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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 21557

Mining — Mining methods — Classification and Specification

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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. www.iso.org/directives

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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

A proper data classification allows your organization to apply appropriate controls based on that predetermined category data. Remember, your controls often come with a cost. You don't necessarily need to have the same kinds of controls for all kinds of data.

Classifying your data can save your time and money because you are able to focus on what's important, and not waste your time putting unnecessary controls in place.

The primary purpose of this document on classification of mining methods is to promote uniformity and comparability of mining information and it will be easier to be found when needed.

There are four main reasons why Information classification is important:

- Efficiency
- Security
- Culture of safety
- Compliance

Mining — Mining methods — Classification and Specification

Note — Table of contents will be completed after final editing.

1 Scope

This document establishes a classification of mining methods based on specification such as ore grade and recovery, cost of infrastructure, ore extraction, labour and machine costs, underground support costs and geotechnical factors.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22932 series apply.

ISO and IEC maintain terminological 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/>

4 General

The purpose of a classification system for mining methods is to provide an initial guideline for the preliminary selection of a suitable method or methods. Its significance is great as this choice impinges on all future mine design decisions and, in turn, on safety, economy, and the environment.

The choice of a mining method assumes a previous but cursory knowledge of the methods themselves. It also assumes a brief understanding of ground control and of excavating and bulk handling equipment. In the formal mine design procedure, the choice of mining methods immediately follows geological and geotechnical studies, and feeds directly into the crucial milestone diagram where regions of the property are delineated as to prospective mining methods. This step in turn just precedes the subjective, complex, and critical layout and sequencing study.

The choice of mining method is an extremely important decision affecting the entire mining project;

The definition of the method permits:

- Establish the configuration of the mine;
- Choose mining equipment;
- Perform an economic evaluation of the project.

Examples of factors in the choice of mining method:

- Form of deposit
- Dimensions of deposit
- Strength of the ore and host rocks Depth

- Geological conditioning
- Content and distribution of the ore deposit.

This document defines two following major mutually exclusive categories to classify mining methods based on the geometry of the deposit and the ground conditions of the hanging wall, footwall and ore zone.

One category is the surface mining and the second one is the underground mining. In this regard, all mining methods can be placed into the categories.

- Surface mining (see [5.1](#))
- Underground mining (see [5.2](#))

5 Classification of mining method based on depth of deposit

5.1 Surface mining methods

5.1.1 Description

Surface mining is a form of mining in which the soil and the rock covering the mineral deposits are removed. It is the other way of underground mining, in which the overlying rock is left behind, and the required mineral deposits are removed through shafts or tunnels.

The traditional cone-shaped excavation (although it can be any shape, depending on the size and shape of the ore body) that is used when the ore body is typically pipe-shaped, vein-type, steeply dipping stratified or irregular.

Although it is most often associated with metallic ore bodies, it can be used for any deposit that suits the geometry – most typically diamond pipes.

5.1.2 Evaluation of surface deposits

The following outline lists the basic factors which must be taken into account for evaluation of a prospective surface mine:

- Geography
- Legal status of land and mining rights
- Historical, political, and sociological factors
- Geology
- Mining conditions
- Ore treatment requirements
- Economic analysis

5.1.2.1 Geography

Topography, a function of location, affects cost of development and operation of a surface mine. Geographic location establishes climate.

Location establishes the condition of remoteness from or proximity to civilization and its developed facilities such as transportation systems, power supply, labor pool, manufacturing and supply services, and specialty repair shops.

Location establishes the condition of remoteness from or proximity to civilization and its developed facilities such as transportation systems, power supply, labor pool, manufacturing and supply services, and specialty repair shops.

5.1.2.2 Legal status of land and mining rights

Land and other necessary rights should be checked, such as water use rights and the ability to acquire auxiliary land for plant site, roads, tailings disposal ground etc.

5.1.2.3 Historical, political, and sociological factors

It is important to determine the extent and nature of national and local laws and regulations in regard to conservation, water use, water and air pollution, tailings disposal, reclamation, handling of explosives, taxes, royalties, import duties, mining safety and health codes, wage and labor conditions, pension requirements, and unions.

5.1.2.4 Geology

Geological evaluation may include wide-spaced drilling, drill-sample logging, testing and processing, plotting of the data on maps and cross-sections, preparation of specialized interpretive maps, calculation of reserves by grades, calculation of stripping requirements, groundwater studies, and economic analysis.

