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Safety technical conditions for continuous casting machines

连铸机安全技术条件

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Safety technical conditions for continuous casting machines

1 Scope

This document specifies the safety requirements, safety measures, verification requirements for continuous casting equipment, during design, manufacturing, assembly, transportation, installation, adjustment, commissioning, operation, maintenance, shutdown. It also specifies the key use information of signs, alarms, delivery and other steps of continuous casting equipment, during transportation, assembly, operation, maintenance.

This document is applicable to continuous casting machines such as slab billets, square billets, rectangular billets, special-shaped billets, round billets, and other similar equipment (such as horizontal continuous casting machines, continuous casting machines for headless rolling production lines, etc.).

2 Normative references

The contents of the following documents constitute the essential terms of this document through normative references in the text. Among them, for dated references, only the version corresponding to that date applies to this standard; for undated references, the latest version (including all amendments) applies to this document.

GB 2893 Safety colors

GB 2894 Safety signs and guideline for the use

GB 3096 Environmental quality standard for noise

GB 4053.1 Safety requirements for fixed steel ladders and platform - Part 1: Steel vertical ladders

GB 4053.2 Safety requirements for fixed steel ladders and platform - Part 2: Steel inclined ladders

GB 4053.3 Safety requirements for fixed steel ladders and platform - Part 3: Industrial guardrails and steel platform

GB 4943.1 Information technology equipment - Safety - Part 1: General requirements

GB 5083 General rules for designing the production facilities in accordance with safety and health requirements

5 Safety requirements and safety measures

5.1 Overview

5.1.1 General requirements

5.1.1.1 Basic conditions

The basic conditions for safety requirements are as follows.

a) This document requires that the continuous casting machine is operated in the design environment of GB 50010, GB 50016, GB 50116. The lighting of the continuous casting workshop shall comply with the provisions of 5.4 of GB 50034-2013; the indoor lighting shall refer to GB/T 26189. The ventilation, dust removal and harmful gas purification, noise reduction and vibration isolation, insulation and corrosion protection of the continuous casting workshop shall comply with the provisions of Chapter 6, Chapter 7, Chapter 12, Chapter 13, Appendix of GB 50019-2015.

b) The supplier of the continuous casting machine shall design and manufacture the continuous casting production equipment safely, in accordance with this document, GB 5083, relevant mechanical safety standards such as GB/T 20850. Among them, the steel straight ladder, steel inclined ladder, industrial protective railing and steel platform shall comply with GB 4053.1, GB 4053.2, GB 4053.3, respectively.

c) This document shall take into account local regulations on lighting, which may differ from the requirements of some local regulations.

d) The factory where the continuous casting machine is located shall establish the safety production rules, implementation rules, operating procedures for the continuous casting machine, in accordance with this document, the supplier's equipment manual, GB 4943.1, with reference to GB/T 30574, GB/T 33000, GB/T 33222, etc. Conduct standardized safety production education, training and quantitative assessment for all employees involved in the operation and maintenance of the continuous casting machine, technology development, test and research, logistics operation, marketing, factory management, etc.

e) Implement the safety production responsibility system; clarify the responsible personnel, scope of responsibility, assessment criteria, supervision measures of each position.

f) Establish a safety officer system. The safety officer of the continuous casting plant shall be familiar with this document; be proficient in the safety production

implementation rules of the continuous casting machine formulated according to this document, the supplier's equipment manual and other safety production standards; conduct a full process investigation of safety risks during the production and maintenance of the continuous casting machine; pay attention to discovering and collecting and summarizing safety incidents not covered by various safety regulations.

g) Safety education shall be conducted for all types of personnel who temporarily enter the continuous casting plant; precautions and safety responsibilities shall be clarified.

h) This document assumes that the continuous casting equipment is operated and maintained by trained and competent personnel, as shown in 7.4. Manual intervention for setting, adjustment and maintenance is part of the intended use of the continuous casting equipment.

i) Strengthen the scientific and technological research on the safe production of continuous casting machines and the promotion and application of advanced safe production technologies; continuously improve the safe production level of continuous casting machines.

5.1.1.2 Summary of this document

The continuous casting machine that complies with this document shall comply with the safety requirements and safety measures specified in this document.

In the use information, the supplier shall provide all the detailed information necessary for the safe operation process of the continuous casting machine under normal operating conditions. The supplier shall also describe specific safety measures under special operating modes (such as maintenance and commissioning work).

