Fire Safety

in Mines and Underground Constructions

SveMin

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PREFACE

This document on fire safety in mines and underground constructions was reviewed by the Fire Safety Committee of the Swedish Mining Industry's Health and Safety Committee. The Health and Safety Committee is administered by the Swedish Association of Mines, Metal and Mineral Producers.

The document includes all types of underground constructions, as well as mills and concentrators, tunnels, drifts and underground constructions in bedrock.

The document is intended for safety coordinators dealing with fire safety issues as well as persons responsible for projects and designs, constructions and installations, and for operators.

The Fire Safety Committee of the Swedish Mining Industry's Health and Safety Committee

Swedish Association of Mines, Metal and Mineral Producers

INTRODUCTION

Monitoring and managing working environment issues of Swedish mines, the Swedish Association of Mines, Mineral and Metal Producers is a member of the employer and trade organization of the Swedish industry. It is also part of Confederation of Swedish Enterprise. The Fire Safety Committee of the Swedish Mining Industry's Health and Safety Committee drew up the first edition of 'Fire Safety Underground' in 1963, which dealt with the fire safety issues of that time. The edition of 1987 was enlarged, and its title changed to 'Fire Safety in Mines and Underground Constructions'.

This edition was reviewed in 2009.

PURPOSE

The purpose of this document is to serve as guidance with regard to the following aspects:

- design,
- preventive maintenance programs,
- risk assessment and safety appraisal,
- fire suppression systems for installations and vehicles,
- introduction for new employees and
- training.

This document as well as the laws and regulations in force shall be complied with.

REPORTING FIRE DAMAGE

The mining companies report all fires and potential fire accident situations to the Fire Safety Committee of the Swedish Mining Industry's Health and Safety Committee, which records the information in its annual report.

The following classification of fire incidents is used for this purpose:

Category 1 Large fires resulting in total destruction. Fires of extensive proportions. Partial destruction of equipment / machinery/facility.

Category 2 Fires that could be extinguished quite quickly with portable fire fighting equipment.

Category 3 Potential fire accidents or fires that did not build up or were easily extinguished or went out by themselves.

The Swedish version of this document is available as a brochure or as a pdf-file on the Internet. The internet version is continuously up-dated.

Other useful links:

The Swedish Work Environment Authority:	www.av.se
The Swedish Civil Contingencies Agency:	www.msb.se
The Swedish Fire Protection Association:	www.brandskyddsforeningen.se
The Swedish National Electrical Safety Board:	www.elsak.se
The National Board of Building, Planning and Housing:	www.boverket.se

CONTENTS

1. TERMS AND DEFINITIONS

Fire safety representative:	The party intending to engage in hot works in a temporary working place shall, in written, appoint a fire safety representative, who shall be responsible for assessing the risks of fire for the work planned. It is the responsibility of the purchaser of the hot works to organise and appoint a fire safety representative.
Fire safety coordinator:	Is a competent and trained person with a good knowledge of fire prevention issues.
Vehicles:	A vehicle is any engine-powered technical equipment, either electric- or fuel-powered.
Tunnel face:	Wall delimiting a drift or a rock chamber.
Mine:	Construction on the surface or underground where minerals and metals are extracted. Quarries are also called mines.
Hot works:	Operations that may cause fires.
Lift shaft:	Connection by lift between the surface and the various levels of the mine/underground construction. Mainly used for the hoisting of ore and for the transport of personnel and equipment/material.
Head frame:	Large building above the shaft. On the uppermost level the hoisting mechanism can be found, among other things.
Drift:	Tunnel without connection into the open in a mine/underground construction. It is most often horizontal, but may also be vertical or steeply rising (a raise).
Ramp/slope/access tunnel:	An inclined opening used by large haulage vehicles, connecting the surface with the mine/underground construction, or the various levels. Inclination ratios are often 1:7 – 1:10.
Raise:	Drift/shaft excavated upwards from below.
Sprinkler screen:	Row of sprinklers producing a curtain of water.
Shaft for bars and cables:	Drift for the installation of power lines and bars.
Bottom:	Floor of a drift or a ramp/slope.
Tunnel:	Horizontal underground passage with two openings.

Ventilation shaft:	Shaft for discharge and fresh air from and to the underground construction or between the various levels.

2. LEGISLATION AND RESPONSIBILITY – WHO DOES WHAT?

2.1. General Remarks

In accordance with the Act on Protection against Accidents, owners or beneficiary owners of buildings or other constructions shall, to a reasonable extent, provide fire suppression and life-saving equipment to be used in the event of fires or other accidents, and, furthermore, take such measures as to prevent fires and to avoid or limit damage caused by fire. It is, therefore, the ultimate responsibility of the owner or the beneficiary owner to take precautions against fire.

In order to fulfil the criteria of the Act it is necessary to engage in a systematic fire safety management. This is also emphasized by the Swedish Civil Contingencies Agency's General Recommendations and Comments:

> "Systematic fire safety management should include both preventive and fire-fighting measures. This means that owners and beneficiary owners continuously should take the measures needed to eliminate or reduce the risk of fire. Both a fire risk assessment and a safety appraisal of the facility and its operations should be conducted."

The Act on Protection against Accidents also requires a written report about the fire safety measures taken. The regulation defines which facilities and operations are subject to this stipulation.

When the construction of facilities is planned, it is important to include effective fire prevention and protection measures; the so-called structural fire precautions. Frequently it is both more expensive and more difficult to make improvements at a later date compared to implementing the correct measures from the beginning. Careful consideration must be given to the equipment in the facility – machines, trackbound transport systems, furnaces, installations, etc.

2.2. Authorities

Fire safety measures are administered by the municipality's committee dealing with rescue service issues and by the Swedish Work Environment Inspection. Safety measures focus on people and the environment, property damage control comes second. The prevention of property damage is important to be discussed with the insurer, which may have additional terms.

3. BUILDING REGULATIONS

3.1. Building Committees

Building in Sweden is primarily subject to the Act on Planning and Construction (PBL). The local building committee is obligated to cooperate with other authorities, make recommendations und provide information for the public and to monitor PBL compliance.

3.2. Building Permit

Applications for a building permit are sent to the local building committee. The committee is obligated to check the compliance of the submitted documents with the ruling regulations and may, after having consulted the authorities concerned (the health and environment committees, the rescue services committee, the Swedish Work Environment Authority, the Swedish Civil Contingencies Agency) grant the building permit. Building permits are needed for new constructions, extensions, alterations, modernisations and conversions.

Note that an exemption from submitting applications for building permits does not imply an exemption from following existing regulations.

Anybody exempted from an application for a building permit can, if they wish, be given the building committee's opinion on the issue.

Compliance with the existing regulations is the responsibility of the constructor.

3.3. Employees' Representatives

Safety representatives, safety committees and managers are entitled to give their points of view on the building plans according to the Planning and Building Act and the Working Environment Act (AML).

3.4. Head of the Local Rescue Services

The building and fire legislation both contain regulations and recommendations about the cooperation between the head of the local rescue services and the local building committee. The head of the rescue services is, among other things:

- a body to which the building committee refers proposed measures for consideration, such measures concerning building permits and permits for the storage of flammable goods;
- responsible for supervising the inspection of fire prevention arrangements and providing information about fire precautions for the public.

3.5. Structural Fire Precautions

3.5.1. The Planning and Building Act

According to the Act building permits are not needed for the construction of subways or mining operations, which is controlled by other laws such as the Work Environment Act and pertaining provisions.

The National Board of Building, Planning and Housing has published regulations and general advice for the interpretation and the application of the Planning and Building Act in its statute book. The ‘Building Guidelines’ series not only provides information about the practical application and applicable technical solutions, but also refers to the European Union’s Building Product Directive.

The Planning and Building Act applies to underground facilities such as workshops and control rooms, which are permanently occupied by staff.

4. BUILDING ENGINEERING

4.1. General Remarks

Building methods and building material greatly influence fire prevention arrangements.

If the persons responsible for fire prevention and protection measures participate in the planning and development of effective structural fire precautions, it is a much more likely that the people working in mines, underground constructions and pertaining facilities will be provided with good escape routes, and that the spread of fire will be reduced.

Underground facilities shall be made of non-flammable material. The use of materials that disintegrate into substances that are injurious to health or may explode in the event of a fire, shall be avoided in constructions underground.

Sheds may temporarily be used underground according to their fire risk category, and in locations, where they are not exposed to danger from fires on the outside.

4.2. Head Frames and Shafts

The mining industry's modernization has resulted in the disappearance of almost all wooden head frames, which strongly reduced the risks of fire. However, the risk of fire has not been entirely eliminated.

Attention must still be paid to guides, bridges and stairs, many of which are still wooden. Moreover, large cable runs usually pass through head frames and shafts, supplying the mines with electricity.

In some cases, fuel is conveyed to underground tanks through hoses laid in the shafts. In such cases, the expert opinion of the Swedish Civil Contingencies Agency must be obtained. Moreover, the following must be observed:

- When building new stairs, bridges, guides and other parts of the structure, non-flammable material should be used.
- When rebuilding and engaging in more extensive repairs, structures of wood should be substituted for non-flammable material.
- Electric cables should, if possible, be installed in non-conductive environment. Where this is not possible, it is particularly important to avoid installing the cables near flammable material and near fuel hoses. Cables must be made of a fire-resisting

- Attention should be paid to the fact that underground mine ventilation may dry up shafts and head frames significantly.

In order to satisfactorily ensure the safety of both staff and property, it may be necessary to install sprinklers in the head frames and the uppermost part of the shaft. It is then possible to begin sprinkling without delay, if need be, without the staff having to squeeze into these often quite inaccessible places. Sprinkling devices may be activated manually or automatically.

4.3. Trackbound Transport Systems

The following should be observed:

- Trackbound transport systems (conveyor belts) shall be made of non-flammable material.
- Preference is given to self-extinguishing conveyor belts.
- Trackbound transport systems shall consist of several compartments. The length of each compartment should not exceed 100 m. Water curtains may be the means of compartmentation.
- If the conveyor belts are not self-extinguishing, automatic sprinklers shall be installed on both sides of the compartments, as well as between compartments.
- Every compartment shall lead to an escape route.
- Trackbound transport systems on surface shall be provided with smoke flues in the roof, which is best done at the end of every compartment. Underground trackbound transport systems should also be provided with smoke ventilation.

Excerpt from AFS

Workplace Conditions

§ 77 Evacuation shall be possible depending on the type of facility, room, workplace and operation. In the event of danger it shall be possible to evacuate all workplaces, changing rooms and other staff rooms before the emergence of critical situations. The amount of escape routes, their location and capacity shall depend on the number of workplaces in use, equipment and dimensions as well as to the greatest amount of people allowed in the place. As a rule there shall always be at least two escape routes, which are not connected with each other. Escape routes shall, whenever possible, directly lead into the open or to another safe place.

4.4. Workshops and Magazines

Service facilities such as underground workshops and magazines should be constructed in separate places, which should already be considered in the planning stage (see also chapter 3).

4.5. Crushers and Concentrators

Fire precautions are mainly defined by the regulations of the Planning and Building Act.

Fire prevention issues shall be dealt with at an early stage of a project.

Examples of fire prevention and protection measures:

- the construction of the facility, escape routes, compartments, casing of walls, etc.
- flue gas ventilation;
- openings in walls for hoses, conveyor belts, etc.;
- cable ducts in walls;
- sprinkler systems for trackbound transport systems or self-extinguishing conveyors;
- automatic fire alarm systems;
- emergency lighting systems;
- emergency communication installations.

4.6. Fire-Compartmentation

4.6.1. General Remarks

The risks of underground fire increase as underground constructions such as mines become continuously deeper and wider. As a result, effective fire prevention measures are needed to minimize the spread of smoke in the event of fire.

Building methods and building material are of great importance for fire precautions. Facilities and underground compartments shall be made of non-flammable material.

4.6.2. Fire-Compartmentation of Underground Constructions

Escape routes shall, wherever possible, be fire areas. Separate evacuation shafts shall also be fire areas.

Haulage ramps/slopes may propagate smoke and should be divided into partitions.

We recommend that constructions of large dimensions, with substantial horizontal and vertical distances, partly be divided into partitions with fire gates. For every 200 metres of

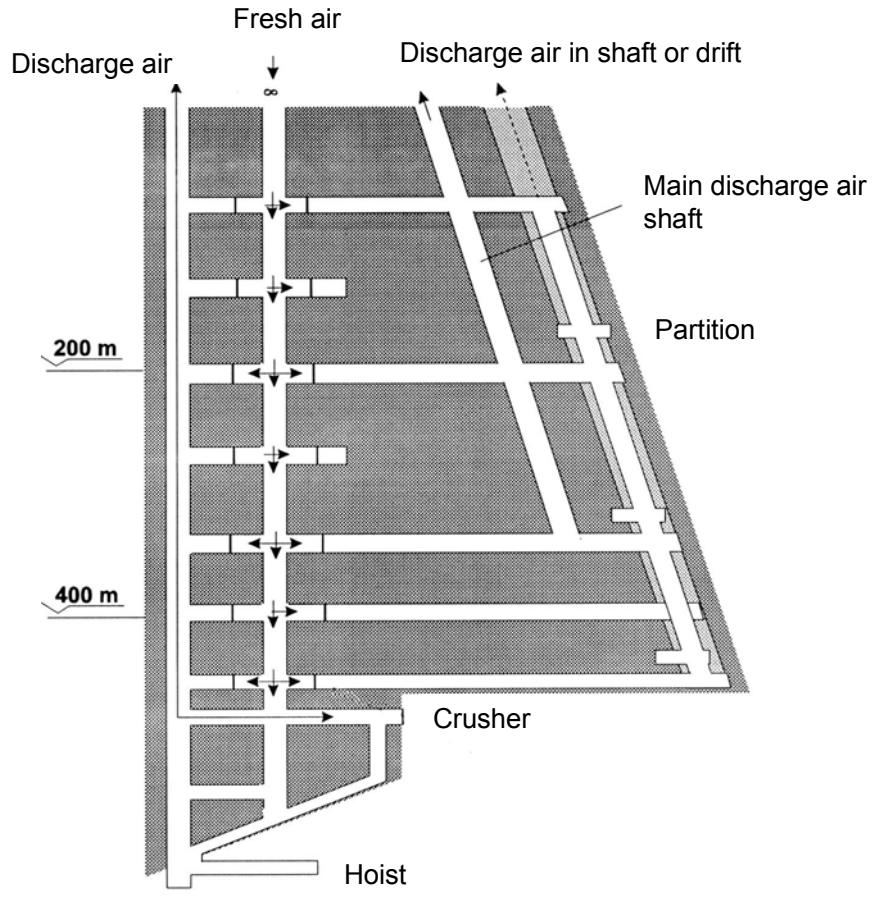
sinking, a new partition should be created. The size of a fire area may be defined with a risk assessment, which includes such factors as ventilation, mining method and smoke propagation.