5.1.2.5 Mining conditions

The geometry of an ore body and the topography of the land surface beneath which the ore body exists will affect the kind and cost of a surface mine. The depth and character of overlying rock and the physical characteristics of the wall rock also affect the configuration and cost of a surface mine.

5.1.2.6 Ore treatment requirements

Almost every potential surface mine must consider some phase of product upgrading (beneficiation).

This may vary from a simple crushing and sizing operation to a complex operation including multiple stages of size reduction, concentration and agglomeration. In many cases, pilot-scale testing is deemed advisable.

5.1.2.7 Economic analysis

In the broadest sense, economic analysis for a surface mine involves the determination of market value of the product and all the elements of cost of production.

By subtraction, a margin of profit (or loss) can be calculated.

Many new surface mines require very high capital investments. There are 3 commonly used yardsticks to value investment worth:

- Degree of necessity,
- Payback period, and
- Rate of return.

5.1.3 Steps of surface mining operation

- a. Strip out overburden (becomes spoils)
- b. Traditional surface mining methods fall into two broad categories based on locale as follow:
 - Mechanical excavation methods
 - Aqueous methods

c. Clean up (reclamation)

5.1.4 Strength and consolidate ore or rock -based mining methods

This category comprises the four following mutually exclusive sub-categories that will be done mechanically:

- Open pit mining
- Quarrying or Quarry Mining
- Strip mining
- Auger mining

5.1.4.1 Open pit mining**5.1.4.1.1 Description**

Open-pit mining is surface mining in which huge portions of earth are dug from the surface to extract the desired mineral within them. During the mining process, the land face is scraped away by explosives and digging creating a deeper and deeper pit until the mining is complete. The final shape of the open pit is decided before excavation begins. To most profitable mining pits are the ones where the entire mining area is divided into 3-D blocks. Using geological information from drilled holes, the value of the desired mineral in each block is estimated. The cost of mining each particular block is also determined; therefore you can designate a profit value for each block in the mine.

Open-pit mining has several levels of excavation in which we see varying visual displays. In the first steps we see strip mining techniques used from explosives, to surface scraping and bulldozing resulting in quite bland rock formations. As the miners dig further we see more specific and detailed work done. Open-pit miners will work around the ore and get rid of all the surrounding material providing near cave-like features. 3-D block miners create a puzzle-like display as shown on the previous slide.

5.1.4.1.2 How it Works**Step 1. Designing the mining layout and blasts**

The mine engineers, geologists, blasters, drillers and void officers all work together to make a safe, profitable and efficient plan to which they all agree to. Until all these parties concur the mining cannot begin. Throughout their planning the size, shape and depth of the mine are decided upon along with a sufficient blast outline.

Step 2. Probe Drilling

Special machines are used for this process. These drills are used to create 16-25 meter probe holes into potentially unstable ground. Using this equipment minimizes injury and costs. Through this step miners find possible hot spots, unsafe areas and useful bench locations.

Step 3. Grade Control Drilling

Once probe drilling is complete, geologists begin work to finalize the location of ore blocks by drilling grade control holes. A sample is taken every 2 meters down and sent to the lab for assessment of value. Through this step engineers know where valuable deposits, waste material and marginal deposits lay, furthering the detail of the production plan. Once all probes are complete the surface is smoothed over in preparation of production drilling.

Step 4. Production Drilling

During this stage drillers find specific areas in which blasters can optimize their clearing ability. As little explosives as possible are used. The mentality of cost-efficiency is always apparent during open-pit mining.

Step 5. Charging

As soon as the drilling pattern is complete quality control is assessed in the holes. Checks for water, poor drilling and overall safety are made. If there is water present during blasting irregular clearing occurs resulting in either toe or over-sized holes. After checks are finished, the holes are filled with the proper amount of explosives.

A detonator and a primer are lowered to about 1 meter above the explosives. The hole is topped off by a minimum of 3 meters of gravel in order to plug the blast.

Step 6. Blasting

Blasting varies from mine to mine and company to company. Regulations in certain countries and cities result in several methods of blasting. If the mine is relatively close to an urban area, the wind is taken into serious consideration. The dust produced by open mine blasting is quite abundant and harmful, so if the wind is blowing towards residents blasting may be delayed. When blasting does commence, it is done hole by hole, never simultaneously to avoid harmful vibration and excessive noise. After workers are cleared the explosives are detonated.

