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Mine Blast-Hole Drills – Safety Requirements

矿用炮孔钻机 安全要求

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Mine Blast-Hole Drills – Safety Requirements

1 Scope

This Standard is a restriction on mining blast-hole drills in terms of physical performance and intended use. The safety requirements specified in this Standard apply to the dangers generated at all stages of the machine's life cycle.

This Standard applies to rock drills, wire rope impact drills, down-the-hole drills, rotary drills and rotary drilling rig (hereinafter referred to as drills) used for drilling blast-holes in open-pit and underground mines and tunnels.

2 Normative References

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB 2894 Safety signs (GB 2894-1996, neq ISO 3864)

GB/T 3766 Hydraulic Fluid Power - General Rules Relating to Systems (GB/T 3766-2001, eqv ISO 4413:1998)

GB 3836.1 Electrical apparatus for explosive gas atmospheres - Part 1: General requirements (GB 3836.1-2000, eqv IEC 60079-0:1998)

GB 3836.2 Electrical apparatus for explosive gas atmospheres - Part 2: Flameproof enclosure “d” (GB 3836.2-2000, eqv IEC 60079-1:1990)

GB 3836.3 Electrical apparatus for explosive gas atmospheres - Part 3: Increased safety “e” (GB 3836.3-2000, eqv IEC 60079-7:1990)

GB 3836.4 Electrical apparatus for explosive gas atmospheres - Part 4: Intrinsic safety “i” (GB 3836.4-2000, eqv IEC 60079-11:1999)

GB 3836.5 Electrical apparatus for explosive gas atmosphere - Part 5: Pressurized enclosures “p” (GB 3836.5-2004, IEC 60079-2:2001, MOD)

reconnection will endanger people around, they shall be able to lock.

After the drill cuts off the energy, it shall be able to safely release the energy left or stored in the circuit so that people around it are not in danger. Some circuits can remain connected to the energy in order to clamp workpieces, save information, and internal lighting. In this case, special measures shall be taken to protect the safety of the operator.

5.2 Safety requirements for operating positions

5.2.1 The operation of the drill shall be carried out in a state where the surrounding environment is not dangerous to personnel. The position and standing space required by the operator shall meet the requirements of GB/T 8420 and JB/T 3683.

5.2.2 For drill used for underground or tunnel operations, protective measures shall be taken as needed to prevent the danger caused by splashing objects.

5.2.3 The driving and operating positions of the drill shall have good visibility to ensure that there is no danger to personnel.

5.2.4 The drill can be equipped with an operator's cab as needed. The operator's cab shall meet the following requirements:

- a) The operator's cab shall be equipped with air conditioning or safe heating and cooling devices according to the working conditions to ensure that the temperature in the operator's cab is within the range of 15°C~31°C;
- b) An air purification device shall be equipped; and the dust concentration in the air in the operator's cab shall meet the requirements of 5.13.1 in this Standard;
- c) When the drill is operating with the doors and windows closed and the air conditioning and purification devices turned on, the noise in the operator's cab shall not exceed 85dB (A), and the noise shall be tested in accordance with the provisions of GB/T 13325;
- d) Necessary vibration reduction measures shall be taken, and the weighted root mean square acceleration correction value at the seat cushion shall not exceed 1.25m/s². The vibration test shall be carried out in accordance with the method of GB/T 8419;
- e) The direction of the door opening shall enable the operator to quickly leave the operator's cab in case of danger;
- f) The decorative materials in the operator's cab shall meet the fire protection requirements of 5.12.1 in this Standard;
- g) The illumination in the operator's cab shall meet the requirements of 5.11.3 in this Standard;
- h) The glass between the operator's cab and the machine room shall be vibration-resistant

and shall not injure the operator after breaking.

5.3 Control system

5.3.1 The safety part of the drill control system shall meet the requirements of GB/T 16855.1.

5.3.2 The main transmission system of the drill shall be manually started through the starting device. If the drill has multiple devices for starting, these devices shall be linked to each other so that one of them can be used to complete the start.

