed the set value, the unit alarm device will automatically alarm.

6.9 Three-phase balancing device

Because of the working principle of the iron-core power-frequency induction furnace, the unit belongs to the unbalanced electrical system with asymmetric load, and the current of the three-phase power supply is unbalanced when working. For the configuration of three - phase balancing device, the current is not balanced. Current unbalance should meet the requirements of the national standard "GB/T 15543-2008 power quality three-phase voltage Unbalance".

## 6.10 power frequency induction furnace

Using qualified furnace building materials, using correct furnace building and opening process, using qualified raw materials, under normal operation conditions, the service life of the power frequency induction furnace should not be less than 6 months after the first furnace building (starting from the furnace opening).

### 7 Requirements for parts provided by users

#### 7.1 Power grid harmonics

The quality of power supply for the production of the up-drawing unit must meet the requirements of the national grid, and the harmonic content in the grid must meet the provisions of the national standard "GB/T 24337-2009 Power quality Harmonics between Public grids".

The total harmonic distortion rate of the power supply voltage is  $< 5\%$  (among which: odd wave  $< 4\%$ , even wave  $< 2\%$ ).

#### 7.2 Standby power supply

Standby power supply for thermal insulation: used for the thermal insulation capacity of the unit after power failure.

Standby power supply for regular power outage: It is used for the power supply capacity that can be used for production after power outage of the unit.

7.3 Cooling water quality The water quality of the cooling water shall meet the requirements of China GB/T 1576-2018 "Industrial Boiler Water Quality" standard.

Turbidity /FTU:  $\leq 5.0$

Hardness /(mmol/L) :  $\leq 0.030$

PH value /(25 °C) : 7.0 ~ 9.0

#### 7.4 Reserve water

It should meet the emergency water capacity during the power outage.

#### 7.5 Cooling water pipe

Water sleeve, coil, ordinary coolers, water supply system, it can choose seam welded water pipe; The water supply system of the enhanced coolers uses seamless pipes.

### 8 Test method

#### 8.1 Power frequency induction furnace

8.1.1 Visual inspection of welding of power frequency induction furnace.

8.1.2 Insulation resistance test of power frequency induction furnace

Connect one outlet wire of the megohm meter to the iron core, and contact the other end with each fixing screw of the transformer respectively to measure the insulation resistance of the transformer iron core, which shall meet the requirements of Article 5.3.2.

Connect one outlet of the megohm meter to the inductor housing and the other end to the furnace housing to measure the insulation resistance of the furnace part in accordance with the requirements of Article 5.3.2.

#### 8.2 Sensor housing temperature test

When the unit is in normal operation, the temperature shall be measured by contacting the sensor housing with a surface thermometer in accordance with the requirements of Section 5.3.3.

8.3 Continuous casting machine test

8.3.1 Test of liquid level tracking transmission device

Traction mounting plate (or upper and lower frame) rise and fall smoothly, mounting plate (or upper and lower frame)no obvious jitter phenomenon, rise and fall test times are not less than 10 times.

#### 8.3.2 Test of mechanical traction transmission device

Before the test run, hand over clutch swing rod, clutch reliable, output shaft steering correct, no stuck phenomenon. During the test run, open the DC motor speed regulating device, the voltage is slowly raised from 0 to 160V, observe the sensitivity of starting, traction action is clear, uniform and consistent with the rhythm of clutch action, the inside of the retractor set should rotate upward. Then run 30min, worm gear box and each transmission parts without heating phenomenon.

#### 8.3.3 Test of servo motor traction transmission system

During the test run, put the lead rod, press the traction wheel, select the required speed of the lead rod, the traction action is clear and uniform, and the traction mechanism does not shake. Observe the running curve of the motor in the computer, whether the waveform is correct, and check whether the pitch of each pin speed is consistent.

#### 8.3.4 Pressure test of coolers

After the cooler is assembled, the pressure test pump is used to add water to the cooler for pressure test: the first pressure test is 2Mpa, the time is 10min, and leakage (possibly leakage in the system) is allowed. Then test pressure 1MPa, time 10min, stable pressure, no leakage phenomenon.

8.3.5 Cylinder pressing mechanism Solenoid valve energized, adjust the air pressure to 0.25~0.4MPa, operate the pneumatic button, cylinder action is correct, flexible, reliable compression.

#### 8.4 Test of coiling machine

8.4.1 Start the coiling motor to drive the transmission mechanism to run for 1 minute, the traction wheel rotates flexibly without abnormal sound, and the coiling frame should be pushed by hand. The coiling frame should rotate flexibly without jam.

#### 8.4.2 Automatic take-up Test

Add 300kg weight to the wire reel and open the jacking cylinder of the friction wheel. The contact between the friction wheel and the wire reel is normal. When the wiring motor is started, the friction wheel and the winding disk rotate smoothly.