The subsequent clauses point out the safety requirements for the continuous casting machine plant design, overall design, equipment design, production operation, equipment maintenance, etc.; put forward the relevance of special safety requirements or safety measures to its major hazards and dangerous conditions.

5.1.2 Layout and on-site inspection of continuous casting machine

The supplier shall conduct a full inspection on site, to ensure the following items of continuous casting machine are well arranged and operate safely:

a) Barrier-free environment;

b) Equipment maintenance and equipment cleaning and cleaning space;

c) Transportation and storage of mechanical equipment and materials;

hydrogen system is referred to GB/T 34542.1. In addition, it shall also meet the requirements of Table 1.

c) In areas prone to fire, the hydraulic system shall use fatty acid ester (vinegar) fire-resistant hydraulic fluid (HFDU) or water-ethylene glycol fire-resistant hydraulic fluid. Fire-resistant hydraulic fluid complies with ISO 7745:2010 and ISO 12922:2012. Water-ethylene glycol fire-resistant hydraulic fluid refers to GB/T 21449.

d) If there are signs of dangerous hydraulic fluid leakage, the operator shall be promptly provided with an audible and visual alarm to stop the leakage.

e) For equipment supported by hydraulic cylinders, especially when supporting containers with steel liquid, a hose rupture protection device shall be installed at the hydraulic cylinder to quickly stop the flow of fluid.

f) Hydraulic accumulators shall be designed in accordance with national pressure vessel standards.

g) Hydraulic stations and lubricating oil stations (depots) shall not be connected to cable tunnels (corridors) and underground electrical rooms. If they must be connected, firewalls and fire doors shall be installed. The design of fire doors shall comply with GB 12955-2008, category A thermal insulation fire doors A3.0 shall be selected.

h) The rooms of the hydraulic station shall be equipped with escape doors in different directions; the hydraulic tunnel shall be equipped with at least one escape exit at both ends.

i) The rooms and water valve stations of the hydraulic station shall be equipped with oil drainage grooves to ensure smooth drainage.

5.1.6 Fluid systems for transporting or carrying fluids

The safety requirements for fluid systems for transporting or carrying fluids are as follows.

a) In the fluid system, the supplier of the continuous casting machine shall consider the protection against temperature and fire for all equipment and parts for transporting or carrying fluids.

b) Hydraulic stations, valve platforms, accumulators, hydraulic pipelines, hydraulic actuators shall be equipped with safety valves, pressure reducing valves, stop valves in accordance with safety requirements. Emergency locking devices shall be installed between accumulators and pipelines and inspected regularly.

c) The connecting parts of cable tunnels (corridors) and cable interlayers with

inspection laboratories shall be fireproofed.

d) Prevent the leakage of toxic gases used in operations such as drying, preheating of tundish, cutting of ingots, accidental cutting, flame cleaning.

e) In permanent workplaces, flanges, fittings, hoses shall be covered if there is a risk of fluid leakage. If pneumatic, hydraulic, oxygen, gas, steam, cable pipelines are found to be damaged or broken, they shall be replaced immediately.

f) When designing hydraulic, oxygen and gas systems, quick-cut devices shall be installed. Flame arresters shall be added to gas pipelines to prevent the spread of flames after flammable gases are accidentally ignited. Quick-cut devices and flame arresters shall ensure:

1) They are installed outside the danger zone;

2) They are easy to access;

3) Their locations are clearly marked.

g) When inspecting the gas system pipeline, the quick-cut valve or blind plate valve shall be closed; the residual gas in the pipeline shall be cleaned up by effective measures, such as replacing the gas in the pipeline with nitrogen and other flame-retardant gases.

h) The emission of pollutants generated by billet cutting, billet flame cleaning and grinding by billet mechanical grinding wheel shall comply with the specific provisions of GB 28664.

i) Operators are prohibited from wearing oily gloves or wearing oily work clothes, work hats and work shoes to contact oxygen and gas equipment.

j) It is forbidden for workers to rest near dangerous sources such as oxygen, gas, steam, high-pressure containers and their pipelines; it is forbidden for unrelated personnel to stay near dangerous sources.

k) It is strictly forbidden to use flammable materials such as gasoline and kerosene to clean equipment in the hydraulic room.

l) When inspecting and repairing pressure pipelines, flammable and explosive gas, liquid transmission pipelines and nearby equipment, strictly implement the relevant safety regulations in the equipment manual; formulate specific fire prevention and explosion prevention safety measures. If hot work is required, it shall be completed in accordance with the hot work grading and basic requirements specified in Chapter 5 of GB 30871-2022.