For pneumatically driven drill, a shut-off valve shall be set on the main circuit to connect or disconnect the power unit and the main machine, and to release the system pressure.

5.3.3 The drill shall have a normal shutdown command device to enable it to stop safely during operation. The drill shall be equipped with a total stop switch; and each operating position for operation and driving shall have an emergency stop device to prevent dangers caused by emergencies.

5.3.4 The interruption of power supply or the re-supply after interruption shall not lead to the occurrence of danger and shall meet the following requirements:

- a) The drill can only be restarted by human command;
- b) If the shutdown command has been issued, the drill must be shut down;
- c) Equipment parts or tools are not allowed to fall or pop out;
- d) Protective devices and protective measures shall be ensured effective.

Power supply failure or hydraulic and pneumatic pressure deviation from the set value is not allowed to cause dangerous actions and emergency shutdown system failure.

5.3.5 Failure of the control circuit or logical failure of the control circuit is not allowed to cause danger.

5.4 Control device

5.4.1 The operation of the control device shall be safe, flexible and comfortable; and its design configuration and marking shall meet the requirements of GB/T 15706.2.

The main control device shall be arranged in the comfortable area of operation, and the auxiliary control device can be arranged in the reach of operation or other positions outside the danger zone.

If the drill has multiple operating positions, a selection switch shall be configured so that the operator can purposefully select a favorable operating position.

5.4.2 The drill shall have corresponding emergency stop and safety devices; and the emergency

5.6.5 When the drill is operating, traveling and stopping on a slope exceeding the maximum allowable slope, a traction winch shall be equipped to prevent the drill from slipping on the slope.

5.7 Protection of moving parts

5.7.1 The design, manufacture and installation of the moving parts of the drill shall avoid the dangers described in GB/T 15706.1; and shall minimize the number of manual operations in the danger zone.

5.7.2 For rotating transmission parts within the reach of personnel, such as drive shafts, couplings and V-belts, protective devices shall be provided.

Transmission parts that are not frequently approached shall be equipped with fixed protective devices. The protective devices shall be placed in their positions by spot welding or fixed installation so that they can only be opened or removed with auxiliary tools such as wrenches.

When frequent repairs or maintenance are required, movable protective devices shall be installed. Movable protective devices shall meet the following requirements:

--- When they are opened, they shall be fixed to the machine as much as possible;

--- Where they are opened, a supporting mechanism shall be equipped.

Protective devices shall meet the requirements of GB/T 15706.2 and GB/T 8196.

5.7.3 If the operator works in a danger zone close to moving parts, special attention shall be paid to the dangers of connecting and disconnecting drill pipes, breaking of the connecting threads of the drill bit group, and installation, disassembly and replacement of drill bits.

5.7.4 If the weight of a single drill pipe exceeds 25 kg, the drill shall have a mechanical connection and disconnection mechanism for the drill pipe or an auxiliary hoist.

5.7.5 The pressure mechanism of the drill with a push slide (except for those driven by oil or air cylinder) must be equipped with upper and lower limit limiting devices.

5.7.6 When the drill operates in the danger zone between the carrying equipment and the working surface of the tunnel, a warning sign shall be set in front of the drill.

5.7.7 If an assistant is required to work in the danger zone during the operation of the drill, it can only be carried out when the requirements of 6.4.5 of this Standard are complied with.

5.8 Electrical equipment

5.8.1 The electrical equipment of the drill shall have a set of grounding protection devices. The electrical equipment shall meet the relevant requirements of GB 5226.1; the drill used for underground explosion-proof requirements shall have explosion-proof functions, and its

electrical equipment shall meet the requirements of GB 3836.1 ~ 3836.9.

5.8.2 For drill with their own transformers, protective railings shall be set around the transformer or the transformer shall be placed in an isolation room; and corresponding safety signs should be set; the safety signs shall meet the requirements of GB 2894.

Drill with their own transformers shall be equipped with cable reels as much as possible. Drill without cable reels shall be equipped with high-voltage cable introduction devices to prevent the joints from falling off. Reliable protection measures shall be taken for manually dragging cables.