Step 7. Clearing the blast and marking the ore

Depending on company regulations a certain number hours are passed before any crew goes to the blast site. First to the site are the blasters to ensure that there are no undetonated explosives present. When satisfied he/she allows the crew to proceed. Geologists then mark where ore blocks are present and create a "dig plan."

Step 8. Digging

In this stage in the operation is where we see the heavy lifting and excavation of the desired ore. Bulldozers, shovels, lifters and water machines are the main components of the crew. Shovels are enormous machines which dig out from the markings and pull out the blocks of material to the surface. Lifters take the blocks from the shovels and put it into either the valuable, marginal or waste dumps. The water machines are used to spray the mine floor constantly to keep the dust down for the miners. They also help reduce the overall dust production of the operation.

Step 9. Drop off

When a lifter possesses a valuable or marginal load, it takes it to a primary crusher or a blend finger. The blocks which need more work go to the crusher where they are obviously crushed and hashed. The pieces which travel to the blend finger are usually quite developed and valuable. They need less destruction work and more detailed mining. Through the finger the ore is found and stockpiled and the waste is then picked up by dumpers.

Step 10. Clean-up

Once the current level of mining is complete shovels and lifters are removed from the site. The level is cleaned off and smoothed over to allow the process to start all over again.

5.1.4.1.3 The significant design issues

5.1.4.1.3.1 Biosphere

a. Clearing

Just the shear clearing of the project creates several problems for the biosphere in the surrounding areas. First the bulldozing and preparation kills all existing flora and fauna species on the site. By destroying the living organisms on the surface the animals and insects that rely on them are out of a food source and must go somewhere else, often resulting in death of the animal much sooner than usual. After clearing out trees and other existing parts of the biosphere the entire habitat of many animals is compromised and basically annihilated.

b. Mining

Open-pit mining is infamous for its disgustingly large amount of dust production. For the remaining animals and humans living in the area, the dust is extremely harmful to their bodies. The animals are overwhelmed by dust clouds and dust particles in their breathing air. Also the noise created by mining is quite immense especially when the project is in the blasting stage, it is so loud that it often scares off existing wildlife.

c. Chemical and toxic pollution

If the mining project is near an ocean or fresh water supply it proves to be a huge pollutant of those areas. The chemicals and toxins exuded by the machinery while under and over ground are quite harmful, because they seep into the nearby water supply and pollute it. If it is a freshwater supply it is virtually undrinkable if exposed to such chemicals, and also it is now a harmful environment to its inhabitants.

5.1.4.1.3.2 Lithosphere

a. Soil degradation

There is the obvious soil degradation when mining occurs. Miners rip into the earth destroying everything in their path. But there is also a chemical degradation that occurs during open pit mining. Strong acidic or alkaline deposits begin to seep into the surrounding soil of the mine, making them useless in terms of growth.

b. Exposure

Open pit mining exposes levels of ground which would never naturally be exposed. This creates problems for the soil; the exposure to weathering erodes the soil much quicker. The chemical altering involved in mining especially with Nitrogen is quite harmful and the soils endure mass compaction.

c. Scree

At times mining operations are found on mountain sides or directly on the mountain. When the miners start to cut into the earth, the mountain's shape is disturbed creating a scree drop effect

5.1.4.1.3.3 Atmosphere/Hydrosphere

a. Dust

Open-pit mining is known for its dust complications. Especially during the blasting stage, dust becomes a major problem for the atmosphere and hydrosphere. Gravel and sand are usually used to plug holes full of explosives, when these explosives disintegrate these substances to dust it is released into the air. Last layers of dust are seen in the air, and you feel it as you breathe it in. Dust particles contribute to ground level ozone as well.

b. Chemical pollution

The machinery used in mining is quite large, and is run on harmful chemicals. These mining projects are continuous for, at times, years. That is 365 days a year of pollution from these monster machines.

c. Clearing of plants and trees

When mining companies must clear lush areas for their production purposes, they take another source of oxygen from our land.

5.1.4.1.4 Pros and cons

The advantages and disadvantages of one type of surface mining versus another are often related to the types of equipment used and the associated costs and benefits derived from their use.

The advantages of open-pit mining in relation to underground mining are lower costs, greater safety, and mechanically easier operations.

It is often agreed upon that surface mining is more sufficient than underground mining in terms of recovery, grade control, economy, and flexibility of operation.