4.6.3. Fire Gates

It is important that fire gates are airtight, made of non-flammable material and provided with penetration seals for pipes, cables, etc. Ventilation ducts passing through partitions shall be made of non-flammable material.

The visual opening of fire gates shall be avoided as fire or blast fumes may cause the gates to open.

Fire-compartmentation of underground constructions



5. VENTILATION

5.1. General Remarks

Ventilation in mines and underground constructions is a significant part of fire prevention. Noxious fumes quickly spread and they are often the most important risk regarding fire underground.

Airflows of 3 – 4 m/s are quite normal in drift systems. This means that fumes may spread 1 km within just a few minutes. As a consequence, it is important to plan the ventilation system carefully and to design it in such a way that the flow and the force of the air may be directed to already evacuated parts. The airflow may be controlled manually or automatically, both locally and by remote-control.

5.2. Planning

When planning the ventilation system, it is particularly important to consider the location and the design of particularly sensitive installations such as workshops, fuel tanks, parking lots, storage facilities, magazines, etc. in relation to fresh air and discharge air currents.

Escape routes shall, whenever possible, not be affected by fumes. This can be achieved by installing fire gates between partitions or with separate supplies of fresh air.

5.2.1. Monitoring

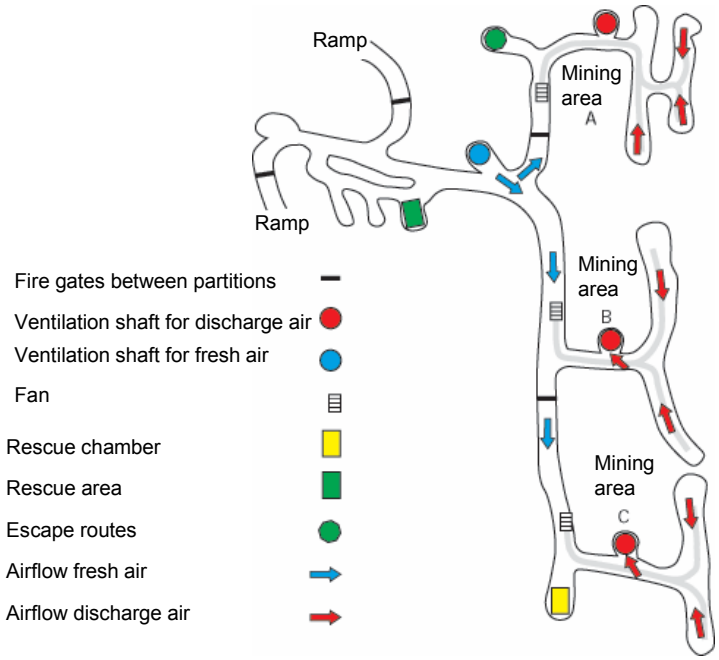
It is of great importance that the ventilation system does not stop working as planned even in the event of a fire. Attention must be paid to the risk of a possible breakdown of the whole or of part of the ventilation system, or of the loss of airflow control. It may be advisable to provide important fans or fan stations, fire gates, etc. with electric current and control wires from two different directions.

If ventilation control is possible, a manual should be compiled, for the various areas of the installation. This manual shall continuously be up-dated; modifications, developments and mining activities shall be taken into consideration, at least once a year. It is an advantage if the system and its control functions can be automated so that a series of control functions can be executed with fewer commands.

The manual of the ventilation system should also include a description of what will happen if control functions and/or the power supply fail entirely or partially.

There should be drawings of the ventilation system. These shall be easy accessible or set up on black boards.

Example of a ventilation plan



Example of control instructions in the event of a fire in the mining area C:

- turn on all the fans in the ventilation shaft for discharge air;
- turn off the flow of fresh air into the area;
- close the fire gate between the areas C and B;
- minimize the ventilation in the areas A and B.

There are special regulations related to the planning and the design of ventilation in magazines (see chapter 11).

5.3. Technical Design

5.3.1. Ventilation Pipes

Ventilation pipes are normally made of flammable material. Such pipes should, however, be substituted for pipes of sheet, whenever the pipes pass flammable stores, substations, transformers, permanent parking lots for vehicles, etc.

Vertically installed pipes in shafts with interior fittings should always be made of non-flammable material.

5.3.2. Fans

“Building Guidelines – Ventilation” of the National Board of Planning, Building and Housing also includes information about fans and dampers used for fire ventilation.

5.3.3. Fire Gates

The gates separating the various partitions usually prevent the propagation of fire and fumes in the installations. It is of uttermost importance that the gates continue to hermetically seal, even after their having been in use for some time. A monitoring program should be set up to ensure the function of the fire-separating gates.

Fires cause an increase air pressure, which affects gates and dampers. This is especially important for gates in vertical shafts.

5.4. Ventilation System Control

In order to ensure the effectiveness of the ventilation system, regular tests involving the propagation of fumes should be carried out.

6. ELECTRICAL INSTALLATIONS

6.1. General Remarks

Fires in electrical installations often result in injuries because of the development of dense and toxic fumes. They also frequently lead to extensive damage of the installations and other equipment, resulting in a costly production standstill. Today the wires used are mostly PVC-insulated, although halogen-free cables are increasingly used underground. As a consequence, fires have become to mean an increasing risk of toxic and corrosion damage. Corrosion damage often means multiplied fire damage costs.

Electrical installations run a high risk of suffering damage in the event of fire. Electrical installations that are important for the supply of power or for the control of the ventilation system are particularly vulnerable.

Therefore, the location of electrical installations and the material of electrical equipment must be chosen with the utmost care. If a fire causes the breakdown of the ventilation system, evacuation and rescue activities are impeded, a situation that must be avoided to the most possible extent.

Fire prevention and protection measures are always an important factor in the planning process. Electrical safety is defined by the Swedish National Electrical Safety Board's regulations on the design of heavy current installations.

"Injuries and property damage caused by fire will be prevented if planners cooperate with safety coordinators from the very beginning."

Electrical installations that are important for the operation must not all be located in places that are not entirely appropriate with regard to fire prevention and protection. Electrical installations or cables that are substitutes shall be placed in separate locations.

Regular monitoring, maintenance and good order are good fire prevention measures. Temporary arrangements always present a high risk factor.

6.2. Material

All material should, whenever possible, be fireproof. In general, isolating circuit breakers should be installed instead of switches and fuses, which work faster and are more sensitive.

Neon lights should work by way of electronic ignition, instead of a glow switch, which can be overheated if it does not work properly.

6.3. Cables

Whenever cables are used, preference should always be given to the highest fire prevention category possible. The cables should, moreover, be halogen-free.
Older types of cables such as PEX- or PVC-insulated cables generally belong to a lower fire category. It must no be forgotten that cables are categorized only according to their ability of spreading fires, and not according to their emission of various kinds of fumes. Most cables contain PVC. Cables with aluminium strips provide better fire protection.

Note: Burning PVC gives rise to hydrogen chloride, which, together with atmospheric humidity, will form hydrochloric acid. One kg of burnt PVC makes 1.5 kg of 30-percent hydrochloric acid.

6.4. Substations and Restricted Access Locations

Transformers and substations may suffer damage by fumes and should, therefore, be protected and be installed in special locations or in cabinets provided with air filters.

Substations or places of similar use must only contain equipment that is used for on-going operations. Substations must never be used as storage facilities!

Substations shall normally have two individual escape routes. The doors are provided with automatic exit devices.

6.5. Transformers

Transformers that are used underground should be provided with dry or silicone insulation. They must be installed in their own fire areas to prevent fires spreading to e.g. substations. For more information see the regulations on the design of heavy current installations.

6.6. Distribution Boxes

Today there are plastic materials with low melting points, which are quickly destroyed by a fire. Manufacturers and distributors shall, therefore, always inform about their materials' qualities, especially with regard to fire. This is particularly important for cables used for the ventilation system.

Distribution boxes shall be mounted on non-flammable foundations. When located in humid and wet places, they shall also be provided with protective roofs.

Each distribution box should be equipped with a switch on the main supply cable. In the event of an emergency, it must be possible to switch off distribution boxes quickly to protect employees and to prevent fires.

The maintenance of all electric machinery (distribution boxes, engines, transformers, etc.) shall be made easier by providing sufficient space for repairs and service; according to current regulations at least 1.5 m.

Electrical machinery must not be encumbered with goods or material that prevent heat emission, easy accessibility or increase the risk of fire.

6.7. Installation of Cables and Wires

The typical measures to prevent fumes from spreading are to divide the area into partitions and to control ventilation. It is of major importance that cables and wires necessary for the control of the ventilation system and for the rescue equipment are installed in such a way as not to be damaged in the event of a fire. Vitally important installations, such as large fan stations, must be powered and connected to the controlling system from two separate directions.

Lift shafts, drifts and ramps run the highest risk of damage.

Satisfactory solutions for the installation of cables are e.g.:

- cables that are placed on the outside of the head frame;
- separate shafts for cables;
- cables that are no longer in use are removed as they present a higher risk of fire.

6.8. Fire-Compartmentation

When cables are fed through walls or floors of sections, the openings shall always be hermetically sealed with non-flammable material, which must be of the same fire category as the walls or floors of the partitions, at least. The person carrying out the sealing should be certified.

The walls, floor and roof surrounding culverts with cables shall comply with the fire category EI 60 at least, and their structural integrity shall be sufficient. The same requirements should

be made on the various sections. Cable ladders should not be used in fire gates. Escape routes or safe places should be accessible from every part of the culverts within a maximum distance of 45 metres.

The use of fire-retarding paint is advantageous: cables can be made non-flammable in places such as parking lots and workshops, and openings for cables passing from one section to another are protected better still. Long cables may be painted in sections, which can help to keep fires within bounds.

6.9. Charging Stations, etc.

For information about the charging of accumulators and batteries of vehicles, trucks, cleaning equipment, etc. see ‘Allmänna Råd’ (General Advice) of the Swedish Civil Contingencies Agency.

6.10. Heating Devices

Infrared heating devices shall be fixed and provided with the necessary protection equipment. Radiation heaters are inappropriate and should not be used. Fixed radiation heaters, however, may be used in substations and the like.

Electric stoves shall be fixed and provided with a protective cover.

If it is only temporarily needed, a mobile heating device may be used. It must, however, be equipped with thermal protection. Its location must not present a risk of fire.

6.11. Drawings

Drawings of the entire electric network, the location of substations, closed operating areas, distribution boxes and other important parts of the network shall be accessible at the workplace. Such drawings shall be up-dated as soon as any alterations have been made.

Drawings are not needed for development areas or other temporary electrical installations.

6.12. Operation and Maintenance of Electrical Installations

All installations shall be maintained in order not to present any danger for persons or property.

Machinery, cables and other parts of the installations shall, whenever possible, be kept clear of flammable or conductive material, if no preventive measures have been taken against ignition or overvoltage at the time of installation of the various parts.

6.13. Fire Suppression Equipment

For transformers, cable culverts and vertical cable runs (e.g. in shafts) fixed firefighting equipment is recommended. It is recommended to provide substations and closed operating areas with CO_2 sprinklers. Note that the fire suppression equipment should be adequate for the entire location, not only for the machinery or for part of the location.

7. VEHICLES

The statistics on fire in mines and underground installations available today show that the most frequent cause of fire are vehicles. Vehicles, therefore, should comply with the requirements defined in chapter 7.5 with regard to fire prevention and protection measures as well as inspections.

7.1. Fire Safety Measures

In general, all electric and electronic equipment should be suited to its purpose, i.e. cables and circuit boards should be protected against mechanical wear and be mounted in such a way as to avoid e.g. short circuits.

Whenever electric or electronic systems are involved, it is important to prevent oil discharge, mechanical friction and overheating. The location of hydraulic pumps and their tanks must be carefully planned with regard to fire prevention and protection. Cleaning and maintenance routines that are followed are an important measure of fire prevention and protection. It is also of importance to earmark resources for the training of operators, mechanics and service/maintenance staff.

In addition to following the requirements defined by GRAMKO, fixed fire fighting systems shall also follow the regulations of SBF 127.

Carbon Dioxide Fire Fighting System

The quantity of fire fighting agent needed to protect machinery/vehicles equipped with CO_2 in electrical rooms and/or other enclosed space shall be calculated at 1 kg/m3. This does not, however, apply for sections such as cabins, engine and hydraulics compartments.

The volume of the sections equipped with CO_2 fire fighting systems shall be the gross volume, i.e. the volume of fixed units and other equipment shall be included.

7.2. Fire Inspections

Because of the high risk of fire, all vehicles, when delivered, shall undergo a fire inspection in accordance with the requirements listed in chapter 7.5.

The following should be paid attention to:

- The fire inspection shall be conducted at the time of delivery. It is recommended that a third party or an authorized body be called in.
- Fire inspections shall be conducted in accordance with the requirements listed in chapter 7.5.
- Fire inspections shall be recorded in written.