m) When equipment and pipelines are frozen, it is strictly forbidden to bake them

5.1.10 Right of access

5.1.10.1 Conditions of access

It is strictly forbidden to enter dangerous areas and dangerous parts without authorization. Physical barriers specified in GB/T 8196-2018 are used to isolate dangerous areas and dangerous parts. When accessing, the safety conditions for approaching mechanical fixed facilities are as follows:

a) The positioning of safety protection devices related to the approach speed of human parts is shown in GB/T 19876;

b) The selection and approach of fixed facilities is shown in GB/T 17888.1;

c) Working platforms and passages are shown in GB/T 17888.2;

d) Stairs, steps, guardrails are shown in GB/T 17888.3;

e) Fixed vertical ladders are shown in GB/T 17888.4.

The exceptions are as follows:

1) Casting platform area: See 5.2.3.1a) for other safety measures;

2) Flame cutting area: See 5.2.5.2 for other safety measures;

3) Non-safe passages in the run-out-area are prohibited for personnel to pass through, see 5.2.6.

These passages shall be protected from heat radiation and high-pressure liquid or gas spray; have the conditions and functions for moving materials and tools.

5.1.10.2 Warning signs

Warning signs comply with 5.1.9.

5.1.10.3 Avoid squeezing of various parts of the human body

The spacing (see GB/T 12265.3) to avoid squeezing of various parts of the human body (possible contact due to being constrained by a small space) near control consoles, pulpits, underground places, maintenance yards, etc. shall follow the provisions of GB 23821 and meet the conditions listed in 5.1.10.1. Safety requirements for machinery, electrical equipment, control systems are listed in GB/T 5226.1-2019, GB/T 16855.1-2018, GB/T 16855.2, GB/T 19876.

5.1.10.4 Railings

Railings shall not be used as the sole measure to protect hazardous areas, except to

prevent slips, trips, falls. Railings may be used in conjunction with other means (such as warning signs) to exclude unauthorized persons from hazardous areas.

5.1.10.5 Anti-slip

The surfaces of walkways, stairs, platforms shall be anti-slip and protected, to avoid or minimize slips or falls caused by scale, oil, emulsions, lubricants.

5.1.10.6 Protective devices

The type of protective devices (fixed or movable protective devices, adjustable protective devices, interlocking protective devices, etc.) used to prevent entry into hazardous areas shall be selected, according to the permitted degree of entry in accordance with Chapter 6 of GB/T 8196-2018. The protective devices specified in Table 1 shall be selected according to the actual situation.

For the design and manufacture of protective devices, refer to the provisions of Chapter 5 of GB/T 8196-2018.

5.1.10.7 Entering the equipment during equipment operation or maintenance

The relevant safety systems required for entering the equipment during equipment operation or maintenance selected according to A.2 shall comply with the relevant requirements of GB/T 16754-2021, GB/T 18831, GB/T 19670-2005.

5.1.11 Escape route

The escape route shall meet the following requirements at a minimum:

a) It shall have two emergency exits; the distance between the two emergency exits shall be as far as possible;

b) It shall have an outward opening door;

c) It shall have an escape sign; the sign shall indicate the escape route under any conditions;

d) It shall be free of obstacles;

e) The floor (slab) shall not be slippery;

f) Guardrails shall be installed in some places; handrails shall be installed where there are steps.

5.1.12 Automation equipment

Automation equipment shall comply with the provisions of GB 7247.1 and GB 28526. It shall be designed with reference to GB/T 5226.1-2019, GB/T 15706, GB/T 16855.1,

for use;

b) When lifting heavy parts with eyebolts or similar auxiliary devices, handles, handrails or grips with non-slip surfaces (such as knurled surfaces) shall also be provided;

c) There shall be no obstacles in the work area where objects are manually moved, to ensure that the operator will not be hindered when working. The working area shall be spacious, so that the operator can carry items close to the body;

d) Use non-slip surface, see 5.1.10.5;

e) Ventilation and air conditioning vibration protection shall comply with the relevant provisions of GB 50019-2015;

f) Heat insulation is as shown in 5.1.14, which shall comply with the relevant provisions of GB 50019-2015;

g) The line nodes, fluid power nodes, connections between electrical equipment shall be as high as possible 400 mm ~ 2000 mm above the plane where the personnel stand, so that the equipment installation, operation, inspection, maintenance can be carried out safely;

h) For the lighting of the working area, refer to GB/T 28780, which shall complies with the provisions of Table 5.4.1 "7 Iron and steel industry, steelmaking and continuous casting" of GB 50034-2013. For the design of human-computer interaction environment, refer to GB/T 14776, GB/T 15241.2, GB/T 16251, GB/T 18717.1, GB/T 18717.2, GB/T 18717.3, GB/T 22188.1 on human ergonomics, to optimize the operation and maintenance environment of the continuous casting machine and effectively protect human health.