However, there are many deposits, that are too small or irregular, and or deeply buried to be extracted cost-efficiently by surface mining methods. When the minerals extend deep in the ground, the removal of the valueless rock becomes too expensive and the mine must be converted to underground operations or abandoned.

Ecological degradation is often associated with open-pit mining.

5.1.4.1.5 The geometry of the deposit

The geometry of the deposit can be any shape, any dip, thick and large size.

5.1.4.2 Quarrying or quarry Mining

5.1.4.2.1 Description

Quarrying or Quarry Mining is usually restricted to mining dimension stone-prismatic blocks of marble, granite, limestone, sandstone, slate, etc. that are used for primary construction of buildings or decorative facing materials for exterior and interior portions of buildings.

Quarries generally have benches with vertical faces from a few centimeters to 66 meters in height. Blocks are drilled and wedged free in a highly selective manner using time consuming and expensive methods.

Planning of the excavation is based primarily on geological factors such as the direction and attitude of bedding and joint systems.

5.1.4.2.2 How it Works

5.1.4.2.2.1 General

Quarrying of stones is the art of extracting stones from the rock beds. The place from which the stones are obtained (by digging or blasting) is known as 'Quarry'.

Quarrying differs from mining in which various operations are carried out for exploring minerals, such as coal, quartzite, etc. from a mine under the ground.

The different methods of quarrying are as follow:

- a. By digging
- b. By heating
- c. By wedging
- d. By blasting

5.1.4.2.2.2 Digging method

Digging or excavation of stones is carried out with the help of tools such as crowbars and pickaxes.

Only those stones which occur in the form of detached nodules buried in earth can be recovered by this method.

5.1.4.2.2.3 Heating method

The use of this method is restored to only in case of those stones which are required in small pieces to be employed for road metal, railway ballast and aggregates.

In this method, fuel is collected on the exposed surface of the portion of the rock to be removed and the fire is burnt for several hours continuously (ordinary bundle wood is employed for burning).

The detached portion is then removed with the quarrying tools and then broken into small pieces as per requirements.

5.1.4.2.2.4 Wedging method

This method of quarrying is employed for the rocks which are in the form of layers along which it can be easily splitted (e.g. sedimentary and soft rocks like limestone, marble, slate and laterite, etc.), and the stone is required in blocks for building purposes.

Soft stratified rock can be removed with the help of pick-axes and crowbars but in case of hard rocks the holes are made and grooves are cut at shorter intervals.

Blunt wedges are then inserted in the grooves or conical pins of steel are driven into the holes with a hammer.

In place of conical pins sometimes plug and feathers are used. The plug is a conical wedge and feathers are flat wedges with upper ends slightly bent.

The plug along with the feathers is applied into the holes and is subjected to hammer blows.

If the plugs and feathers are arranged a few centimetres apart and all driven at the same time, the stone will get cracked.

In the case of harder stone, the holes are originated from a pneumatic drill.

5.1.4.2.2.5 Blasting method

This method is employed for quarrying hard and compact stones.

The various stages involved in the method of quarrying by blasting are as follows:

a. Boring hole in the rock

The holes are usually made (of desired depth, from 1,25 to 2,5 m deep, and 20 to 40 mm diameter) with a steel bar with knife-edged ends called jumper. When a large quantity of stones is required, holes may be drilled by a drilling machine.

During the drilling operation, water is used to facilitate the operation. The mud and rock powder produced as a result of drilling are removed by a scraper, or a spoon or by a compressed air blast.

b. Charging with explosive

The drilling of the hole is followed by charging it with an explosive. It should be ensured that the hole is thoroughly dry before being filled with explosives.

c. Tamping

Tamping is of paramount importance to prevent the reaction of the explosive along the blasting hole itself.

While charging the hole with explosive and prior to tamping a fuse of sufficient length is inserted.

Tamping consists in filling the hole with stiff sandy clay by a brass rod called the tamping bar (made of brass 15 mm diameters).

Occasionally a priming needle of 1,6 mm diameter is inserted in the tamping materials which are removed after tamping.

This is followed by the insertion of fuse to help explosive being fired. A little quantity of gun powder is put in the hole to link the explosive to the bottom of the fuse.

d. Firing

The fuse is kept of a sufficient length as to enable the person firing it enough time to retire to a safe place before the explosion of the charge occurs.

The use of electrically firing devices is also made to create the spark needed for the explosion. When the explosion occurs masses of stones around the hole are removed.