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NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA

ICS 29.260.20

CCS K 35

GB/T 3836.15-2024

Replacing GB/T 3836.15-2017

**Explosive atmospheres - Part 15: Specification of electrical
installations design, selection and erection**

爆炸性环境 第 15 部分：电气装置涉及、选型、安装规范

Issued on: July 24, 2024

Implemented on: August 01, 2025

**Issued by: State Administration for Market Regulation;
National Standardization Administration.**

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Explosive atmospheres - Part 15: Specification of electrical installations design, selection and erection

1 Scope

This document specifies specific requirements for the design, selection, installation, initial inspection of electrical installations in or related to explosive atmospheres.

This document applies to fixed, portable, mobile, individual electrical equipment.

This document does not apply to:

- Coal mines (the design, selection, installation of electrical equipment in coal mines can refer to this document);

Note 1: For specific requirements, see the Coal Mine Safety Regulations.

- Dust environments formed by inherently explosive substances and explosives or self-igniting substances (such as the manufacture and processing of explosives);
- Medical rooms.

Note 2: Appendix A provides additional guidance on the hazards of dust or flying catkins mixed with flammable gases or vapors.

2 Normative references

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

GB/T 3836.1 Explosive atmospheres - Part 1: Equipment - General requirements

GB 3836.16 Explosive atmospheres - Part 16: Specification of electrical installations inspection and maintenance

3 Terms and definitions

The terms and definitions defined in GB/T 3836.1, as well as the following terms and definitions, apply to this document.

b) Equipment:

- Explosion-proof certificate documents;
- Manufacturer's instructions;

Note: The instructions are confirmed by the explosion-proof inspection agency.

- Equipment installation drawings and control schematics;
- System description documents of intrinsically safe electrical systems (see 7.3.1.4.2).

c) Installation:

- Relevant documents to ensure the correct installation of equipment, such as installation plans or operating instructions;
- Wiring system plan;
- Drawings and table documents related to circuit identification;
- Initial inspection records (checklist according to Appendix B).

4.3 Equipment qualification guarantee

4.3.1 Equipment with explosion-proof certificate

Equipment installed in explosive atmospheres shall have a valid explosion-proof certificate and meet the use requirements of corresponding hazardous areas.

4.3.2 Use of repaired, second-hand or spare equipment

When installing repaired, second-hand or spare equipment, at least the following conditions shall be met:

- It can be verified that the equipment has not been modified and is in the condition specified in the original certificate (including any repairs or overhauls);

Note: For example, the judgment is made by professionals or competent body through verification of relevant documents and specific status of the equipment.

- The standards based on which this product is certified do not conflict with the requirements given in this document.

4.3.3 Equipment without explosion-proof certificate

Equipment without explosion-proof certificate shall not be used in hazardous areas.

Note: Except for simple devices that are specified to be allowed in intrinsically safe circuits.

4.4 Personnel competence and qualifications

4.4.1 General

The design, selection, installation of electrical installations covered by this document shall only be carried out by professionally trained personnel whose knowledge, skills, qualifications shall comply with the provisions of this clause and shall be appropriate to the type of work performed.

Personnel shall receive appropriate training and continuing education on a regular basis.

4.4.2 Knowledge and skills

4.4.2.1 Person in charge

The “Person in charge” is responsible for the processes involved in the design, selection, installation of explosion-proof equipment and shall have at least the following conditions:

- a) General understanding of the relevant electrical engineering;
- b) Understanding and having the ability to read and evaluate engineering drawings;
- c) Practical understanding of explosion-proof principles and techniques;
- d) Knowledge of operations and understanding of relevant standards in the field of explosion-proof;
- e) Basic knowledge of quality assurance, including audit principles, documentation, measurement, traceability of instrument calibration.

Such personnel shall be limited to the management of qualified operators engaged in selection and installation. When such personnel also possess the capabilities required by 4.4.2.3, they can directly engage in explosion-proof selection and installation work.