7.2.1. Annual Fire Inspections

All vehicles used in mines and underground installations shall undergo an annual fire inspection.

The following should be paid attention to:

- The fire inspection shall be conducted by persons that have received training for the purpose.
- The fire inspection should be part of the schedule, i.e. included in the normal routines for service and maintenance.
- The fire inspection shall be recorded in written.

See the appendices:

App. 1 Fire Damage Report Form

App. 2 Checklist for Yearly Fire Safety Inspection

App. 3 Guidelines for Yearly Fire Safety Inspection

App. 4 Guidelines for checklist of Yearly Fire Inspection of High Voltage Equipment (> 50 V)

7.3. Electric-Powered Vehicles

The risk of fire does not decrease significantly when electric-powered vehicles are used instead of diesel-powered vehicles. Fires are usually caused by the electrical system of diesel-powered vehicles. The electrical system of electric-powered vehicles does not differ significantly from the system of diesel-powered vehicles.

7.4. Remote-Controlled and Automatic Machinery and Equipment

More and more remote-controlled and/or automatic machinery and equipment is used in mines and underground installations, which results in new and unknown risks of fire and problems for the working environment.

In most cases, a comprehensive risk assessment will be necessary to identify dangerous situations that may occur when remote-controlled and/or automatic machinery and equipment is used.

All operations that are connected to such systems should be included in the risk assessment.

Exhaustive risk assessments are also recommended when it comes to the layout and the operation of emergency stop devices for remote-controlled and/or automatic machinery and equipment.

7.5. Rules concerning Fire and Safety Requirement by the Mining Industry's Health and Safety Committee

7.5.1 Electrical Systems

7.5.1.1. General Remarks

An electrical system is defined as being of extra low voltage, normally up to 24 V. The electrical systems of machines shall, when damaged, not be able to cause a fire or a production standstill.

7.5.1.2. Wiring

Electrical cables and wires shall be protected against mechanical wear, high temperatures, fuel and lubricants, water and dirt. They shall be installed in such a way as to avoid leakage, short circuits and other types of damage.

Particular attention must be paid to cable conduits, movable joints and seams, which must never be damaged by mechanical wear.

Cables fused with 10 A or more shall have the appropriate dimensions with respect to the charge that can occur and shall be encased in protective tubes that meet the requirements according to chapter 7.5.1.3 at the least.

The terminals of the generator shall be protected with terminal covers.

Switchgear cabinets shall be jet-proof, and at least meet the requirements made in SS-IEC 529, IP 65.

Electrical cables must never be placed or fastened directly against the fuel hoses or hydraulic pipes of the machine. An exception can be made for correctly fused low voltage cables that are enclosed in protective tubes. They may be fastened against hydraulic pipes, but not fuel hoses.

Cables and cable coils shall be relieved of strain. They shall be fastened in such a way that the insulation may not take damage because of the cramps.

Cramps shall be insulated.

7.5.1.3. Protective Tubes

Protective tubes shall be made of a material suitable for the types of oil/fuel and gases used in the machine/vehicle. The material shall also endure temperatures of –30° up to more than 105° C, during a short period of time up to 125° C. Protective tubes shall always meet the requirements made with respect to environmental impacts and mechanical wear as defined by the standard SAE J517 (SAE 100 R 6).

Mining machinery/vehicles that are used only underground do not need to meet the same strict requirement concerning the resistance to cold.

7.5.1.4. Battery Cable/Positive Cable

The positive cables shall be well attached with insulated clamps. They shall be protected in their entire length, from the battery to the battery isolator and the start-engine, by a protective tube that meets the requirements according to chapter 7.5.1.3, “Protective Tubes”.

The battery isolator and the connections with the start-engine shall be protected against short circuits (battery terminal covers).

The battery cables shall at least meet the requirements of standard IEC 811.

Fixed jump wires shall be protected in accordance with the requirements described above.

7.5.1.5. Batteries

The battery compartment shall be located in the immediate vicinity of the start-engine and must be large enough for ventilation purposes. The battery shall be firmly attached and safe from mechanical wear and short circuits.

The battery shall be provided with terminal protection covers.

7.5.1.6. Battery Isolator

It must be possible to switch off the power in the machine by way of an automatic battery isolator, the dimension of which must be designed for the charges possible, including

additional equipment. The battery isolator shall be located in the immediate vicinity of the battery and shall be connected to the battery with the shortest battery cable possible. It is recommended that machinery equipped with computer equipment and/or other components, which are connected before the battery isolator, have the battery isolator fused with positive disconnection or positive and negative disconnection. See also chapter 7.6.1.7. ‘Fuses’. The terminals of the battery isolator shall be protected with terminal covers.

7.5.1.7. Fuses

Equipment (such as computer equipment, emergency and/or warning systems and equipment necessary for the operation of automatic machinery) connected before the battery isolator of the machine must be fused separately with the least possible ampere and must be enclosed in a protective tube that at least meets the requirements according to chapter 7.5.1.3. ‘Protective Tubes’.

7.5.2. Disconnecting/Releasing Devices

7.5.2.1. General Remarks

Manual disconnecting devices shall be within easy reach for quick and easy disconnection and stop. Manual disconnecting devices shall be disconnected when the machine is left unattended. Releasing devices of fixed fire fighting systems shall be mounted at the same place as emergency stop devices.

The handles and levers as well as other components and parts of the machinery pertaining to the shut-off and the starting devices shall be made of fire-resisting material and designed in such a way that they are easily accessible, even when safety gloves are used. The shut-off and the starting devices shall be safe from damage caused by fire and mechanical wear.

Handles, levers and other components for the manual shut-off must not be mounted within fire hazard zones.

Electrical shut-off and starting devices on the outside of the cabin shall be protected by enclosures and meet the requirements described by standard class IEC 529, IP 65 (jet-proof design).

Remote-controlled machinery. It must be possible to disconnect all power supply units, to shut down the engine and the work equipment and to activate the fixed fire extinguishing system both by remote control and manually.

7.5.2.2. Location of Releasing Devices

Releasing device, automatic or semi-automatic fire fighting system

Underground mining machinery/vehicles shall be equipped with a releasing device for automatic and semi-automatic firefighting systems.

In underground mining machinery/vehicles:

- automatic releasing device;
- one releasing device in the interior of the cab;
- two releasing devices at the exterior: one device at the back of the machine/vehicle, and one near the normal entrance/exit door of the machine/vehicle;
- machines/vehicles equipped with hoist cages/scissor tables shall have a releasing device mounted in the hoist cage/scissor table;
- the releasing devices shall be situated in the same places as the emergency stop devices.

Remote-controlled machinery shall satisfy the rules described above and shall, moreover, have a releasing device at the operator's position.

In mining machinery/vehicles on surface:

- releasing device for manual and mechanical firefighting system;
- one releasing device in the cab;
- two releasing devices at the exterior, one on each side of the machine/vehicle;
- the releasing devices shall be situated in the same places as the emergency stop devices, if there are any.

Automatic releasing device

If a machine/vehicle is equipped with automatic releasing devices, only one manual releasing device is needed in the operator's cab.

An indicator in the operator's cab shall indicate the state of the automatic fire extinguishing equipment.

7.5.2.3. Emergency Stop Devices

General Remarks

Underground mining machinery/vehicles shall be equipped with emergency stop devices, which interrupt all power supply and stop engines and work equipment. Exception is emergency lightning.

Location of the emergency stop device:

- one emergency stop device in the operator's cab;
- two exterior emergency stop devices: one at the back of the machine and one near the normal entrance/exit door of the cab of the machine;
- machines equipped with hoist cages/scissor tables shall be equipped with an emergency stop device as part of the control pad of the hoist cage/scissor table;
- the emergency stop devices shall be situated in the same places as the releasing devices for fixed fire extinguishing equipment.

Remote-controlled machinery shall satisfy the rules described above and shall, moreover, have an emergency stop device at the operator's position.

7.5.2.4. Engine Shut-off

General Remarks

Mining machinery/vehicles shall be equipped with an engine shut-off mounted at the exterior of the machinery/vehicle. This requirement does not, however, apply if the machinery/vehicle is equipped with an electro-magnetic device, which interrupts the power by way of a circuit breaker.

7.5.2.5. Fuel Hoses and Air Conduits

(including pivot tubes/glasses and the like)

Fire Resistance

Fuel hoses and the like connecting tanks with combustible oil/fluids shall be made of a material that at least satisfies the requirements with respect to fire resistance defined by the test standard ISO 7840 annex.

Air tubes that are continuously under pressure in hazardous areas shall be made of a material that at least satisfies the requirements with respect to fire resistance defined by the test standard ISO 7840 annex.

Fuel Shut-off

Underground mining machinery shall be equipped with an electromechanical shut-off for fuel systems or clack valves. If the shut-off cannot be mounted directly at the outlet of the tank, the fuel hose between the tank and the shut-off must be as short as possible and shall be made of steel or of another material that is at least as durable and fire-resistant as steel. The

fuel hose shall at least satisfy the requirements with respect to fire-resistance defined by the test standard ISO 7840 annex.

The electromechanical fuel shut-off shall be powered by way of the ignition key of the machine and shall shut off by itself in the event of a voltage drop.

The return conduit must be equipped with a check valve.

7.5.3. Heating Devices

7.5.3.1. LP Gas and Oil Heaters

Engine and/or cab heaters operating with LP gas or oil must not be installed in such a way that escaping fuel may ignite the machine.

The fuel hose between the fuel tank and the pump of the heater shall be made of a material that at least satisfies the requirements defined in the test standard ISO 7840 appendix. Furthermore, the heater shall satisfy the requirements defined by the Swedish Testing and Research Institute in its 'Rules Defining the Approval of Different Types of Heaters' ('RTE-meddelande 7').
Hoses connecting LP gas heaters shall be equipped with a pipe rupture valve and shall satisfy the regulations of the Swedish Gas Association.

Heaters installed in fire hazard zones must dispose of a draining rack in order to prevent leaking fuel/gas from getting into the machine.

The exhaust pipe of the heater shall be insulated and lead into the open, or to another place where the exhaust fumes cannot ignite.

7.5.4. Machinery/Vehicle Design

7.5.4.1. General Remarks

Machinery/vehicles shall, whenever possible, be designed in such a way that the accumulation of combustible material, oil, fuel, etc. is avoided. If combustible material or the like accumulate in a spot, this spot shall be easily accessible for inspection and cleaning.

7.5.4.2. Spaces of Difficult Access

Sheets and girders surrounding spaces of difficult access shall have clearly marked conduits with a diameter of 50 mm, which makes it possible to use portable fire extinguishers.

7.5.4.3. Insulation

Material for noise insulation and interior fittings shall be fireproof and at least satisfy the requirements of ISO 3795.

7.5.4.4. Plastic Tanks

Plastic tanks shall at least satisfy the requirements of ECE R 34 annex 5 with regard to fire prevention and protection.

7.5.5. Other Fire Suppression Equipment

7.5.5.1. Portable Fire Extinguisher

The machine/vehicle must be equipped with easily accessible portable fire extinguishers and instruction for their use and maintenance. If dry powder fire extinguishers are used, their maintenance instructions must be on a plate/sticker in the cab and contain details about how to loosen up the powder. If fire extinguishers are out of sight (e.g. in lockers, cabs or the like), their location must be clearly marked with signs on the outside.

The requirements for portable fire extinguishers are defined by the European standard EN 3.

Dry powder fire extinguishers and fluid fire extinguishers shall be equipped with pressure gauges (manometers), with the manometer needles positioned in the green sector.
The minimum requirement for portable dry powder fire extinguishers is class 43A 233BC, at least 6 kg.

For machinery with high-voltage installations it is possible to choose a portable CO_2 fire extinguisher; the minimum requirement is class 89B.
A fluid fire extinguisher may be chosen as a complement, the minimum requirement being class 34A 233B.
The number of portable fire extinguishers may vary according to the type of machinery/ vehicle and its use.

7.5.6. Informative and Instruction Signs

The machine shall be equipped with exterior informative and instruction signs, which shall be mounted close to releasing, stop and disconnecting devices. They shall clearly indicate the measures that have to be taken if a fire breaks out and/or if the machine is left unattended, and give safety instructions.

Informative and instruction signs, as well as marked releasing and stop devices and levers, must not bear text abbreviations or symbols that can be misunderstood or misinterpreted.

There shall be clearly visible firefighting instructions near the operator's position, describing in a simple way the measures to be taken in the event of a fire and the use of the fire suppression equipment as well as maintenance instructions for portable fire extinguishers, including instructions about how to loosen up the powder.

The container of the fire extinguisher shall bear permanent information about the type of firefighting agent and the amount, as well as instructions concerning the use and the maintenance of the fire extinguisher.

The signs shall be made of metal, with the instructions engraved or etched in metal; any alternative must be at least as durable.

There shall be the following informative and instruction signs:

- instruction signs for battery isolators (not required if there is an automatic battery isolator);
- instruction signs for portable fire extinguishers that are out of sight;
- instruction signs for emergency stop and/or engine shut-off devices;
- instruction signs for releasing and stop devices.
- At the operator's position there shall be clearly visible firefighting instructions as well as a sign describing how to loosen up the powder in a portable fire extinguisher.
- Openings in the sheets and/or girders of the machine body for extinguishing fires with portable fire extinguishers shall be well marked.

7.5.7. Low / High Voltage Installation > 50 V

Effective rules and regulations on high voltage shall be followed.

7.5.8. Fire Prevention Control

All machinery/vehicles shall undergo an annual fire protection inspection in accordance with the checklists (appendix 2) and guidelines (appendices 3 and 4) set up by the Mining Industry's Health and Safety Committee. The inspections shall be carried out by specially trained staff.

7.5.9. Fire Suppression Equipment for Machinery/Vehicles

Portable fire extinguishers must comply with the European standard EN 3.