5.8.3 The battery shall be firmly installed in the designated position; and the electrolyte shall not be allowed to splash onto people or surrounding equipment. The electrodes shall have protective shields; and the circuit shall be equipped with insulating switches. Protective shields shall be installed around the battery to prevent the operator from being burned by electrolyte or steam when the drill overturns.

5.8.4 The ladder for climbing onto the drill from the ground shall be laid with insulating materials such as rubber or plastic to prevent injury to personnel due to leakage.

5.9 Hydraulic system

The hydraulic system shall comply with the relevant safety provisions in GB/T 15706.2 and GB/T 3766. The system pressure shall not exceed the maximum allowable pressure of the pipeline, and the pressure drop and liquid leakage shall not cause danger. The system shall be equipped with temperature and pressure monitoring devices to sound an alarm when the temperature or pressure exceeds the permitted range.

The hydraulic oil should be non-toxic.

Hydraulic hoses shall be prefabricated. Hydraulic hoses shall be isolated from electrical wires and away from hot surfaces and sharp edges. Moving hydraulic hoses shall be equipped with guide devices.

Hydraulic oil tanks shall have level indicators; and the full oil tank shall not overflow when the drill is operating and traveling on an inclined surface.

5.10 Pneumatic device

Pneumatic devices shall meet the relevant safety requirements in GB/T 15706.2 and GB/T 7932. The system pressure shall not exceed the maximum allowable pressure of the pipeline, and the pressure drop and gas leakage shall not cause danger. The pneumatic system shall be equipped with a pressure monitoring device to sound an alarm when the pressure exceeds the permitted range.

Pneumatic hoses shall have necessary guide devices, and measures shall be taken to prevent the

- Moving wire rope under exceptional operating case is 2.0;
- Wire rope for installation, traction and hanging is 2.5;
- Wire rope for impact drilling is 5.0 (ratio of minimum breaking load of wire rope to weight of drill bit group);
- Wire rope for feed is 3.0.

Diameter:

- Winch drum diameter $\geq 16.0d$;
- Pulley diameter $\geq 18.0d$;
- Auxiliary pulley diameter $\geq 14.0d$;
- Feed system pulley diameter $\geq 12.5d$.

NOTE: d is the wire rope diameter.

All pulley blocks shall be equipped with devices to prevent wire rope loosening. The wire rope shall be wound at least 3 times on the winch drum, and the U-shaped clamp is not allowed to be used between the end of the wire rope and the drum.

The maximum tension of the innermost wire rope of the winch shall be marked on the winch sign.

The winch shall be equipped with a working brake system and a safety brake system.

5.15 Sprocket and chain

The safety factor (minimum breaking force/maximum load) of the sprocket and chain in the drill propulsion system shall be no less than 3.5, and there shall be a set of appropriate and safe tensioning devices.

5.16 Drilling rig, drill pipe and working platform

5.16.1 The lifting and lowering mechanism of the drilling rig and the drill pipe shall be equipped with a safety device, which can automatically prevent the drilling rig and the drill pipe from falling down in the event of an accidental failure of the lifting and lowering mechanism. The lifting and lowering of the drilling rig and the main working state of the drill shall be within the operator's field of vision.

5.16.2 There shall be appropriate stairs or steps at the entrance of the working platform, and there shall be guardrails around it. The high drilling rig shall be equipped with a ladder, and there shall be guardrails around the ladder and on the top of the drilling rig.

5.16.3 The working platform of the drill and the passageway accessing to the working platform shall comply with the provisions of GB 17888.2; and the equipped stairs, steps and guardrails shall comply with the provisions of GB 17888.3.

5.17 Special requirements for remote control (including remote) drill

5.17.1 The drill shall be equipped with an additional controller to operate the drill.

The start and stop of the drill are only allowed to be controlled by the operating device on the drill or at an operating position. This operating position shall be able to clearly monitor the working area. If this operating position cannot directly monitor the working area, it can be monitored by a monitoring system such as a TV screen.

The drill shall be equipped with a visual or audible warning device, which automatically intervenes in the work before the drill is started and displays the working status of the drill working in the remote-control state.