Note: The person in charge in this document refers to the senior leaders of the enterprise/organization, who are in charge of design, selection, installation.

4.4.2.2 Designers (design and selection)

Designers shall meet the following conditions to complete their work tasks:

- a) Proficient in the knowledge of the basic principles of explosion-proof;
- b) Proficient in the knowledge of the basic principles and signs of explosion-proof types;

be clarified.

Note: Someone may only be competent for the design, selection, installation of Ex "i" equipment, but not fully competent for the design, selection, installation of Ex "d" equipment or Ex "e" equipment.

4.4.3.2 Person in charge

The person in charge shall be able to provide proof of competence to prove that he/she has met the knowledge and skills requirements specified in 4.4.2.1 related to the explosion-proof type and/or the type of equipment involved.

4.4.3.3 Designers

The designer shall be able to provide proof of competence, to prove that he/she has met the knowledge and skills requirements specified in 4.4.2.2 related to the explosion-proof type and/or the type of equipment involved. At the same time, documents shall be provided to prove that he/she is capable of doing the following:

- a) Drafting the documents specified in 4.2;
- b) Drafting the designer's certificate provided to the user in accordance with 4.2;
- c) Preparing and drafting the practical experience necessary for the relevant explosion-proof type and system-related design details;
- d) Updating and drafting the installation records specified in 4.2.

4.4.3.4 Operators/technicians

The operator/technician shall be able to provide proof of competence, to prove that he/she has met the knowledge and skills requirements specified in 4.4.2.3 related to the explosion-proof type and/or the type of equipment involved. At the same time, documents shall be provided to prove the ability to perform the following tasks:

- a) Use the documents specified in 4.2;
- b) Draft reports provided to users in accordance with 4.2, such as inspection reports;
- c) Prepare and install the practical experience required for the relevant explosion-proof type;
- d) Use and draft the installation records specified in 4.2.

4.4.4 Assessment

The ability of the person in charge, operator, designer shall be assessed according to the time period required by the standard or the user, to fully prove that they have the

following conditions:

- a) Possess the necessary skills required by the scope of work;
- b) Be able to play a role within the specified scope of work;
- c) Have the ability to consolidate relevant knowledge and understanding.

5 Design and selection of electrical equipment

5.1 Document requirements

In order to select electrical equipment suitable for hazardous areas, the following documents are required:

- Classification of hazardous areas, including requirements for equipment protection level;
- Classification of gases, vapors or dusts related to the category and further classification of electrical equipment;
- Temperature group or ignition temperature of the gas or vapor involved;
- Dust characteristics involved, including resistivity, minimum ignition temperature of dust cloud, minimum ignition temperature of dust layer, minimum ignition energy of dust cloud;
- Intended use of the equipment;
- External influences and ambient temperature.

Note: If necessary, record the requirements for equipment protection level (EPL) on the location zoning map.

5.2 Design and selection based on EPL

5.2.1 General

When new devices or equipment are used, the compliance of the equipment shall be verified in accordance with 4.3. The EPL in the area classification document shall follow the relationship between EPL and area in Table 1.

5.6.2.2 Power supply and accessory connection, grounding

The power supply and accessory connection, grounding shall comply with the relevant design and installation documents.

5.6.2.3 Motors powered by frequency converters

For motors powered by frequency converters that adjust frequency and voltage, the appropriate dedicated frequency converters, similar frequency converters or protective devices shall be selected and installed, in accordance with the requirements of the instruction manual and certification.

Note 1: The filter at the output end of the frequency converter may cause the voltage at the motor terminals to drop. The voltage drop causes the motor current to increase, resulting in slip, which in turn causes the stator and rotor temperature of the motor to rise. This temperature rise is very obvious under constant rated load conditions.

Note 2: For other information on the use of motors powered by variable frequency power supplies, see GB/T 21209. The main precautions include voltage and current spectra and their additional losses, overvoltage effects, bearing currents and high-frequency grounding.