Alt.1: Unmanned underground mining machinery/vehicle:

- Fixed automatic fire extinguishing system according to SBF 127.
- Two portable fire extinguishers of at least class 43A 233 BC.

Stop devices in accordance with the Rules for Fire Protection and Safety set up by the Mining Industry's Health and Safety Committee.

- Electrical system
- Fuel system
- Emergency stop

Alt.2: Mining machinery/vehicle with fixed fire extinguishing equipment:

There usually is fixed fire extinguishing equipment in accordance with SBF 127 on heavy mining machinery / vehicles or wherever it seems to be needed with regard to fire prevention. Additionally:

- there shall be at least two portable fire extinguishers of at least class 43A 233 BC
- or see alternative described under 7.5.5.1.

Stop devices in accordance with the Rules for Fire Protection and Safety set up by the Mining Industry's Health and Safety Committee are needed for:

- Electrical systems
- Fuel systems
- Emergency stop.

Alt.3: Mining machinery/vehicles without fixed fire extinguishing equipment

Normally small transport and service vehicles.

- At least one portable dry powder fire extinguisher, at least class 43A 233 BC, 6 kg.
- Stop device for the electrical system.

Vehicles for passenger service (busses), trucks and other large transport vehicles:

- At least two portable dry powder fire extinguishers, at least class 43A 233 BC, 6 kg.

Alt.4: Mining machinery/vehicles on surface

- At least two portable dry powder fire extinguishers, at least class 43A 233 BC, 6 kg.
- Stop device for the electrical system.

The machines/vehicles shall furthermore entirely satisfy the requirements made in the Rules for Fire Protection and Safety set up by the Mining Industry's Health and Safety Committee.

Alt. 5: Other vehicles used on surface (e.g. service and transport vehicles, busses):

- At least one portable dry powder fire extinguisher, at least class 43A 233 BC, 6 kg.
- Stop device for the electrical system.

7.6. Parking

7.6.1. Parking Suggestions

In addition to the design and the size of the parking lot, the following should be paid attention to:

- The parking lot must not be part of an escape route or be in a drift for fresh air.
- Lift shafts used for passenger transport shall be partitioned off from parking lots by fire- and smoke-separating walls.
- The distance between parking lots and workshops, canteen, transformer cabinets, fuel stations, magazines and areas where combustible goods are stored must be at least 50 m.
- In addition to the fire extinguisher present in every single vehicle, parking lots shall be provided with the necessary number of portable fire extinguishers (depending on the number of parking spaces).
- The parking lots shall be marked with signs.
- Large parking lots should be provided with water sprinklers and fire detectors.
- The parking of several vehicles in narrow blind drifts is not recommended.
- If parking lots are located in large underground openings with high ceilings and sufficient space between the vehicles, the vehicles may be parked somewhat closer than in narrow places.
- When parking lots are planned, the expert opinion of the supervisory authority and the fire safety coordinator must be taken into consideration.
- The parking of vehicles in workshops or the like is not recommended. Garages are preferred.

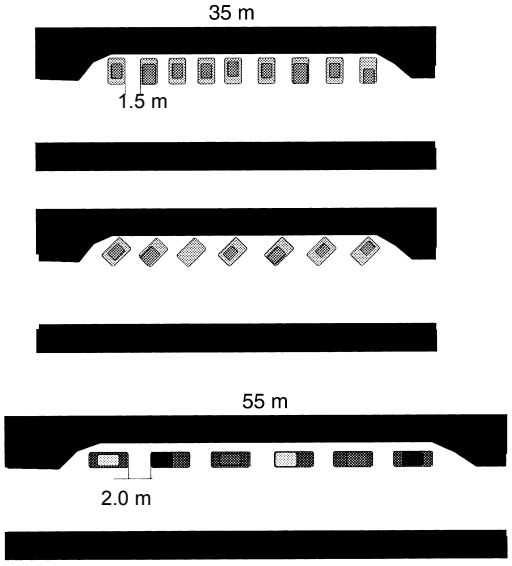
- Parking lots for vehicles used for charging and for explosives should be located in places that are not connected with the parts of a mine that are being mined or developed. Smoking and hot works must never be carried out in those places.

7.6.2. Small Vehicles

Small vehicles are passenger cars and small motor vehicles used for maintenance (e.g. jeeps). The amount of cars used should be limited because of the risk of fire.

Examples of underground parking lots and the minimum space between vehicles, see examples below.

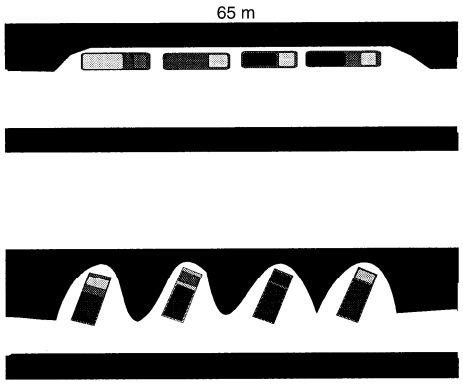
Example of an underground parking lot for small vehicles



7.6.3. Large Vehicles

Large vehicles are loaders, trucks, mining trucks, busses, etc. Machines such as drill rigs and the like need to have more space, and for those, separate parking lots should be made available.

Example of an underground parking lot for large vehicles



8. FIXED MACHINERY AND PROCESSING EQUIPMENT

8.1. General Remarks

The installation of fixed machinery such as pumps, mills and mixers should always be preceded by risk assessments, which also include risks of fire. It is both easier and more cost-efficient to take risks of fire into consideration at the planning stage. Risks which are recognized only after having taken the machinery into operation and which must be addressed then are likely to result in much higher costs, depending on the object.

8.2. Trackbound Transport Systems

Conveyor belts present high risks of fire: the rapid and often very violent course of fire becomes even more dangerous underground because of the development of very toxic fumes. The fumes produced by fires in conveyor belts make it impossible to see anything, which greatly impedes evacuation and rescue actions.

If the installation of a trackbound transport system is planned, it should consist of self-extinguishing tracks.

Effective smoke and heat exhaust ventilation may be difficult to achieve and rescue actions may take a long time. It is, therefore, very important to have automatic fire detection and alarm installations and a fire suppression system, which ensure that the fire can be suppressed at an early stage.

Conveyor belts in underground installations shall always be self-extinguishing.

8.3. Hydrogen Plant

There are many and comprehensive regulations concerning the construction, installation and maintenance of hydrogen plants. The Swedish Welding Commission has published a compilation of these regulations in its brochure ‘Design and Erection of Gas Supply Systems’ SV 39.

9. HAZARDOUS MATERIALS

Goods that are transported are considered to be dangerous if they contain or consist of

- explosive articles;
- compressed, condensed or pressurized gases;
- combustible fluids;
- combustible solid articles;
- articles at risk of spontaneous combustion;
- articles developing flammable gases when reacting with water;
- oxidizing articles;
- toxic articles;
- radioactive articles;
- corrosive articles;
- other articles that may damage persons, animals, the environment or property.

9.1. Transport

The legislation of the transport of hazardous materials is regulated through the law concerning the transport of hazardous materials and the regulation concerning the transport of hazardous materials. The Swedish Civil Contingencies Agency is the authority responsible for transport by road and by train and is authorized by the government to issue regulations concerning national transport by road and by train. The regulations of the Swedish Civil Contingencies Agency are based on the European agreement on international transport of hazardous materials by road, called ADR. For more information on the agreement or on the transport of hazardous materials, see the regulation of the Swedish Civil Contingencies Agency.

Examples of danger signs. Combustible fluid or gas. Explosive article.

9.2. Safety Advisor

All companies, authorities or juridical persons that are the consignors of hazardous materials, or responsible for the shipping, unloading or loading of hazardous materials must assign safety advisors.

Assignment of Safety Advisors

The company decides on the responsibilities and the mode of procedure of their safety advisor, depending on which kind of business the company deals with. It is most important that the person assigned has the appropriate qualifications to meet the demands.

However, the responsibility for the safety of the transport of hazardous materials continues to be with the company management, even after the assignment of a safety advisor. The safety advisor shall advise on the company's safety management of hazardous materials. The safety advisor is not responsible for supervising every single transport, he/she is responsible for setting up routines for the prevention of accidents and for ensuring that instructions are observed. The safety advisor shall, among other things, promote the prevention of accidents and report accidents and near-accidents. Safety advisors must have been trained and certified by the Swedish Civil Contingencies Agency.

9.3. Personal Protective Equipment

It is of major importance that anybody working with chemicals and other aggressive substances know which kind of personal protective equipment to use.
There shall be a safety document available for each type of chemical used describing which kind of personal equipment must be used. The safety document also gives information about regulations on the usage of the chemicals and the risks of health and fire, etc.

10. COMBUSTIBLE ARTICLES

10.1. Combustible Articles

The usage and storage of combustible articles requires a permit. The person designated to use and handle combustible articles shall be sufficiently knowledgeable and competent. Combustible articles are:

a) gases that may ignite and burn at temperatures of +21°C or lower;

b) fluids or semi-fluids with a flash point of ≤ + 100 °C.

There are four classes of combustible articles:

1. fluids with a flash point of < + 21°C, e.g. waste oil;

2a. fluids with a flash point of ≥ + 21 °C, but of ≤ + 30 °C;

2b. fluids with a flash point of > + 30 °C, but of ≤ + 55 °C, e.g. diesel fuel MK 1 or MK 2;

3. diesel oil, heating oil and other fluids with a flash point of > + 55 °C, but ≤ + 100 °C.

Combustible articles must be handled with extreme care because they are prone to fire or explosion. The most important characteristics of these articles that must be paid attention to are the following:

- the flash point: the lowest temperature at which the vapour of a combustible fluid will cause the air to become an explosive atmosphere. A fluid with a low flash point is much more hazardous with respect to the risks of fire and explosion than a fluid with a higher flash point.
- flammability range: the area within which mixtures between air and the vapour of the combustible fluid can cause explosions. An example is flammability range of gasoline, which lies between 1 and 7 percent by volume. A 200 l barrel filled with a combustible mixture of air and vapour needs only approximately 10 g of gasoline (1.3 cl) to explode.
- the thermal ignition point: the mixtures of combustible gas or vapour of the fluid ignite at varying temperatures depending on the type of combustible article. The ignition temperature is called the thermal ignition point, which means that the mixture can ignite without the occurrence of a spark or flame.
- heavy vapours: vapours from combustible articles are generally heavier than the air. Some gases, such as liquefied petroleum gas, are heavier than air, whereas e.g. acetylene and hydrogen gas are lighter. Heavy gases and vapours often “leak” from their source of generation and can accumulate in dangerous concentrations at low points such as greasing pits, cable trenches, ditches or the like. The vapour can

Placards for combustible articles.

Examples of common combustible fluids

Name	Combustible fluid, class	Flash point, degrees °C	Combustion area, percentage by volume	Ignition temp. degrees °C
Acetone	1	-19	2.5 - 13	540
Petrol	1	<-30	1 - 7	250
Fuel oil, heating oil	3	(ASTM D 93 min) 56.0 degrees	-	220
Paraffin oil (kerosene)	2b	+35 - +55	1 - 8	230
Mineral spirits, spirits of turpentine, white spirit, dilutin, vanolen	2b	ca. +40	1 - 6	230
Methylated spirits	1	+ 12	3 - 19	425
Methyl alcohol 100 %, wood alcohol, methanol	1	+ 11	5 - 37	455

10.2. Storage and Distribution of Diesel Fuel

Combustible fluids are stored in stationary or mobile tanks in mines and other underground constructions. Mobile tanks and movable cisterns are considered to be equal in terms of safety.

Tanks and oil reservoirs shall be located in such a way as to be protected against moisture and waste water, mechanical effects, shock waves due to blasting, rocks falling from the roof or the walls, traffic as well as collisions.

Tanks and oil reservoirs should be located at least 50 m away from workshops, magazines, parking lots, crushers, winders, changing rooms and the like. If, however, there is only solid rock between, the distance may be shorter. Special attention must be paid to the pipes conveying the fuel from its location of storage to other locations, as they may spread a fire very quickly. The pipes shall be made of non-flammable material, protected against mechanical wear and be entirely accessible for inspection purposes.

The distance between two tanks shall always be at least 100 m, unless there is solid rock between the tanks.

Tanks shall be provided with collecting basins or the like, which can hold the equivalent volume or more.

Mobile tanks shall be located at least 12 m away from combustible material. If the tanks are stationary, the bottom must be hardened.

Pumps shall be installed within the collecting basin of the tanks.

The pipes between tanks as well as between tanks and taps must be made of non-flammable material; they shall be provided with the appropriate warning signs and they shall be well protected. They shall always be entirely accessible for inspection purposes.

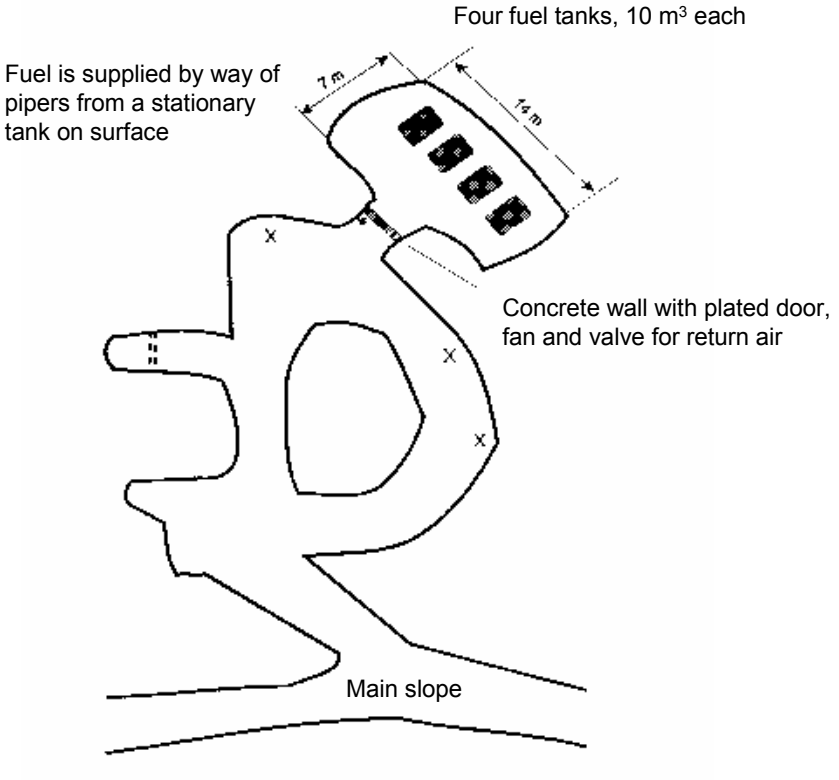
If diesel fuel is conveyed in pipes, the Swedish Civil Contingencies Agency shall give its expert opinion and approve of the means of conveyance. The installation of this type of pipe system must comply with the regulations of the Working Environment Authority.

