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Structures for mine shafts —

Part 4:
Conveyances

Structures de puits de mine —

Partie 4: Titre manque

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/NP 19426 was prepared by Technical Committee ISO/TC 82, Mining.

ISO/NP 19426 consists of the following parts, under the general title *Structures for mine shafts*:

— Part 1: Terms and definitions.
— Part 2: Head frame structures.
— Part 3: Sinking stages.
— Part 4: Conveyances.
— Part 5: Shaft system structures.

Introduction

Many mining companies, and many of the engineering companies which provide designs for mines, operate globally so this International Standard was developed in response to a desire for a unified global approach to the safe and robust design of structures for mine shafts. The characteristics of ore bodies, such as their depth and shape, 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 International Standard will facilitate improved safety and operational reliability.

In most countries where mining is conducted it is governed by legislative authorities, and is subject to a set of regulations. This International Standard cannot, and it is not intended to, replace any of these regulations, but it is intended to supplement these regulations by providing rational guidance to enable engineers to design appropriate structures for mine shafts. For this reason this International Standard should be used with a full understanding of local regulations, and it should be recognised that some of the clauses may not be relevant in all countries.

The majority of the material in this International Standard deals with the loads to be applied in the design of structures for mine shafts. 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. It is also recognised that typical equipment varies from country to country, so the clauses in this International Standard do not specify application of the principles to specific equipment. However, in some cases examples demonstrating the application of the principles to specific equipment are provided in Informative Appendices.

Structures for Mine Shafts – Part 4: Conveyances

1. Scope

This document defines the loads and load combinations to be adopted and specifies the design procedures to be used for the design of the steel and aluminium alloy structural members of conveyances used for the transport of men, materials, equipment and rock in vertical and decline shafts. The conveyances covered by this document include personnel or material cages (or both), skips, kibbles, equipping skeleton cages, inspection cages, bridles, crossheads and counterweights.

This document is not intended to be used for the design of ropes, sheaves or attachments. The design of ropes, i.e. sizes, is covered in the relevant national legislation.

This document does not cover chairlifts.

This document does not cover matters of operational safety which are required to comply with the provisions of the regulations of the relevant jurisdiction. Where specific country requirements exist which relate to and interact with the requirements of this document, or which are supplementary to this document, it is expected that the user will take these into account when using this document.

This standard adopts a limit states design philosophy.

NOTE 1: Exceptions to the provisions of this document are permitted only if the required safety margins are proved by acceptable analytical or experimental procedures.

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.

Use of appropriate national standards in place of the standards listed below should be done with caution, always complying with national construction regulations and safety margins.

EN 485-1, *Aluminium and aluminium alloys – Sheet, strip and plate – Part 1: Technical conditions for inspection and delivery*.

EN 485-2, *Aluminium and aluminium alloys – Sheet, strip and plate – Part 2: Mechanical properties*.

EN 485-3, *Aluminium and aluminium alloys – Sheet, strip and plate – Part 3: Tolerances on dimensions and form for hot-rolled products*.

EN 485-4, *Aluminium and aluminium alloys – Sheet, strip and plate – Part 4: Tolerances on shape and dimensions for cold-rolled products.*

EN 515, *Aluminium and aluminium alloys – Wrought products – Temper designations*.

EN 573-3, *Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products*.

EN 755-1, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 1: Technical conditions for inspection and delivery*.

EN 755-2, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 2: Mechanical properties*.

EN 755-3, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 3: Round bars, tolerances on dimensions and form*.

EN 755-4, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 4: Square bars, tolerances on dimensions and form*.

EN 755-5, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 5: Rectangular bars, tolerances on dimensions and form*.

EN 755-7, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 7: Seamless tubes, tolerances on dimensions and form*.

ISO 2394, *General Principles on Reliability for Structures*.

EN 1999-1-1, *Eurocode 9 – Part 1: Design of aluminium structures – Part 1: General structural rules*.

EN 1999-1-3, *Eurocode 9 – Part 1: Design of aluminium structures – Part 3: Structures susceptible to fatigue*.

EN 1999-1-4, *Eurocode 9 – Par 1: Design of aluminium structures – Part 4: Cold-formed structural sheeting*.

EN 10025-1, *Hot rolled products of structural steels – Part 1: General technical delivery conditions*.

EN 10025-2, *Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels*.

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

ISO 10721-2, *Steel Structures – Part 2: Fabrication and erection.*

EN 12020-1, *Aluminium and aluminium alloys – Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 – Part 1: Technical conditions for inspection and delivery*.