#### 8.5 Electrical system test

8.5.1 Turn on all operating mechanisms and run for 1 minute. Observe that handles and buttons are flexible and correct, and auxiliary switch contacts are reliably closed and meet the requirements in 5.6.2. 8.5.2 Check that the electrical clearance and creepage distance between exposed charged bodies of different polarity in the electronic control equipment and between them and the shell comply with national standards.

8.5.3 Conduct action tests according to the electrical schematic diagram to check whether the electrical connection conforms to the requirements of the electrical schematic diagram.

8.5.4 Automatic tracking test of coiling, The traction motor driver outputs pulse signals to the frequency converter

controlling to control the speed and keep the synchronization between the coiling speed and the traction speed. 8.6 Test of water cooling system 8.6.1 Ordinary type: When no-load test is carried out on site, the pressure of the water cooling system shall be increased to 0.45MPa (the whole system) and 0.25MPa (the water sleeve and coil), and the holding time shall be no less than 15min. The pressure of the whole system shall be stable without leakage.

8.6.2 Enhanced type: The water cooling system used for cooler shall be pressurized to 0.75MPa (the whole system) during no-load test on site; The water cooling system for water sleeve and coil is pressurized to 0.25MPa. Hold time no less than 15min, the whole system pressure is stable, no leakage phenomenon.

8.7 Alarm test of temperature measurement system

8.7.1 Adjust the adjusting screw in the pressure controller to the low setting control point, so that when the water pressure is low, the signal lights up and the electric bell sends an alarm signal. Adjust the adjusting screw in the other controller to the higher setting control point, so that when the water pressure is too high, the signal light is on, and the electric bell gives an alarm signal.

8.7.2 Adjust the high and low values of the XMT-121A digital display regulator so that the signal light and buzzer send alarm signals in the high and low areas.

8.8 Appearance: Visual inspection.

9. Inspection rule 9.1 All components of the unit shall be inspected and qualified before leaving the factory with the product qualification certificate attached. 9.2 Unit inspection is divided into ex-factory inspection and on-site inspection.

9.3 The unit shall be inspected before leaving the factory according to the items specified in Table 2.

Table 2 Delivery inspection items

NO.	Test item	This standard clause No	
		Technical requirement	Test method
1	Insulation resistance of insulation furnace and melting furnace	6.3.2	8.1.2
2	The continuous casting machine moves upward and downward according to the loading plate (or the upper and lower frame)	6.4.1	8.3.1
3	Traction action	6.4.2	8.3.2、8.3.3
4	Water pressure resistance of cooler	6.4.3	8.3.4
5	Cylinder action	6.4.4	8.3.5
6	Take-up machine traction wheel, take-up frame action	6.5.1	8.4.1
7	Coiling machine automatic wiring mechanism action	6.5.2	8.4.2
8	Electrical system operation is correct and reliable	6.6.2	8.5.1
9	Electrical clearance and distance of electrical components in electronic control equipment	6.6.3	8.5.2
10	Electrical components and equipment in an electrical system	6.6.4	8.5.3
11	Unit appearance inspection	6.2	8.8

9.4 On-site inspection of the unit shall be conducted after the installation and commissioning of the user.

9.5 On-site inspection of the unit shall be carried out according to the items specified in Table 3.

Table 3 On-site inspection items

NO	Test item	This standard clause No	
		Technical requirement	Test method
1	Sensor housing temperature	6.3.3	8.2
2	The cooling water system can withstand water pressure	6.7	8.6
3	Alarm system	6.8	8.7
4	The traction motor is synchronized with the line speed	6.6.5	8.5.4

9.6 On-site inspection of the unit, if there are unqualified items, it is allowed to readjust until qualified.

## 10 Delivery

Unit products are delivered in the form of components. Site installation, furnace building, commissioning.

## 11 Marking, packaging, transportation and storage

### 11.1 Marking

11.1.1 The nameplate shall be placed in an obvious and appropriate part of the unit, and the nameplate shall indicate:

11.1.1.1 Manufacturer's name and address

11.1.1.2 Product Name and Model

11.1.1.3 Number of casting rod

11.1.1.4 Casting rod Specifications

11.1.1.5 Manufacturing year, month and factory number

11.1.2 Each unit shall be delivered with the following documents:

11.1.2.1 Instruction Manual

11.1.2.2 Process documents

11.1.2.3 Installation Diagram

11.1.2.4 Maintenance drawings

11.1.2.5 Certificate of Conformity (including product implementation standard number)

### 11.2 Packaging

Electrical cabinet (table) moisture-proof packaging, key small wooden packing, general parts leaving the factory, in order to be safe and complete delivery to the destination for the principle.

11.3 transportation

The product should be protected from rain or moisture during transportation.

11.4 Storage

The product should be protected from rain or moisture during storage.