Combustible fluids of Class 1 shall be used underground only in exceptional cases.

Minor quantities of bottled gas may be used for operations such as the soldering of cables. The underground storage of LPG is prohibited.

Example of petrol station

Storage facilities for combustible goods shall be provided with ventilation



11. EXPLOSIVES

11.1. Protection Against Fire

With new explosives constantly being developed, it is difficult to give general guidelines about fire protection and prevention.

Nevertheless, the following may be pointed out: if a fire is detected at an early stage, the fire shall be suppressed with large quantities of water, preferably by sprinklers.
Always consider that heated explosives are sensible for pressure. High-pressurized, large jets of water must not be aimed at burning explosives.

If the fire cannot be extinguished with water, it shall be abandoned and all personnel be evacuated as fast as possible.

The same can be said if the fire occurs in the proximity of detonators. First, an attempt to remove the detonators should be made. If this is not possible, the fire should be suppressed with large quantities of water, as soon as it is detected.

All types of detonators explode at approximately 160°C.

The Act on Flammable and Explosive Articles and its regulations give more and detailed information, e.g.:

- There are to be no open flames in places where explosives and detonators are handled, stored or conveyed.
- Hot works shall always be carried out at a safety distance of 50 m.

11.2. Heating of Magazines

11.2.1. Prerequisites and Regulations

In underground magazines large quantities of explosives of various properties and compositions may be stored.

The Swedish legislation has been dealing with, among other things, the design and the storage volume of magazines for many years; it does not, however, give any information on the design and/or the installation of heating devices. Certain types of explosives that are stored in moist magazines can cause problems, when they are used.

Water radiators are a preferable means of heating.

The expert opinion of the Swedish Civil Contingencies Agency should be called for, before any heating and ventilation system is installed.

11.2.2. Approved Solutions

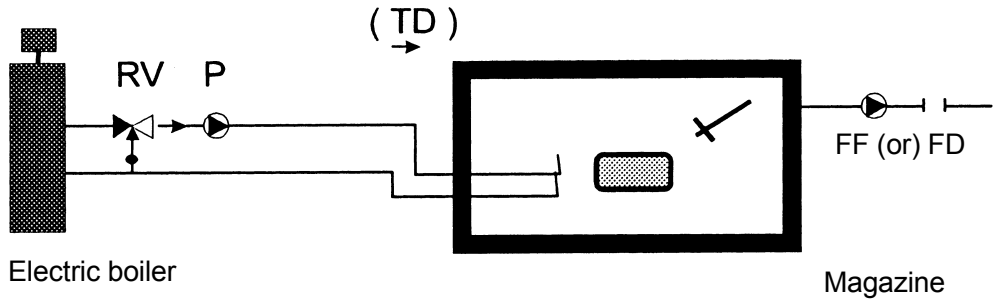
In addition to complying with the requirements made specifically for each solution, all approved solutions observe the following requirements:

1. Electric boilers shall be provided with thermostats set at a maximum of 80 °C.
2. The engines of blowers shall not be installed in airways.
3. Temperature sensors in air ducts shall be protected in accordance with Enclosure classification IP 54, at least.
4. The blower shall consist of one of the following combinations of material:
   The drum of the blower shall be made of steel or cast iron and the wheel of the blower of bronze, brass or copper, but not of light metals or light metal alloys.
   The drum and the wheel of the blower shall be made of stainless steel.
5. All material used for the air duct is non-flammable.
6. All ventilation equipment shall be easily accessible for care and maintenance.
7. Instructions for periodic monitoring activities shall be available at site.
8. The installation shall otherwise comply with the regulations on the design of heavy current installations.

11.3 Heating with Radiators

Ventilation with Blower or Draught

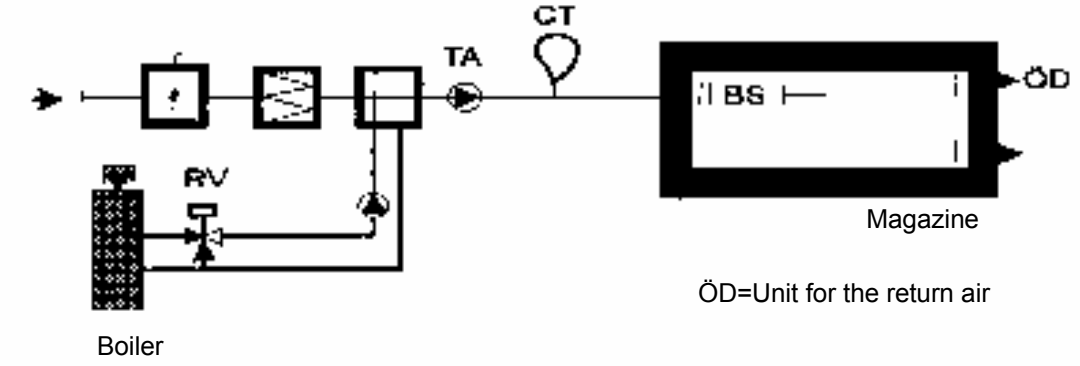
Heat is generated in an electric boiler, which is located in a closed area. The hot water is distributed from the boiler to the radiators in the storage magazine by way of pipes. A shunt valve (RV) is installed in the pipe monitoring the temperature of the outgoing hot water, and a pump (P) is installed to ensure the flow of hot water to the radiators.
In certain installations, glycol should be added to avoid damage by cold.
The return air is lead away by the return air blower (FF). A blower for the intake air and protected grilles are installed, their size adapted to the actual installation.



Rad=radiator TD=intake air blower FD=return air blower

11.4. Heating and Ventilation with Water-Heated Fresh Air

The heat is generated in the boiler. By way of a pump the hot water heats the air in a unit for intake air (TA). The air is blown into the storage magazine by a blower. The return air is lead away from the storage magazine by way of a unit for return air (protective grilles).
A shunt valve (RV) should be installed to monitor the temperature of the water (and, indirectly, of the intake air).
The duct for the intake air, after leaving the unit for the intake air, shall be provided with a temperature sensor (GT), which turns the blower off, if the temperature rises above + 50 °C.
Dampers (BS) EI 60 are installed on the inside of the wall of the magazine. The dampers close at a temperature of 50 °C.



11.5. Ventilation without Heating

An acceptable atmosphere can also be achieved with an abundant flow of intake air, without heating the air.
A blower for intake air is installed. The air blown into the storage magazine comes from near-by areas. The return air is lead away by means of a valve in the wall of the magazine.

The moisture content can be decreased from some 90 % to 65 %, when a dehumidifier is used (which must have been approved for the use in magazines). It has also been noted that magazines that were blasted into the rock and used to be very moist became dry thanks to ventilation, which significantly improved the working environment.

12. DUST EXPLOSIONS

12.1. General Remarks

Dust explosions can be triggered by certain solid and densely dispersed particles, which, when whirling into or floating in the air in certain concentrations, will ignite. If the particles start burning in a closed area, the air and the gaseous products cannot expand, which leads to a rapid pressure gain.

However, large and unhindered dust clouds may also cause significant pressure gains. The size of the dust particles is of major importance: the smaller the particles, the more violent the explosion.

The risk of dust explosions is particularly high, where operations involve working with coal, sulphide, flour, wheat, plastics, starch (farina) and wood-flour. Even the dust of certain metals, such as aluminium, magnesium, zinc and lead may cause explosions, if conditions like the ones described above arise.

12.2. Sulphide Ore Dust Explosions

Mines and underground constructions with a sulphur content of ca. 30 percent and more have, because of the high risk of fire, a potentially explosive atmosphere. Sulphide ore dust explosions give rise to toxic sulphur-bearing gases such as SO_2.

In order to decrease the risk of fire, exposed surfaces shall be washed down before blasting. For the same reason even other locations within the mining area, e.g. haulage areas, ventilation drifts and raises as well as installations such as cable ladders, should be washed down.

When blasting in areas with potentially explosive atmospheres, the detonation shall be set off from a central location on surface or from a safe location underground. The design and the erection of shelters are outlined in special regulations.

12.3. Coal Dust Explosions

Working with coal involves the risk of dust explosions and self-ignition. Coal may self-ignite when handled and stored. In the event of longer standstills (> 24 hours), it is recommended to empty coal powder containers to avoid self-ignition. However, if coal powder containers are provided with fixed fire suppression equipment, they do not need to be emptied of their content.

Coal dust can cause explosions if there is a sufficient amount of fine particles in an area and an ignition source. The risk of a coal dust explosion increases, the finer the particles are and the higher the concentration of dust in the air. A dust explosion is generally much more

violent, and therefore more dangerous, when it is caused by an ignition source and not by self-ignition.

In general, dust explosions may be prevented with the following precautionary measures:

- The accumulation of dust is prevented by regular and continuous cleaning activities.
- The oxygen content of the air is kept low in closed areas to prevent an explosive atmosphere.
- The lighting of fires is strictly forbidden within the installation.
- Tanks, containers, equipment, areas, etc. are all kept ‘dust-proof’.

12.4. Personal Protective Equipment

Respiratory protection equipment shall be available in areas at particular risk of sulphur ore dust explosions. Rescue chambers with pressurized fresh air supply may be needed because of long escape routes.

13. EVACUATION

13.1. Fire Alarm Systems

Mines and underground constructions shall have warning systems for evacuation purposes. The system should depend on the conditions of the works, e.g.:

- Acoustic alarm.
- Two-way radio for communication, covering the entire works, can be used, provided everybody can be alerted in case of alarm.
- Flashing emergency lighting can be used provided that there are fittings throughout the entire works. Power cuts always lead to the evacuation of all personnel.
- The new “through the earth” radio systems have the potential to become an effective, all-covering alarm system, which reaches all underground personnel within only few seconds. The systems are based on one-way communication and are, therefore, no substitute for the ordinary two-way communication. They may, however, be seen as a helpful complement in areas where there is no complete coverage for the two-way communication or where the two-way radio may not work any longer in case of fire.

13.2. Evacuation Plan

Schematic maps of escape routes shall, whenever necessary, be set up in the appropriate places. They shall also give information about how to alert the local rescue services and other necessary first-aid personnel. The locations of manual alarms and emergency telephones are also indicated on the map, as well as the meeting point.

13.3. Emergency Preparedness Plans

Emergency preparedness plans shall be established for all installations underground. Such plans shall be thoroughly examined and reviewed at least once a year. See appendix “Establishing an Emergency Preparedness Plan”. Evacuation plans shall be regularly practised to the extent necessary.

13.4. Escape Routes

The principal rule consists in any construction’s having two entirely separate escape routes. This means that if one escape route becomes unusable due to damage, the other escape route may still be used.

Operations involving a risk of fire must not be conducted in areas with only one escape route; the operations must then be moved to another area. Such areas and their escape route should be kept empty of combustible material.

Vertical and/or steep escape routes shall be equipped in such a way as to allow rapid evacuation. If the only underground escape routes are lifts, there shall be an independent means of power supply, e.g. a diesel generator.

High buildings, e.g. head frames, shall have stairs or ladders on the inside, and ladders on the outside of the buildings. The ladders shall be hoop ladders and be provided with intermediate landings, and they shall be accessible from each floor.

Lifts shall not count as escape routes; the only exception being lifts in mines, which may be used as escape routes provided there is a lift only for rescue purposes or there is an independent means of ensuring the power supply.

13.4.1. Mobile and Stationary Rescue Chambers

Rescue chambers may often be an alternative or complement to escape routes. This is especially true for areas that are difficult to clear of all personnel within a short time in the event of a fire. The erection of a rescue chamber should be preceded by a risk assessment.
Rescue chambers may be mobile or stationary.
Rescue chambers shall be designed for a defined number of people and be equipped in such a way as to provide them with the necessary amount of breathing air for at least four hours. The chambers should also dispose of an emergency communication installation.
Rescue chambers shall be regularly controlled in accordance with an established procedure.
All escape routes shall be clearly marked with signs.

13.5. Emergency Lightning/Emergency Exit Signs

In underground constructions everybody shall carry their personal lamps. Underground constructions must be provided with emergency lights that ensure the safe clearing of all personnel. Fluorescent lighting/signs may be used as a complement.

14. PERSONNEL CONTROL SYSTEMS

14.1. General Remarks

The regulation on mining, of the Working Environment Authority says that underground installations shall have a personnel control system. The system shall make it possible to check how many persons are underground and in which areas in the event of an emergency such as a fire, cave-ins, the emission of toxic gases, etc.

14.2. Alternatives

14.2.1. Example

- We recommend the clocking-in or tagging as a personnel control system. It is, however, important to locate the cards near the entrance of the underground installation in order to make sure that the personnel does clock in.
- In areas that are frequented by few persons only and very rarely by temporary visitors, a board with e.g. name badges or the like may be used.