5.6.2.4 Motors powered by reduced voltage starting (soft starting)

For motors powered by reduced voltage starting (soft starting), the soft starting device and/or protective device shall be selected and installed in accordance with the requirements of the instruction manual.

5.6.2.5 Motors above 1 kV

When using vacuum circuit breakers or vacuum contactors, for high voltage motors with an initial starting current $I_A > 600$ A, surge suppressors shall be installed between the circuit breaker and the motor cable terminals in the switchgear.

When commissioning high voltage motors/switchgear of 3 kV ~ 13.8 kV, take precautions to avoid shutting down the motor during the starting process, for example, to check whether the starting control is wrong or the protection settings are too sensitive. During the starting process, stops for checking the direction of rotation or other tests shall be kept to an absolute minimum.

The values in Appendix C shall be used to select increased safety motors with rated voltages above 1 kV. For increased safety motors above 1 kV with anti-condensation space heaters, if the sum of the stator risk factors is greater than 6, special measures shall be taken to ensure that there is no explosive gas atmosphere in the enclosure during starting.

Note 1: Special measures may include ventilation before starting, fixed gas detectors in the motor, or other methods specified in the manufacturer's instructions.

Note 2: When the explosion-proof certificate number contains the symbol "X", special conditions of use of the motor need to be considered.

5.6.3 Lamps

The type or rating of the lamp shall be selected according to the required temperature group. "e" type lamps with fluorescent lamps and electronic ballasts shall not be used in places requiring temperature group T5 or T6, or places where the ambient temperature is greater than 60 °C.

Low-pressure sodium lamps shall not be used, stored or transported in hazardous areas.

For lamps with pins, the pins shall be made of brass.

5.6.4 Plug and socket terminals

Plug and socket terminals shall not be installed in places requiring EPL Ga and Da.

In places requiring EPLDB and Dc, the installation of the socket terminals shall not allow dust to enter the socket regardless of whether the plug is installed in the socket. The installation angle of the socket terminals shall not exceed 60° from the vertical line, meanwhile the opening shall be downward.

When using connectors in hazardous areas with explosive dust atmospheres, care shall be taken to ensure that dust does not enter the connector when disconnected.

5.6.5 Batteries and battery packs

Batteries and battery packs shall only be charged in non-hazardous areas, unless charging in hazardous areas is permitted in the certificate and manufacturer's instructions.

Note: This includes charging of batteries in Ex "d" enclosures.

Before returning the equipment to a hazardous area, ensure that:

- The temperature is below the marked temperature group;
- There is no gas generated during charging in the container.

If there are openings on the enclosure required for battery venting, ensure that the openings are not affected by the installation.

5.6.6 Electric heating system

The electric heater shall have an explosion-proof certificate for the entire machine. Electric heating elements with only Ex component explosion-proof certificates shall not be used alone, but shall be used together with the electric heater after obtaining an

TN systems in explosive atmospheres shall use TN-S type.

6.1.3.3 Grounding of TT type systems

TT type power supply systems in explosive atmospheres shall use residual current operated protective devices.

6.1.3.4 Grounding of IT type systems

IT type power supply systems in explosive atmospheres shall be equipped with insulation monitoring devices.

6.1.3.5 SELV and PELV systems

Live parts of safety extra low voltage (SELV) system circuits shall not be connected to the ground or to live parts or protective conductors forming part of other circuits.

For grounding of protective extra low voltage (PELV) system circuits, any exposed conductive parts shall be connected to a common grounding (and potential equalization) system.

Note: SELV and PELV requirements are shown in GB/T 16895.21. Safety isolation transformers for SELV and PELV are shown in GB/T 19212.7.

6.1.3.6 Non-explosion-proof electrical equipment above hazardous areas

When non-explosion-proof equipment and connecting circuits that may become ignition sources or may generate hot particles or hot surfaces are located above hazardous areas, they shall be fully enclosed or equipped with appropriate protective covers or protective nets, to prevent equipment or hot particles from falling into hazardous areas.

