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**M421-16**

## **Use of electricity in mines**

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# Preface

This is the fifth edition of CSA M421, *Use of electricity in mines*, one of a series of Standards on mine safety. It supersedes the previous editions, published in 2011, 2000, 1993, and 1985.

The following significant revisions have been made to this edition:

- a) Clauses 4.3.1.3 and 4.3.1.4 on vertical cable installations have been revised to clarify the criteria for vertical cable installations.
- b) New Clause 4.3.3.3 recognizes the use of portable power cable marked TC in cable tray, with references to the *Canadian Electrical Code, Part I*.
- c) New Clause 4.4.2.1 requires that cable couplers operating at voltages exceeding 750 V meet the requirements of CSA C22.2 No. 298.
- d) New Clause 4.5.9 requires the auto-reclosing functions of circuit breakers be turned off by default and are only permitted to be activated after a safety study is performed.
- e) Clause 5.3.1 c) has been revised to recognize connections to a movable switch house or substation by way of an interlocked plug.
- f) Existing Clauses 5.4.3.2.2 and 6.3.2 on flame test rating have been revised to reflect the current CSA C22.2 specifications.
- g) New Clause 5.4.3.2.3 on external portable power cables excludes the requirement of a flame test rating for cables external to the mobile equipment.
- h) New Clause 6.2 on electrical equipment rooms defines general requirements for electrical equipment rooms located underground in mines. This addition resulted in incremental renumbering for the remainder of Clause 6.
- i) Clause 6.3.1 on conductors clarifies requirements for support, design, and cable pulling.
- j) Clauses 6.4.2 and 6.5, dealing with underground transformers and switchgear, introduces the CAN/BNQ 2910-510 requirements for the installation locations relative to explosives.
- k) Clause 6.4.5 on underground transformers introduces new requirements specific to nitrogen and SF6 gas filled transformers.
- l) New Clause 6.8.3 on ground potential rise specifies a maximum value for GPR and transfer of potential at movable or mobile equipment.
- m) Clause 6.10.3.4 on mine hoist protective circuit introduces a “control reliable” requirement, as detailed in CSA Z432, for the manually operable switch (E-stop).
- n) Clause 6.11.5.2 on haulage rails has a new requirement for annual inspection of rail bonds.
- o) Clause 7.2.1 on electrical equipment has been revised to align requirements with the *Canadian Electrical Code, Part I*. As a result of this change, a number of clauses were deleted causing the renumbering of subsequent clauses.
- p) A new informative Annex F on options for equipment control power has been added to clarify application aspects of different methods of control power as they relate to the power system, particularly for fail-safe circuits (e.g., UPS sources, undervoltage vs. shunt tripping methods).
- q) A new informative Annex G on equipment protection levels and methods of explosion protection for underground coal mines has been added to provide guidance when using Group I electrical equipment that is approved for use in underground coal mines under the IEC 60079 series of standards and its associated system of equipment protection levels (EPL).
- r) A new informative Annex H on underground coal mine ac system grounding considerations provides recommendations for system grounding as they relate to Clause 7.10.3.
- s) A new informative Annex I on flame test ratings provides an overview of various flame tests and their relative severity.

This Standard, used in conjunction with the *Canadian Electrical Code, Part I*, establishes minimum safety standards for the installation and maintenance of electrical equipment in mines or other mining applications requiring special consideration beyond the requirements of the *Canadian Electrical Code, Part I*.

This Standard is not intended as a design specification nor as an instruction manual for untrained persons.

In the preparation of this Standard, consideration has been given to the prevention of fire hazards and injury to persons and property, and to proper maintenance and operation. Due regard has been given to recognized codes and standards now in force.

This Standard was prepared by the Technical Committee on Use of Electricity in Mines, under the jurisdiction of the Strategic Steering Committee on Occupational Health and Safety, and has been formally approved by the Technical Committee.

**Notes:**

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- 3) *This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.*
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  - b) *relevant clause, table, and/or figure number;*
  - c) *wording of the proposed change; and*
  - d) *rationale for the change.*

# M421-16

## *Use of electricity in mines*

### 1 Scope

#### 1.1 Purpose

This Standard establishes minimum requirements for electrical work and electrical equipment operating, or intended to operate, at a mine.

**Note:** *Users should be aware that federal, provincial, and territorial legislation can impose additional requirements.*

#### 1.2 Application

This Standard is supplementary to, or amendatory of, the requirements of the *Canadian Electrical Code, Part I*, as adopted by the regulatory authority having jurisdiction.

**Note:** *Adherence to the Canadian Electrical Code, Part I, normally addresses the minimum electrical safety requirements for mining-related fixed buildings, structures, and premises located on the surface, as these are no different from other industrial facilities. Such facilities could include processing plants, camps, offices, and dries. However, specific applications can exist within or on such buildings, structures, or premises that warrant the application of this Standard, e.g., the following equipment operating at voltages exceeding 150 V to ground:*

- a) *mobile equipment fed by portable power cables;*
- b) *movable equipment fed by portable power cables where the ground-fault voltage and ground potential rise (GPR) relative to the surrounding earth or structures is required to be limited to 100 V; and*
- c) *quick-connect couplers that are not mechanically interlocked with a load-break-rated disconnect switch.*

#### 1.3 Application to non-mining structures

This Standard does not apply to tunnels, aqueducts, conduits, or excavations for civil construction purposes. However, where mines incorporate such structures, this Standard applies.

#### 1.4 Structure of this Standard

Clauses 1 to 4 apply to all mines. The remaining clauses apply as follows:

- a) Clause 5 applies to surface mines and quarries;
- b) Clause 6 applies to underground mines; and
- c) Clause 7 applies to underground coal mines.

#### 1.5 Terminology

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the Standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

## 2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

### CSA Group

CAN/CSA-B72-M87 (R2013)

*Installation code for lightning protection systems*

B167-08 (R2015)

*Overhead travelling cranes — Design, inspection, testing, maintenance, and safe operation*

C22.1-15

*Canadian Electrical Code, Part I*

C22.2 No. 0.3-09 (R2014)

*Test methods for electrical wires and cables*

CAN/CSA-C22.2 No. 0.17-00 (R2013)

*Evaluation of properties of polymeric materials*

C22.2 No. 31-14

*Switchgear assemblies*

C22.2 No. 33-M1984 (R2014)

*Construction and test of electric cranes and hoists*

C22.2 No. 40-M1989 (R2014)

*Cutout, junction, and pull boxes*

C22.2 No. 94.1-15

*Enclosures for electrical equipment, non-environmental considerations*

C22.2 No. 94.2-15

*Enclosures for electrical equipment, environmental considerations*

C22.2 No. 96-13

*Portable power cables*

C22.2 No. 96.1-13

*Mine power feeder cables*

C22.2 No. 298-16

*High voltage couplers*

C22.2 No. 2556-15

*Wire and cable test methods*