14.3. Respiratory Protection

In accordance with the Working Environment Authority's regulation on mining, all mobile machines must carry respiratory protection equipment for as many people as are allowed to ride the machine.

15. ALERTING

15.1. Internal Alerting Mechanism

Instructions shall be available on how to alert the works' rescue service and on how to inform the personnel concerned about evacuation quickly (see chapter 13 on evacuation).

15.2. External Alerting Mechanism (Emergency phone # 112)

Instructions/alert procedures shall be available describing how to alert the local rescue services and any other external parties.
In accordance with the Working Environment Authority's regulation on mining an appropriate alerting and warning system should be part of the emergency preparedness plan.
Emergency preparedness and respond should be trained and evacuation plans be practised.
Installations, machinery, devices, etc. shall be properly inspected to the extent necessary.
Detailed instructions shall be set up and the personnel concerned shall be informed.
It can be appropriate to take specific measures that will ensure correct and easier alerting; e.g. an emergency phone number or an emergency telephone line that make it possible to alert a number of people at the same time.
Automatic fire alarm installations and automatic fire suppression equipment should be installed in areas where the risk of fire is high and a fire can cause severe injuries and great property damage.

15.3. Automatic Fire Alarm Systems

Automatic fire alarm systems protect both property and personnel, as they alert at an early stage. In some cases insurance conditions may make the installation of automatic fire alarm devices mandatory.
It must be emphasized that fire alarm devices are installations that guarantee safety, and the demands made on the quality and reliability of such appliances must, therefore, be very high.
The system must be carefully planned and installed. It is regularly tested and maintained.
The system should be designed and installed by an authorized company specializing in fire alarm installations. If the person installing the system is not certified, the installation shall be carried out under the supervision of the company issuing the installation certificate. The installed system shall then immediately be inspected by an authorized company.

15.4. Definitions – Installation of Fire Alarm Systems

15.4.1. Emergency Cabinet

The emergency cabinet shall comply with the Swedish standards in force. The emergency cabinet shall be designed and erected in such a way as to allow the storage of maps and

drawings, operation and maintenance instructions and control records. It is also possible to use an additional cupboard as a complement.
The emergency cabinet shall also contain instructions on emergency response and emergency measures, on false alarm, and information about the person responsible for the alarm system. The location of the emergency cabinet is determined in cooperation with the local rescue services.

15.4.2. Alarm Center

Responds to all incoming and outgoing signals. The alarm center is supposed to be staffed 24 hours a day.

15.4.3. Fire Alarm Installations

The alarm device may give visible and/or audible signals. The fire alarm signal shall be unique, which means it may not be taken for some other signal, e.g. operational signal (for more information see AFS on signage).

15.4.4. Detectors

The probable development of a fire at an early stage, the dimensions of the area, the conditions of the surroundings and possible sources of false alarm in the area to be protected are important factors to consider when selecting detector type.

Heat detectors: react to increasing temperature.

Smoke detectors: react to smoke. There are

- ionising smoke detectors and
- visual smoke detectors.

Aerosol detectors: react to fire aerosols. Recommended for immediate detection.

Flame detectors: react to light variations caused by the fire.

Automatic fire alarm systems shall be installed in accordance with SBF 110.

16. FIRE SUPPRESSION EQUIPMENT

16.1. General Remarks

Fires that are left unattended soon make evacuation very difficult or impossible. In order to be able to start fighting the fire quickly, the right type of fire suppression equipment must be easily accessible.

2§ of the Act on Protection against Accidents states as follows:
"Owners or beneficiary owners of buildings or other facilities shall, to an appropriate extent, have equipment for the suppression of fire or for life-saving activities in readiness in case of a fire or other accidents, as well as take the necessary precautions for the prevention of fire. Furthermore they shall take the steps needed for the prevention or restriction of damage caused by fire."

16.2 Portable Fire Extinguishers

Extinguishers Class A	for the suppression of fire in solid organic material such as wood, paper and textiles.
Extinguishers Class B	for the suppression of fire of fluids or plastics.
Extinguishers Class C	for the suppression of fire with gases.

In most situations powder is the most effective fire-fighting agent.

16.3 Hose Reels

The modern design mainly consists of a reel with a shape-resistant hose that is permanently connected to a water tap. This modern type of hose reel is more useful than the older slimline hose reels, as the user does not need to pull out more than the length of hose

needed. When using the ordinary slimeline hoses, the fire-fighter must pull them out in their entire length, before water can be conveyed.

Fire hose with reel

16.4 Heavy Fire Suppression Equipment

In areas at great risk of fire it may be necessary to have access to heavy fire suppression equipment such as thick hoses (normally 63 mm), dividing breeching, jet-pipes and even water cannons. Light foam may be used in closed areas, e.g. workshops. Fire suppression equipment and other life-saving equipment may be stored and transported in a equipment trolley.

16.5 Sprinklers

Sprinklers may be used to suppress fires or to keep fires within bounds in order to facilitate evacuation and further fire-fighting activities. The agent most commonly used is water and carbon dioxide. Dry powder sprinklers are used for selective suppression. Sprinklers may be used for selective and total suppression.

16.6 Selective Fire Suppression

Equipment for selective fire suppression is often used for machinery, vehicles, trackbound transport systems, etc. The most common means of suppression in underground constructions is water and dry powder, sometimes even carbon dioxide.
Releasing devices may be activated manually or by remote-control.

16.7 Total Fire Suppression

The installation of equipment for total fire suppression is appropriate in areas where fires would probably cause great damage on property or where evacuation would become more difficult or even impossible.

Sprinklers should, in such cases, be installed together with an automatic fire alarm system, which will also bring the sprinklers into action.
Examples of installations that should be protected by sprinklers:

- large workshops and storage facilities,
- magazines;
- transformers,
- important closed operating areas,
- head frames,
- parking lots.

16.8 Water Supply

The water supply of hose reels for indoor use does usually not present any problems, as the water supply installations of both the industry and the municipality can be used without additional pressurization.
Extensive sprinkler systems often make it necessary to install larger pipes to ensure the supply of water. It may also become necessary to build additional water reservoirs. Even pressurization installations may be needed.

16.9 Inspection and Control

16.9.1. Inspection

Fire suppression equipment is inspected as often as necessary with respect to the environment of the workplace. The following must be paid attention to:

- the fire suppression equipment is where it should be,
- the fire suppression equipment is easily accessible,
- the fire suppression equipment is in working order,
- each inspection and supervision are carried out in accordance with maintenance instructions,
- safety representatives of each workplace are responsible for replacing faulty or used fire suppression material.

16.9.2. Control

Control involves the regular checking of portable fire extinguishers and fire suppression equipment, usually once a year – is anything damaged? Does everything work properly?
Moreover, the following shall be checked:

- the portable fire extinguishers can be easily removed,
- the location of the fire suppression equipment is clearly marked,
- the directions for use can be read,

- refilling antifreeze in places at risk,
- the tanks are still sufficiently pressurized (test pressure if necessary),
- date and signature must be registered on the card fastened on the extinguisher.

Hose reels for indoor use shall be tested. Sprinkler systems shall be regularly tested. Sprinkler systems actuated by automatic fire alarm systems shall be tested every three months. Attention must be paid to local factors such as risk of frost and possible pollution of water. Instructions for the testing of sprinkler systems shall be set up, and controls registered in a logbook.

16.10 Recommendations concerning Fire Suppression Equipment

16.10.1. Staff Shelters and Tool-Sheds

Dry powder fire extinguisher ABC, at least 6 kg. Foam fire extinguisher AB, at least 6 l.

16.10.2. Oils Reservoirs

Dry powder fire extinguisher ABC, at least 6 kg or foam fire extinguisher AB, at least 9 l for small tanks (maximum 1000 l). At least two fire extinguishers for larger tanks (more than 1000 l).

If the reservoir has more than one access, there shall be a fire extinguisher at every entrance.

16.10.3. Workshops and Maintenance Facilities

Dry powder fire extinguisher ABC, at least 6 kg for small workshops and maintenance facilities.

The fire-fighting agent of a fire extinguisher of Class ABC is capable of suppressing fires of both fibre material and oil and gas. The dry powder used today can also be used to suppress electrical fires.

Large workshops that are at risk of more extensive fires should be provided with as many hose reels as needed for the suppression of fire in any part of the location (hoses with a length of 20 – 30 m).

Wherever flammable liquids are handled, there shall be fire extinguisher of Class B. The distance to one of these fire extinguishers should not exceed 20 m. In some cases the installation of sprinklers and/or other fire suppression equipment may become necessary.

16.10.4 Magazines

See recommendations for workshops.

16.10.5 Trackbound Transport Systems

Shorter conveyor belts are provided with hose reels and an appropriate number of portable fire extinguishers ABC.

Long conveyor belts that are not self-extinguishing shall be provided with water sprinklers.

Self-extinguishing conveyor belts shall be provided with fire suppression equipment in the following areas:

- the area where the drive rollers are situated,
- the head end and tail end of the conveyor belt,
- the area where electrical engines and electrical equipment are situated,
- the belt maintenance areas.

16.10.6 Other Facilities

Recommendations are meant to help the fire safety coordinator form a view about the need of fire suppression equipment, which type of equipment should and, in most cases, must be installed.

The fire safety coordinator should seek advice from the local rescue services in order to get an expert opinion. Sprinkler and automatic fire alarm systems are always designed and installed in accordance with the regulations in force.

16.10.7 Vehicles

See chapter 7.5.

16.10.8. Sprinklers

Sprinklers shall be installed in areas where fires would cause great material damage and evacuation would become more difficult or impossible.

Sprinklers may, and in such cases should, be installed together with an automatic fire alarm system, which also actuates the sprinklers. Automatic fire alarm systems should preferably transmit the alarm to the local rescue services.

Examples of installations that should be protected by sprinklers:

- large workshops and storage facilities,
- trackbound transport systems,
- magazines,
- transformers,
- important closed operating areas,
- head frames,
- parking lots.

17. ORGANISATION AND EDUCATION

17.1. General Remarks

In accordance with the Act on Protection against Accidents “owners or beneficiary owners of buildings or other facilities shall, to an appropriate extent, have equipment for the suppression of fire or for life-saving activities in readiness in case of a fire or other accidents, as well as take the necessary precautions for the prevention of fire. Furthermore they shall take the steps needed for the prevention or restriction of damage caused by fire”.

It is, therefore, the owner’s or the beneficiary owner’s ultimate responsibility to make sure that the necessary precautions are taken. Nevertheless, the local rescue services are responsible for rescue operations.

Fire prevention and protection issues must be considered all the time. It is, therefore, necessary to designate a fire safety coordinator who has the necessary knowledge for the task. If there is a works’ fire brigade, its commander shall act as fire safety coordinator.

The fire safety coordinator shall see to it that the precautions are appropriate and satisfying. He/she shall carry out inspections, making certain that:

- evacuation plan and evacuation routes would work satisfyingly in the event of a fire,
- alert and warning systems work properly,
- each and every employee knows what to do in case of alarm.
-

Furthermore, the fire safety coordinator shall be in charge of:

- minimizing the fire load,
- making sure that necessary storage facilities and areas for storage are adequately located and do not encumber each other or escape routes,
- ensuring an adequate supply of water,
- establishing contact with the local rescue services and the insurer of the company in the event of modernisation and extension,
- setting up routines for the reporting of fire damage.

The fire safety coordinator should be responsible for the organisation of rescue and fire suppression equipment and see to the following:

- the availability of appropriate rescue and fire suppression equipment in effective order in the appropriate locations and to the extent necessary within the installation;

- the personnel has received appropriate instructions and is drilled in the use of the equipment.

The fire safety coordinator shall be in continuous contact with the local rescue services with respect to fire prevention and protection matters.

Great fires in underground constructions may turn out impossible to control even by the joint actions of the works' fire brigade and the local rescue services. It must, therefore, always be possible to call for reinforcements (of both personnel and equipment) from other plants and rescue services within short notice. The fire safety coordinator is responsible for establishing emergency preparedness plans.

17.2. Organisation

Preventive actions and measures, although well-planned and implemented, never guarantee safety. Fires can always break out, and there is always a certain fire load and risk of ignition. Not only fires, other accidents may also occur, which will have to be dealt with in a safe and appropriate manner.

In mines and underground constructions, just as in other industrial plants, systematic fire management should include the organisation of rescue and fire suppression actions, which should based on the following principles:

- all areas at risk, e.g. canteens, storage facilities, magazines, workshops, open storage areas, fixed and mobile machinery, etc. shall be provided with portable fire extinguishers and other appropriate emergency equipment. All personnel shall know how to use fire extinguishers and emergency equipment.
- If there is a risk of more extensive fires, heavy and more effective equipment and appropriate respiratory protection is needed. The usage of this kind of equipment requires a well-drilled fire-fighting team.
- The local rescue services are alerted at the same time as the rescue and fire-fighting team (in some cases the industrial fire brigade) of the installation.
- The incident commander of the local rescue services is in charge of the organisation and extent of the actions.

Joint actions are conducted in accordance with emergency preparedness plans that have been agreed upon beforehand.

17.3. Training

All personnel, contractors included, shall be trained to use fire suppression and rescue equipment. They shall also receive information about hazards resulting from fire, e.g. toxic gases, cave-ins, etc.

17.3.1. Basic Training

Basic training shall include both theoretical and practical aspects.

- Theoretical aspects should include parts of the Act on Protection against Accidents, the Working Environment Act, the cause and spread of fires, fire prevention and suppression measures, alerting, evacuation and statistics on fire damage.
- Practical aspects include the use of fire suppression and rescue equipment located at the workplace.

The participants of a basic training course shall, after the course,

- understand how fires can break out and how they spread,
- know about the regulations in force with respect of fire prevention,
- have received information about the risk of fire at the workplace,
- have received information about alerting, evacuation and fire suppression equipment,
- have received information about measures to be taken in the event of a fire,
- recognize signs marking fire suppression equipment and escape routes,
- understand the importance of informing themselves on the risks of fire at their own workplace, alerting, fire suppression equipment and escape routes,
- be able to use the fire suppression equipment located at their own workplace,
- know the duties/obligations of employer and employee.