6.1.4 Equipotential bonding

6.1.4.1 General

Electrical installations in hazardous areas require potential equalization. For TN, TT, IT systems, all exposed external conductive parts shall be connected to the equipotential bonding system. The equipotential bonding system may include protective wires, metal conduits, metal cable sheaths, steel wire armor and metal parts of the structure, but shall not include neutral wires. The connection shall be firm to prevent self-loosening; corrosion shall be reduced to prevent reducing the effectiveness of the connection.

6.1.4.2 Temporary equipotential bonding

Mobile equipment shall be temporarily equipotentially bonded.

The final connection of the temporary equipotential bonding shall meet at least one of

the following conditions:

- a) It is located in a non-hazardous area;
- b) It uses a connection that meets the EPL requirements of the area;
- c) Measures are taken to reduce the spark hazard to an acceptable level.

The resistance between the metal parts of the temporary equipotential bonding shall be less than 1 M Ω . The conductors and connectors shall be durable, flexible, have mechanical strength sufficient for mobile applications.

The mechanical strength of the bonding conductor shall be at least equivalent to 4 mm² of copper.

6.1.5 Static electricity

6.1.5.1 General

External non-metallic materials, which are used for structural or protective purposes and not part of explosion-proof electrical equipment (such as plastic-coated cable trays, plastic mounting plates, plastic guards and enclosures), shall be anti-static.

Note 1: Non-metallic coatings, films, foils, plates attached to the outer surface of the enclosure have the ability to store electrostatic charges.

Note 2: Glass and ceramic surfaces are generally considered to be less likely to store electrostatic charges.

6.1.5.2 Avoid accumulation of electrostatic charge on structures and protective parts in places requiring EPL Ga, Gb, Gc levels

Structures and protective parts shall be designed to avoid ignition hazards caused by electrostatic charge during normal use. This requirement shall be met by one or more of the following measures.

- a) Select materials reasonably so that their surface insulation resistance meets at least one of the following criteria.
 - Not more than 1 G Ω when measured at relative humidity (50 $\pm$ 5)%;
 - Not more than 100 G Ω when measured at relative humidity (30 $\pm$ 5)%.
- b) Limit the surface area of non-metallic parts of the enclosure, see Table 6.

The surface area is defined as follows:

- For thin plate materials, the area shall be the exposed (chargeable) area;

6.1.6 Cathodic protection of metal parts

Metal parts in locations requiring EPL Ga or Da levels shall not be cathodically protected, unless they are specifically designed for this application.

6.2 De-energizing and galvanic isolation

6.2.1 Overview

The requirements of 6.2 do not apply to intrinsically safe circuits.

6.2.2 De-energizing

When de-energizing explosive atmosphere lines, the phase and neutral conductors shall be disconnected simultaneously.

6.2.3 Galvanic isolation

In order to ensure the safety of electrical work, appropriate isolation measures shall be provided for all live conductors, including the neutral conductor.

6.3 Cables and wiring systems

6.3.1 Aluminum conductors

Where aluminum is used as a conductor, the conductor shall be connected in an appropriate manner and, except for the installation of intrinsically safe circuits, the cross-sectional area shall be at least 16 mm².

The connection shall ensure that the additional measures required to connect the aluminum conductors do not reduce the specified creepage distances and electrical clearances.

The minimum creepage distances and electrical clearances can be determined, according to the requirements of the voltage level and/or explosion-proof type.

Measures shall be taken to prevent electrolytic corrosion and/or galvanic corrosion.

6.3.2 Cables

6.3.2.1 General

In hazardous areas, cables with inner or outer sheath tensile strength less than 8.5 N/mm² shall not be used, unless they are laid in conduits.

Note: Solid conductors are not usually used for conductors of wires and cables in hazardous areas (GB/T 3956).

6.3.2.2 Cables for fixed devices

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