EN 12020-2, *Aluminium and aluminium alloys – Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 – Part 2: Tolerances on dimensions and form*.

EN 10137-1, *Plates and wide flats made of high yield strength structural steels in quenched and tempered or hardened conditions. Part 1: General delivery conditions*.

EN 10137-2, *Plates and wide flats made of high yield strength structural steels in quenched and tempered or hardened conditions. Part 2: Delivery conditions for quenched and tempered steels*.

EN 10149-1, *Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 1: General delivery conditions.*

EN 10149-2, *Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 2: Delivery conditions for thermomechanically rolled steels.*

EN 10149 3, *Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 3: Delivery conditions for normalized or normalized rolled steels.*

ISO 19426-1, *Structures for mine shafts – Part 1: Terms and definitions*.

ISO 19426-2, *Structures for mine shafts – Part 2: Headgear structures*.

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

ISO 22111, *Bases for design of structures -- General requirements*.

ISO 60079, *Explosive atmospheres - Equipment - General requirements.*

3. Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

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

- ——ISO Online browsing platform: available at http://www.iso.org/obp
- ——IEC Electropedia: available at http://www.electropedia.org

For the purposes of this document, the definitions in ISO 19426-1 apply.

4. Symbols

For the purposes of this document, the following symbols apply.

A_o	is the operating winder system acceleration/deceleration load (N)
A_t	is the trip-out winder deceleration load (N)
a_D	is the maximum permitted deceleration of the conveyance when the dogging system activates (m/s^2)
a_o	operating winder system peak acceleration/deceleration (m/s^2)
a_t	is the trip-out winder system peak deceleration (m/s^2)
C	is the impact load during loading of the conveyance (N)
C_h	is the horizontal impact load from rolling stock (N)
C_v	is the vertical impact load from rolling stock (N)
C_y	is the conveyed load (*P*, Σ*M*, *U* or *R*, as appropriate) (N)
D	is the dogging system load (N)
d_i	is the deformation of the skip door (m)
E_j	is the emergency dropback load (N)
E_r	is the rope emergency load (N)
e	is the maximum moving beam misalignment of the guide (m); lateral flare dimension (see figure 1)
F	is the design load, or load effect (N, Nm).
F_v	is the friction induced vertical load (N)
G_1 and G_2	are the permanent loads, including the self-weight of the structure and the structural components, in newtons (N)
G_c	is the conveyance self-weight load (N)
g	is the acceleration due to gravity (= 9,8 m/s^2)
H	is the lateral imposed load (N)
H_r	is the rubbing block load (N)
H_s	is the lateral slipper plate load (N)
h_d	is the length through which the rock falls (m)
h_h	is the height to which the skip is filled above the lowest point of the skip door (m)
K	is the station-mounted holding device engagement load (N).

K_c	is the conveyance-mounted holding device load (N)
K_g	is the lateral stiffness of the steelwork at the guide mid-span or at the end of the flare (N/m)
K_s	is the buffer spring stiffness (N/m)
L	is the guide span, bunton to bunton, or the length of the flare (m).
L_1	is the distance between the pivot and the centre of gravity of the skip, or the radial door (m)
L_2	is the distance between the pivot and the return-stop (or the tipping roller) (m).
L_T	is the length of the crawler track (m).
M	is the load from each item of rolling stock or equipment (N)
M_1	is the heavier axle load (N)
m_c	is the conveyance mass including all attachments, excluding rope attachments (kg)
m_r	is the mass of largest rock that will be loaded into the skip (kg)
P	is the load from personnel (N)
p_o to p_3	is the skip pressures (N/m^2)
Q_1	is the dominant imposed load or load effect (N, Nm).
Q_2 to Q_n	are the additional independent imposed loads, or load effects (N, Nm).
Q_e	is the emergency load or load effect (N, Nm)
R	is the static rock or sludge load (N)
R_d	is the bridle/transom load during filling (N)
R_f	is the friction load on the skip door (N)
R_i	is the single rock impact vertical load on the skip door (N)
R_k	is the single rock impact horizontal load on the skip sides (N)
R_s	is the load on skip return-stops (N)
R_t	is the load on tipping rollers (N)
T	is the load due to the tail rope (N)
U	is the load due to underslung equipment (N)
z	is the maximum depth of rock or sludge contained in the conveyance (m)
Z_i	is the impact energy of the falling rock (J)
α_d	is the dynamic impact factor
α_h	is the horizontal load impact factor
α_k	is the holding device impact factor
α_p	is the rock impact factor
α_t	is the tipping impact factor.
α_v	is the vertical load impact factor