Basic training courses are conducted by the fire safety coordinator, or by another employee knowledgeable about fire safety matters, possibly in cooperation with an instructor of the local rescue services.

17.3.2. Safe Performance of Hot Works

Personnel engaging in hot works shall be trained to adapt a safe means of performing hot work. The training leads to a certificate issued by the Swedish Fire Protection Association. There are similar certificates in the other Nordic countries. Hot works include operations such as welding, grinding, brazing, etc.

17.3.3. Emergency Assistant

The emergency assistant is mainly responsible for guiding the local rescue services in the event of rescue or fire suppression operations.

Emergency assistants shall be trained and have knowledge about the following:

- the physiology of the human body,
- safety requirements,
- caustic substances and toxic gases,
- the design and operation of respiratory equipment,
- the usage, control and care and maintenance of respiratory equipment,
- the putting on, checking, taking off of respiratory equipment,
- full suit rescue methods,
- practise full suit rescue – increasing degrees of difficulty,
- life-saving actions,
- practice exercises,
- care and maintenance of equipment.

The conditions underground being special, the practical aspects of the training are best addressed underground.

Drills shall take place at least four times a year.

Interaction with the local rescue services should be practised regularly.

Emergency assistants should be trained by professional civilian national service fire and rescue instructors.

18 REFERENCES

The most recent versions are available at:

The Swedish Work Environment Authority:	www.av.se
The Swedish Civil Contingencies Agency:	www.msb.se
The Swedish Fire Protection Association:	www.brandskyddsforeningen.se
The Swedish National Electrical Safety Board:	www.elsak.se
The National Board of Building, Planning and Housing:	www.boverket.se

The regulations of the Swedish Work Environment Authority:

AFS 2001:3	Use of Personal Safety Equipment
AFS 2009:2	Workplace Design
AFS 2007:7	BA and/or Full Suit Rescue
AFS 2007:1	Blasting Work
AFS 2003:2	Mining
AFS 2008:13	Information and Warning Signs
AFS 2006:4	Use of Working Equipment
AFS 2003:3	Working in Potentially Explosive Atmospheres

Other laws, regulations and standards:

ELSÄK-FS 2008:1-4	Regulations on the Design of Heavy-Current Installations
SFS 2003:778	Act on Protection against Accidents
SFS 2003:789	Regulation on Protection against Accidents
SFS 2006:263	Law concerning the Transport of Hazardous materials
SFS 2006:311	Regulation concerning the Transport of Hazardous materials
MSBFS 2009:2	Directions on National Land Transport of Dangerous Goods (ADR-S)
MSBFS 2009:3	Directions on Transport of Dangerous Goods by Railway (RID-S)
SFS 1988:868	Act on Flammable and Explosive Articles
SFS 1988:1145	Regulations on Flammable and Explosive Articles
SBF 110	Rules concerning Automatic Fire Alarm Systems
SBF 120	Rules concerning Automatic Sprinkler Systems

SBF 127	Rules concerning Machinery Used in Forestry and Road Building
SFS 1987:10	Building and Planning Act
SFS 1987:383	Building and Planning Regulations
BFS 1993:57	Building Regulations of the National Board of Building, Planning, and Housing – Mandatory Regulations and General Recommendations

SveMin

FIRE DAMAGE REPORT

To be sent in asap after fires or incidents

Fire damage report is sent to

FIRE SAFETY SUPERINTENDENT OF THE COMPANY

Company _____

Location _____

_____

Contact _____

tel _____ fax _____

Department _____

Location _____

☐ Underground ☐ On surface

Date and time of occurence _____

Date of report _____

Separate report exists ☐ yes ☐ no

Authority concerned has been informed ☐ yes ☐ no

Contractor ☐ yes ☐ no

Class ☐ ☐ 2 ☐ 3

2 FIRE OBJECT

2.0 Type of object

☐ Building ☐ Electrical installation ☐ Conveyer belt ☐ Other

☐ Fixed machinery ☐ Cable ☐ Storage of material _____

☐ Vehicle ☐ Wooden structure ☐ Waste

2.1 Type of machinery

☐ Drill machinery ☐ Loading truck ☐ Truck E ☐ Other maintenance vehicle

☐ Loader D ☐ Work. platform ☐ Truck ☐ Other

☐ Loader E ☐ Truck D ☐ Veh. for passenger transp. _____

2.2 Make _____

2.2.1 Model year _____

Fire Inspection ☐ yes ☐ no **Date** _____

3 CAUSE OF FIRE

3.0 Cause of fire

☐ Hot works ☐ Low voltage 50-1000 V ☐ Overheating/friction ☐ Other

☐ High voltage ☐ Extra-low voltage -50 V ☐ Hot surface _____

3.1 Hot works

☐ Welding
☐ Gas welding
☐ Grinding
☐ Heating with LPG
☐ Rotary cutting
☐ Other

3.2 Electrical faults

☐ Cable with ext. damage
☐ Old cable
☐ Cable overloaded
☐ Overdimens. fuse
☐ Underdimens. cable
☐ Unfused cable
☐ Short circuit
☐ Other

3.3 Overheating

☐ Diesel engine
☐ Electr. engine
☐ Bearing
☐ Conveyer belt
☐ Brake drum
☐ Brake disc
☐ Hydraul. pump
☐ V-belt
☐ Other

3.4 Hot surface

☐ Fuel on engine
☐ Oil on engine
☐ Engine + other comb. mat.
☐ Fuel on brake disc/drum
☐ Oil on brake disc/drum
☐ Brakes + other comb. mat.
☐ Oil on exhaust system
☐ Fuel on exhaust system
☐ Exh.syst. + other comb. mat.
☐ Other

SveMin

FIRE DAMAGE REPORT

To be sent in asap after fires or incidents

Fire damage report is sent to

FIRE SAFETY SUPERINTENDENT OF THE COMPANY

4 ALERTING

Detected by ☐ Automatic detector ☐ Staff

Alarm by ☐ Phone ☐ Comradio ☐ Other

5 RESCUE OPERATIONS

5.1 Fire and rescue crew

☐ Local rescue services ☐ Works' rescue service ☐ Staff at site

5.2 Equipment and material used

☐ Fire engine ☐ Port. fire extinguisher ☐ Hose

☐ Pumps ☐ Exist. water supply installations ☐ Pressurization installations

☐ Nothing/self-exting. ☐ Other ……

5.3 Fire-fighting agents

☐ Water ☐ Dry powder ☐ Carbon dioxide

☐ Foam ☐ Other - - - - - - - - - - - - - -

5.4 Sprinklers

☐ Sprinkler activated ☐ Sprinkler not activated ☐ Not applicable

5.5 Evacuation

☐ Total ☐ Partial ☐ None

5.5.1. Number of persons - - - - - - - -

5.6 Rescue chambers

☐ Were used ☐ Were not used ☐ None at the location

6. INJURIES

6.0 Injuries

☐ yes ☐ no

6.1 Number of injured

- - - - - - - - -

6.2 Absence from work with sickleave ☐ yes ☐ no

7. MATERIAL DAMAGE

7.1 Property damage

- - - - - - - - - - - ca. SEK

7.2 Damage due to operational breakdown

- ca. SEK

FIRE DAMAGE REPORT

To be sent in asap after fires or incidents

Fire damage report is sent to

FIRE SAFETY SUPERINTENDENT

OF THE COMPANY

8.0 Description of the events

9.0 Proposed measures

Date ---

Employer's representative

Safety representative

Yearly Fire Safety Inspection

Construction, industry and maintenance machinery in the mining industry (incl. contractors)

Machine manufacturor	Type	Company/Plant
Year of delivery	Intern no.	Dept.
Manufacture ID	Reg. no.	Machine operator
Operating hours		Tel.

Receiver of protocol if other than machine operator/fire safety coordinator

☐ Commented defects shall be repaired by the machine operator

Sect.	Components	OK	Repaired by	Repair no later than	Se enclosure
1	DESIGN-RELATED TECHNICAL SAFETY INSTRUCTIONS				
1.1	Signs for Instructions				
2	MACHINE ELECTRICITY				
2.1	Positive cables				
2.2	Other cables and cabling				
2.3	Battery				
2.4	Battery isolator and engine shut-off				
2.5	Start motor, alternator mounting and belt tension				
3	Electric power > 50 V (according to Heavy-Current Regulations)				
	see separate check list				
4	ELECTRIC SYSTEM-CABIN				
4.1	Cables / connections, damage				
4.2	Fuses, damage-function-attachment				
4.3	Cabin heat, damage - function				
5	MACHINE DESIGN				
5.1	Nozzle pipes, fuel, oil, hydraulic hoses/tubes, etc.				
5.2	Leakage, clamps				
5.3	Accumulation				
5.4	Hydraulic tanks				
5.5	Sheets/insulation				
5.6	Engine cleaning and machine washing				
6	EXTINGUISHING SYSTEM				
6.1	Portable fire extinguisher				
6.2	Sprinkler system				
7	HEATING EQUIPMENT				
7.1	Installation				
7.2	Fuel system				
7.3	Exhaust system				
7.4	Electrical system				
7.5	Engine, car heater				

Have any incidences occured during the past year? ☐ Yes ☐ No

Supplementary information

Inspection performed by	Date	Worksite/dept.

SveMin

Yearly Fire Safety Inspection (cont'd)

Machine manufacturor	Type	Company
Year of Delivery	Intern no.	Dept.
Manufacture ID	Reg. no.	Machine operator

SECT.	COMMENTS	REPAIR/SIGN

Inspection performed by	Date	Worksite/dept.

SveMin

Yearly Fire Safety Inspection

Checklist Inspection of Electrical High Voltage Equipment

Construction, industry and maintenance machinery in the mining industry (incl. contractors)

Machine manufacturor	Type	Company/Plant
Year of delivery	Intern no.	Dept.
Manufacture ID	Reg. no.	Machine operator
Operating hours		Tel.

Receiver of protocol if other than machine operator/fire safety coordinator

☐ Commented defects shall be rapaired by the machine operator

Sect.	Plant section	OK	Repaired by	Repair no later than	See appendix
3.1	**Power supply**				
3.1.1	Network connection				
3.1.2	Cable sleeving				
3.1.3	Cable coils, incl. connection				
	cables, limit switches				
3.1.4	Collector				
3.2	**Control box**				
3.2.1	Casing				
3.2.2	Connections				
3.2.3	Main power switch				
3.2.4	Cleanness of control box				
3.2.5	Surge voltage protector				
3.2.6	Conductors				
3.2.7	Devices				
3.2.8	Residual-current device				
3.3	**Electrical cables**				
3.3.1	Damage				
3.3.2	Maintenance				
3.3.3	Cable bridges				
3.4	**Electrical sockets**				
3.4.1	Casing				
3.4.2	Connections				
3.4.3	Test residual-current device				
3.5	**Lighting**				
3.5.1	Casing				
3.5.2	Connections				
3.5.3	Protection against falling objects				
3.5.4	Function				
3.6.	**Terminal boxes**				
3.6.1	Casing				
3.6.2	Connections				
3.7	**Engines**				
3.7.1	Casing				
3.7.2	Connections				
3.7.3	Cleanness				
3.7.4	Maintenance				

Have there been any fire incidents during the past year? ☐ Yes ☐ No

Details

Inspection performed by | Date | Worksite/dept.

SveMin

Yearly Fire Safety Inspection (cont'd)

Inspection of electrical high voltage equipment

Machine manufacturor	Type	Company
Year of Delivery	Intern no.	Dept.
Manufacture ID	Reg. no.	Machine operator

SECT.	COMMENTS	REPAIR/SIGN

Inspection performed by	Date	Worksite/dept.

Appendix 3

YEARLY FIRE SAFETY INSPECTION

Guidelines

SveMin

Swedish Association of Mines, Mineral and Metal Producers

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Yearly Fire Safety Inspection - Checklist Guidelines

Introduction

All vehicles/machines shall be subject to undergo a yearly fire and safety inspection according to the established GRAMKO guidelines and checklist.

For a more detailed explanation, see GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry.*

The following items shall be inspected and repaired.

1 Design-related Technical Safety Instructions

1.1 Instruction and Informative Signs

Signs shall be clearly visible, with Swedish text and/or with symbols, and shall be in good condition.

The following instruction signs are required:

- Direction signs for battery isolators.
- Direction signs for concealed portable fire extinguishers.
- Instruction signs for releasing and shut-off devices.
- Clearly visible instructions for the use and the maintenance of portable fire extinguishers shall be located close to the operator's position.
- Any openings in the machine body for the extinction of fires with portable extinguishers shall be well marked.

For signs in general, see GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 8, Instruction and Informative Signs.

1.2 Disconnecting/Releasing Devices. Emergency Stop Devices and Engine Shut-off

Underground machines/vehicles shall be equipped with emergency stop devices disconnecting all power supply as well as stopping engines and working tools.

Machines operating on surface shall, in some cases, be equipped with external engine shut-off devices.

Emergency stop/engine shut-off devices shall work according to GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 3, Disconnecting/Releasing Devices.

2 Electrical System of the Machine/Vehicle (up to 50 V)

General remarks

The electrical system of a machine shall be designed in such a way that failure resulting in fire is avoided.

For more details on wiring aspects, see GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 2, Electrical System.

2.1 Electrical Cables and Wiring

Cables and wires shall always be protected against rubbing, overload or high temperatures and shall therefore be encased in protective tubes when installed in engine compartments or the like. Cables and wires must not fail because of mechanical wear, age, oil or desiccation.

Cables or wires must not be fastened directly to fuel or hydraulic hoses/pipes. Exceptions can be made for correctly fused low-voltage cables enclosed in protective tubes. They may be fastened to hydraulic hoses/pipes.