5.1.16 Fire protection

Equip fire alarm devices and establish fire protection systems in specific rooms such as the main pulpit, hydraulic station, electrical room of the continuous casting machine, or in the exposed areas in the workshop and the tunnels (corridors) of hydraulic equipment. Fire protection follows the following rules:

a) Fire protection of continuous casting machine shall comply with GB 50414;

b) In continuous casting machine equipment, if a gas fire extinguishing system is used, its design shall comply with GB 50370. Use heptafluoropropane (HFC227ea) fire extinguishing agent, as shown in GB 18614; gas fire extinguishing system and components shall comply with GB 25972;

c) The design of automatic sprinkler fire extinguishing system shall comply with GB 50084;

d) Fire water supply and fire hydrant system shall comply with GB 50974;

e) Hydraulic system exposed to molten steel shall be equipped with separate fire alarm and firefighting system (such as protective shield, small storage tank, flame-retardant fluid, etc.), or take other measures to reduce fire risk;

f) In case of fire, in addition to cutting off gas and oil sources, the power supply shall be cut off for fire extinguishing.

5.1.17 Continuous casting machine operating position

5.1.17.1 Overview

The setting of the operating position shall comply with the following provisions.

a) The setting of the operator's operating position shall be close to the frequently operated control device, to ensure the operator's comfortable operation. For control devices used occasionally, they shall be placed within the reach of the operator, see GB/T 21935.

b) The visual display is arranged to ensure that it is non-reflective and clearly visible.

c) Ensure that the operator can directly see the operation process from his position. If it is not possible to see all the operation process areas, visual aids such as industrial televisions, reflectors, etc. shall be provided.

5.1.17.2 Pulpit

When designing the pulpit, refer to GB/T 22188.1. The pulpit shall have:

a) Automatic control air conditioning system;

b) Heat insulation function;

c) Sound insulation function (see 5.4);

d) If necessary, install heat reflective windows;

e) If necessary, configure special color glass areas to protect the operator's eyes from radiation injury;

f) Not affected by external factors such as slag and molten steel splashing.

5.1.17.3 Local control stand

The local control stand shall be protected to avoid external factors such as slag and molten steel splashing.

5.1.17.4 Human cooling fan

The cooling water system shall comply with the following requirements.

a) The operation of the cooling water system of the continuous casting machine shall comply with GB 13456, 13.5 of AQ 2001-2018, Chapter 8 of GB 50580-2010, with reference to GB/T 50050.

b) The cooling water system shall be equipped with monitoring functions and fault alarms. Once any fault occurs during the production process of the continuous casting machine, an alarm shall be issued through the alarm system (see 5.1.9).

c) An emergency cooling water system independent of the main water supply system shall be established, to supply cooling water through gravity (accident water tower) or emergency power supply (including diesel/gasoline engine). The emergency cooling water supply volume and supply time shall be sufficient, to avoid personnel and related equipment from falling into dangerous conditions.

d) When a crystallizer leaks or a low flow (including no flow) alarm is issued by the pipeline, the continuous casting machine shall stop operating immediately, to avoid burning the crystallizer or even causing an explosion.

e) The return water flow and temperature difference of the equipment cooling water shall be mastered in a timely manner, to avoid insufficient cooling water, causing the radiant heat of the high-temperature ingot burning the bearings and equipment.

f) Check the blockage of the secondary cooling nozzle regularly and replace it in time if it is found to be blocked, so as not to affect the cooling effect and cooling uniformity, which may cause cracks in the casting and even cause steel leakage accidents.

g) Necessary safety response measures shall be taken for sudden water outages and other dangerous signs.

h) In the equipment manual, special instructions shall be given for the measures to be taken in case of emergency in the cooling water system.

5.1.22 Radioactive source

When using radioactive sources to control the liquid level of the crystallizer, refer to GB/T 19661.1 and GB/T 19661.2. Pay special attention to the following matters:

a) Use radioactive sources with low radiation intensity;

b) The installation and replacement of radioactive sources can only be carried out in a safe location;

c) Radioactive sources shall be stored in special containers and rooms; special radiation protection measures shall be taken;

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