
**Mining structures — Underground
structures**

Structures minières — Structures souterraines

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 82, *Mining*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Many mining companies, and many of the engineering companies that provide designs for mines, operate globally, therefore this document was developed in response to a desire for a unified global approach to the design of safe and reliable structures used in underground mines. The characteristics of ore bodies, such as their depth and shape, and the geotechnical parameters, vary in different areas so different design approaches have been developed and proven with use over time in different countries. Bringing these approaches together in this document will facilitate improved safety and operational reliability.

There are many reasons, based on mining processes, mining equipment, technical, timing, and cost factors why certain structures can be constructed underground for a particular application rather than on surface, and these are carefully assessed at feasibility stage of any mining project. While this document is not meant to provide comments or recommendations regarding the advantages and disadvantages of using any type of structure underground, it covers specific design aspects that need be considered when using structures in underground mines. It is thus primarily intended to provide the technical information necessary to ensure good engineering of structures where their construction and use underground is the chosen solution.

The majority of the material in this document deals with the loads to be applied in the design of structures used in underground mines. Many of the loads and design considerations for underground structures are identical to the loads and design considerations for similar structures on surface. However, the underground context introduces some specific differences and challenges that must be addressed in order to achieve safe and cost-effective structures. This document deals with those issues and concepts that are specific to structures used in underground mines.

Some principles for structural design are given, but for the most part it is assumed that local standards will be used for the structural design.

Mining structures — Underground structures

1 Scope

This document specifies the design loads and the design procedures for the design of structures used in underground mines. It covers all steel and concrete structures used in underground mines, irrespective of the depth of the mine or the product being mined.

This document adopts a limit states design philosophy.

Typical underground structures covered by this document include, but are not limited to:

- box front structures at the bottom of rock passes;
- conveyor gantry and transfer structures;
- chairlift support structures;
- crusher support structures;
- fan support structures;
- fixed or retractable arresting structures for ramps (see ISO 19426-5);
- foundations for pumps, fans, winches and underground winders;
- high-pressure bulkheads;
- monorails;
- overhead crane gantries for workshops, pump stations and sub shaft winder chambers;
- settler structures;
- silo bulkhead structures;
- silo structures;
- structures supporting loose rock;
- tip structures, including dump structures;
- underground head frames;
- ventilation control doors and other ventilation structures;
- walls and floors for safety bays, refuge stations and sub-stations;
- water control doors;
- water retaining structures.

This document does not cover matters of operational safety or layout of the underground structures.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2394, *General principles on reliability for structures*

ISO 3010, *Bases for design of structures — Seismic actions on structures*

ISO 4354, *Wind actions on structures*

ISO 10721-1, *Steel structures — Part 1: Materials and design*

ISO 12122, *Timber structures — Determination of characteristic values*

ISO 19338, *Performance and assessment requirements for design standards on structural concrete*

ISO 19426-1, *Structures for mine shafts — Part 1: Vocabulary*

ISO 19426-2, *Structures for mine shafts — Part 2: Headframe structures*

ISO 19426-5, *Structures for mine shafts — Part 5: Shaft system structures*

ISO 22111, *Bases for design of structures — General requirements*

EN 1997-1, *Eurocode 7: Geotechnical design – Part 1: General rules*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19426-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

**3.1
arresting structure**
structure installed in a ramp or inclined roadway to arrest the motion of a runaway vehicle, or installed in a roadway approaching a vertical or decline shaft to prevent vehicles inadvertently entering the shaft

Note 1 to entry: See emergency arresting dropset in ISO 19426-1.

**3.2
bagcrete**
required dry ingredients to prepare a specified strength of concrete, put into a bag with the cement in a smaller waterproof bag inside the larger bag and sealed

3.3 Bulkheads

**3.3.1
high-pressure bulkhead**
liquid-retaining structure constructed in underground excavations, primarily designed to prevent water or other liquid from entering a working area of a mine or to prevent compressed air from escaping, and where the pressure exceeds 70 m head of water

**3.3.2
silo bulkhead**
structure at the bottom of an underground silo that contains the weight of material in the silo

**3.4
development**
tunnel excavated through *ground* (3.7) to gain access and provide a ventilation airway to the orebody and infrastructure required to mine the orebody