Electrical cables fused with 10 ampere or more shall be encased in protective tubes.

The protective tubes for cables shall meet the requirements defined by SAE J517 (SAE 100 R 6).

Special attention shall be given to cable conduits, movable joints and seams.

Insulated clamps shall relieve the strain on the cables/wires.

2.2 Battery Cables, Positive Cable

The positive cable of a battery shall be well attached and protected in its entire length by a protective tube that does not show any signs of damage caused by use, oil, desiccation or wear.

Battery terminal covers/insulation shall be found on all connections.

2.3 Battery

The battery shall be firmly attached. Battery terminals shall be provided with covers/insulation.

The battery compartment shall be well ventilated.

2.4 Battery Isolator

The machine shall be equipped with a working battery isolator that shall be easily accessible and equipped with battery terminal covers/insulation.

It is recommended to have at least one disconnection at the positive terminal or an automatic disconnection.

2.5 Start Engine and Alternator Mounts, and Belt Tension

The start engine and the alternator shall be firmly attached and the belt tension shall be checked according to the manufacturer's recommendations.

Battery terminal covers/insulation shall be installed.

2.6 Electrical System in the Cabin (Cables/ Connections)

Cables and cable clusters must not undergo any strain and must not be fastened in such a way that the insulation may take damage.

Insulated clamps shall be used.

Cable conduits shall be protected with insulating material. See also Section 2.1.

2.7 Fuses (Damage, Function and Installation)

Check fuses and fuse slots.

Computer equipment, emergency and/or warning systems connected before the battery isolator of the machine shall be fused separately or with the minimum amperage.

3 High-voltage Equipment – Electrical power > 50 V

Electrical power > 50 V shall be checked by authorized staff only and according to instructions for high-voltage devices. See separate checklist.

4 Machine Design and Maintenance

See also GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry.* Chap. 4. Fuel and Air Conduits.

4.1 Nozzle Pipes, Fuel, Oil and Hydraulic Hoses/Tubes, etc.

Fuel, oil and hydraulic hoses/tubes shall be undamaged and without leakage and wear.

Special attention shall be given to the fuel system according to the following:

Nozzle pipes shall not show damage caused by wear.

The nozzle pipe shall have vibration-damping elements correctly mounted and tightened.

Nozzle pipe connections shall be appropriately tightened and sealed.

Fuel lines shall be fire-resistant and without wear.

Fuel/hydraulic hoses/tubes shall not be in contact with hot surfaces. If unavoidable, insulating elements shall be mounted.

Fuel/hydraulic hoses/tubes shall be installed in such a way as to avoid damage caused by bending stress. They must not show signs of wear.

4.2 Leakage, Clamps

Fuel lines must not leak. The hydraulic system must not leak abnormally. Electric cables shall never be mounted together with hydraulic hoses. An exception can be made for correctly fused low-power cables and cables encased in protective tubes.

All types of cables shall be clamped.

Hydraulic hoses shall be encased and clamped in such a way as to avoid ruptures next to connections and cables. Even hydraulic pipes shall be well clamped.

4.3 Accumulation of Flammable Materials/Fluids

The accumulation of flammable materials/fluids shall be avoided in the machine.

Pockets and places where oil and/or other flammable materials can accumulate should, if possible, be drained.

4.4 Fuel and Hydraulic Tanks

Tanks shall be of fire-resistant material and must meet the requirements in ECE R 34 annex 5.

Pivot tubes and similar inspection glass shall be of fireproof material and must not leak abnormally.

Hydraulic tanks that are located at some height and prone to leak oil in large quantities should be furnished with valves that can easily be shut off.

4.5 Sheets, Insulation

Hot surfaces should, if possible, be shielded with protective sheets or other insulating material.

Insulation and other materials shall be fire-resistant and fulfill the requirements in ISO 3795.

Inaccessible areas within reach of the fire extinguishing system shall be equipped with well-marked instructions facilitating the extinction of fires with portable extinguishers. Conduits shall have a diameter of at least 50 mm.

4.6 Exhaust System

No leakage shall occur and no flammable materials shall be found in the vicinity of hot surfaces.

The exhaust system shall be well mounted.

4.7 Fuel Shut-off

Underground machinery shall be equipped with easily accessible fuel shut-off devices. It is recommended that the machines be equipped with electro-mechanical shut-off devices.

See GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 4.2. Fuel Shut-off.

4.8 Engine Cleaning and Machine Washing

Cleanness is the most important aspect with regard to fire prevention and fire waste reduction.

5 Fire Extinguishing System

5.1 Portable Extinguishers

The machines shall be equipped with the recommended amount of portable fire extinguishers.

See GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 11. Fire Prevention Devices and Safety Alternatives for Machinery/Vehicles.

The minimum requirement for portable fire extinguishers is class 43 A 233BC, 6 kg according to standard EN 3.

The extinguisher shall have undergone a check/service within a determined time period.

Inspections shall make sure of the following:

- Portable fire extinguishers shall be mounted in assigned spots.
- Portable fire extinguishers shall be easily accessible and easily removable from their holders.
- Fuses shall be sealed.
- Instructions shall be readable.
- Portable fire extinguishers shall show no external damage.
- Portable fire extinguishers shall be equipped with a pressure gauge (manometer) and the manometer needle shall be positioned in the GREEN sector.
- Informative signs for portable extinguishers shall be mounted according to instructions.
- Loosen up the powder in the extinguisher by striking the extinguisher with a plastic/rubber hammer or a similar object that will not damage the container. Reload the extinguisher when uncertain about the viscosity of the firefighting agent.

5.2 Fixed Fire Extinguishing System

For fixed fire extinguishing systems, the service and maintenance instructions of the contracting company shall be followed.

The function and efficiency of the extinguishing system shall always be maintained and failures shall be attended to without delay.

Check that service/function inspections are performed.

Service and function inspections of the extinguishing system shall be performed yearly by an approved organization or service staff certified by the organization.

5.3 Releasing Device

The releasing device and lever shall not be damaged.

See GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 3, Disconnecting/Releasing Devices.

6 Heating Equipment

See GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry,* Chap. 5, Heating Equipment.

6.1 Installation

LP or diesel-fueled engines and/or cabin heaters shall not be installed in order to prevent the ignition of the machine because of leaking gas/fuel.

6.2 Fuel System

The fuel line between the pump of the heater and the socket of the tank shall be of fire-resistant material. The hydraulic hose SAE 100 R1 may be used or material that meets the requirements in the standard ISO-EN 7840 annex. Check that pipes are well attached and that no wear/rubbing or other damage can occur.

6.3 Exhaust System

Check that the exhaust system of the heater is in good condition and that no leakage occurs.

The exhaust system must not be in the vicinity of and/or in areas where flammable material/fluids may accumulate.

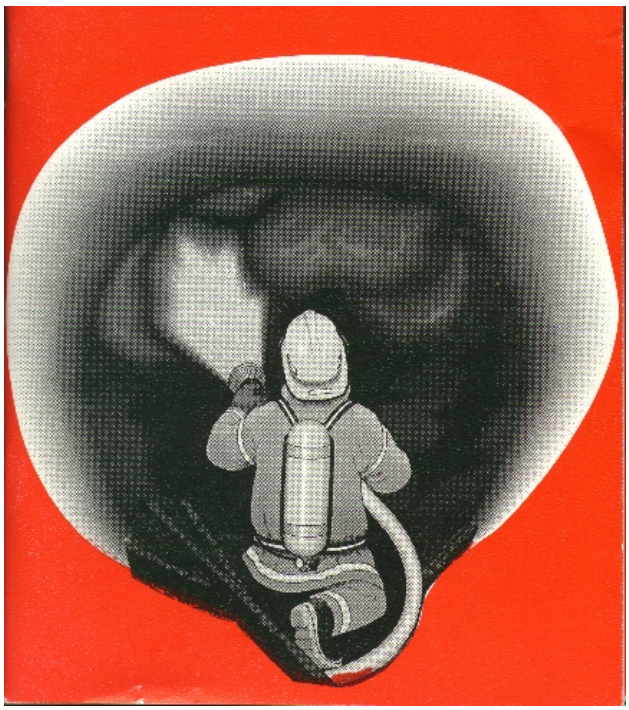
6.4 The Electrical System of the Heater

Fuses shall be installed as closely to the electrical socket as possible.

Fuses shall have the correct amperage.

Cables shall be protected and encased in protective tubes for their entire length, and they shall be undamaged.

Appendix 4



Yearly Fire Safety Inspection

High Voltage Equipment of Machinery – Electric Power > 50 V

Checklist Guidelines

SveMin
Swedish Association of Mines, Mineral and Metal Producers

Table of Contents

Guidelines for the Yearly Fire Safety Inspection of High Voltage Equipment of Machinery – Electric Power > 50 V

General Remarks

All vehicles/machines shall be subject to undergo a yearly fire and safety inspection according to the established GRAMKO guidelines and checklist.

For a more detailed explanation, see GRAMKO's *Rules for Fire Safety and Technical Safety Equipment of Construction, Industry and Maintenance Machinery in the Mining Industry.*

The following items shall be inspected and repaired:

3 High Voltage Equipment of Machinery – Electric Power > 50 V

Electric power > 50 V shall be checked by authorized personnel only and according to instructions for high voltage equipment.

3.1 Power Supply

3.1.1 Connecting Plugs	Inspect plug for burn marks, openings, cracking on the insulation.
3.1.2 Cable Fitting	Damaged wires? Correct exterior and interior fastening? Correct length and connection?
3.1.3. Cable Reel, Cable, Limit Switches	Brake, damaged cables, correctly set limit switches.
3.1.4 Collector	Damaged brushes, insulation, rings. Maintenance, cleanness.

3.2 Control Box

3.2.1 Casings	Rubber strips, locks, mechanical damage.
3.2.2 Connections	Check the connections of the incoming cable and motor cables.

3.2.3 Main Power Switch	Check if handle/switch is damaged. Check the settings.
3.2.4 Cleanness	The control box and the casings must be clean and the interior must be dry.
3.2.5 Overcurrent Protection	Check the settings and push the test button (motor started).
3.2.6 Conductors	Check the correct setting of the conductors in their connections, particularly the ground wire.
3.2.7 Devices	Check that all devices are safely set in their proper places.
3.2.8 Residual Current Device	Equipment protection 300mA.

3.3 Electrical Wiring

3.3.1 Damage	Cable casings shall be undamaged.
3.3.2 Cleanness	Dust, concrete remains, grease or the like impair cooling and must not be allowed to accumulate between cables.
3.3.3 Cable Protection	Protective tubes and cable ducts shall be undamaged and intact in order to avoid damaging the encased cables.

3.4 Electrical Sockets

3.4.1 Casings	Casings shall be intact and complete, and the sleeves for the socket connection shall be undamaged.
3.4.2 Connections	Connected cables shall be undamaged and equipped with cable glands. Connection cables shall also have strain relief fittings.
3.4.3 Test Residual Current Device	230 V and 400 V

3.5 Lighting

3.5.1 Casings	Lighting fittings shall have undamaged casings that may even consist of safety glass. The installation of the fittings in the machine body shall be undamaged.
3.5.2 Connections	Connected cables shall be undamaged and equipped with cable glands. Connection cables shall also have strain relief fittings.

3.5.3 Protection against Falling Objects	Additionally reinforced protection against mechanical damage shall be intact and in such good shape that e.g. bulbs can be replaced.
3.5.4 Function	All lighting shall work as intended.

3.6 Connection Boxes

3.6.1 Casing	Rubber strips, locks, mechanical damage.
3.6.2 Connection	Cable connection casings shall be intact. Connection cables shall be undamaged and equipped with strain relief fittings.

3.7 Motors

3.7.1 Casing	Casings shall be intact, and lids shall be in place and appropriately sealed.
3.7.2 Connections	Cable connections to the casing shall be intact. Cable connections shall be undamaged and equipped with strain relief fittings.
3.7.3 Cleanness	The motor frame and the grid of the cooling fan shall be clean and free from dust, etc. to ensure the necessary cooling.
3.8.4 Maintenance	The correct type of lubricant must be used.

Appendix 5

Establishing an Emergency Preparedness Plan

CONTENTS

Commentaries

1 Contact List

Contains the names and phone numbers of the mine superintendent, fire safety superintendent, trained fire-fighters and full suit rescuers, trained first aid personnel, rescue experts and other individuals involved in the Emergency Preparedness Plan.

2 Equipment and Material

Should be divided into:
A. Fire suppression equipment (list and location)
B. Compressed-air apparatus (location)
C. Rescue equipment (location)

3 Alerting

Should be divided into internal and external alerting.

Internal alerting

There shall be instructions describing how to alert the works' rescue service and how to clear the site of the staff concerned quickly.

External alerting

There shall be instructions describing how to alert external parties such as the local rescue services and other rescue teams.

4 Evacuation

The Emergency Preparedness Plan can contain information on the conditions under which to carry out total or partial evacuation. Large mines/underground constructions establish a separate evacuation plan (separate file).

5 Power Supply

Set up a map of power supply areas and switchpoints.

6 Ventilation

Set up a map of main airflows, as well as a list of important blowers and gates.

7 Water Supply

Locate all hose reels (with hose length) and water reservoirs on a map.

8 Instructions

Set up separate instructions for switchboard staff, lift operators, gatekeepers, etc., if necessary.

9 Information

Designates spokesperson/s and defines how information shall be given to families, authorities, media, etc.

10 Reinforcements

List of possible additional supplies of people and/or equipment that will be able to assist if the resources of the installation or of the municipality are judged to be insufficient.

General Remarks

The Emergency Preparedness Plan shall also include the following information:

- the number of copies;
- a listing of all recipients;
- a record of plan amendments (the plan should be updated at least annually).

The local rescue services shall also receive a copy of the Emergency Preparedness Plan.