5.17.2 The remote-control position of the drill shall be equipped with an emergency stop device, and the auxiliary emergency stop device shall be installed on the drill and can be safely and conveniently reached from outside the drill.

5.17.3 The design of the control system shall meet the following requirements:

- If the contact between the operator and the drill is interrupted or the initial command sequence is completed, the control circuit shall be able to automatically stop the drill;
- The control system of the unmanned automatic control drill shall be equipped with a complete diagnostic system, which shall be able to stop the drill if an error state or abnormal operation is found;
- After an error occurs in a part of the system, restarting through automatic functions is not allowed. The operator is only allowed to start the recovery operation through manual startup;
- The drill shall be equipped with a selection switch to switch between on-site control and remote control. On-site control shall take precedence over remote control.

5.17.4 Remote control drill for underground operations shall be equipped with an automatically activated onboard fire extinguishing device that can extinguish fires in diesel engines and electrical systems.

The fire extinguishing system shall be able to be triggered from the control panel or monitoring position.

5.18 Warning device

The warning device that sends out signals shall be able to send out warning signals conveniently

- Explanation of use markings;
- General drawing of components and the whole machine;
- Required symbols, schematic diagrams, and example illustrations, which shall be of sufficient size to clearly indicate the model, function, location of the main components and their relationship with the entire drill;
- Load/speed diagram of winch and lifting mechanism;
- Maximum ground pressure ratio under certain working conditions;
- Special warning before the occurrence of behavior that can cause injury to the operator or other personnel;
- Treatment of engine exhaust gas for drill working under specific conditions;
- Description of restricted areas. For remote-controlled (including remote) drill, the restricted areas shall be marked;
- Description of safety areas of remote-controlled drill (including remote), such as the safe distance between the operator and the drill;
- Description of possible dangers that may be ignored in the protection system;
- Safety measures for various components and auxiliary mechanisms during the transportation, installation and disassembly of the drill
- Installation and use of fire extinguishers;
- Ambient temperature for the use of the drill;
- Noise in the operator's cab and detection methods;
- Vibration in the operator's cab and detection methods.

6.4.3 Special safety instructions in the operating instructions.

The following safety requirements shall be stated in a separate paragraph in the operating instructions:

- The operator must clearly know where the danger is and what measures he shall take to safely resolve it during work;
- Diagrams showing danger zones during the movement and operation of the drill;
- Instructions on safely replacing the drill pipe with the help of auxiliary mechanisms;

- Instructions on the installation and function of the emergency stop device and protective device;
- The operator must undergo practical training, especially the key points of the safety measures mentioned above;
- Drill with a blast-hole diameter of no less than 250mm shall be equipped with at least two operators;
- Instructions on monitoring the surrounding environment when the drill operates in a space subject to certain restrictions;
- Instructions on the installation and disassembly of the structural components of the drill;
- Instructions on flood control measures for working at the bottom of an open pit;
- Instructions on deicing at temperatures below 0°C.

6.4.4 In addition to the contents in the operating instructions, the maintenance instructions shall also include the following contents:

- The name and contact address of the entrusted repair and maintenance company;
- Diagrams indicating daily, weekly or other maintenance intervals;
- Detailed classification of working fluids for hydraulic transmission devices;
- Maintenance instructions for fire extinguishers;
- Installation instructions for heavy parts and parts that are difficult to operate manually;
- Instructions for fault diagnosis/detection devices measuring points or installation locations, which shall be clearly indicated by the application diagram;
- Symbols/functional diagrams for electrical, hydraulic and pneumatic components, which shall be of sufficient size to clearly show the model, function, installation location and relationship of the main components to the overall drill;
- Instructions for examination and replacement of wearing parts;
- Maintenance/detection instructions for wire ropes, winches, pulleys, sprockets and chains;
- Warnings for actions that may cause injury to maintenance or other personnel.

6.4.5 Special safety instructions in the maintenance instructions.

If the operator needs to perform maintenance work while the drill is operating or in a danger zone, it must be carried out under the following conditions:

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