

SveMin's instruction for vehicles, machinery and technical equipment



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Preface

This work environment and safety instruction for vehicles, machinery and technical equipment in the mining and mineral industry is published by SveMin and the Mining and mineral industry work environment committee (GRAMKO).

SveMin is a trade association for mines, mineral and metal producers in Sweden, that through GRAMKO monitors and handles work environment issues.

The GRAMKO Work group Technology has, commissioned by GRAMKO, the task to advise and promote an overall perspective on the essential and applicable health and safety requirements in order to improve and ensure a good work environment and a good protection against personal injury and property damage.

The GRAMKO Work group Technology prepared this instruction, which replaces the "EHS guidelines for machinery used in the mining and minerals industry" (2013).

This instruction was prepared for employers, manufacturers and suppliers in/to the mining and mineral industry to provide advice regarding safety and health for procurement, design, manufacturing, installation, repair and maintenance of machinery and other work equipment.

The starting point in order to comply with the product and work environment requirements are the requirements stated in the Product Liability Act and the Work Environment Act, as well as the provisions under these laws. Work environment hazards may also be described by other legislation. This instruction refers to, clarifies and complements the specific requirements stated in regulations and standards.

SveMin owns this instruction and it is the responsibility of the GRAMKO Work group Technology to maintain and develop it.

To constantly improve the instruction, feedback and experiences are collected from the member companies and other stakeholders and decisions are then made on possible revisions/additions.

Changes in the instruction are approved by GRAMKO.

Scope

The instruction includes requirements and recommendations on vehicles, machinery and technical equipment used both on surface and underground.

In addition to the applicable statutes and regulations and what is described in this instruction, there may be specific corporate requirements, instructions and/or recommendations.

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Introduction

In procurement, design, manufacturing and supply of vehicles, machinery and technical equipment it is important to identify the EU directives, national laws, harmonised standards and industry requirements that apply to the product.

The directives specify in general terms the essential requirements the product must comply with. In the harmonised standards associated with the product directives, the essential requirements are specified in detailed technical terms. In the harmonised standards, important product requirements are defined.

A list with examples of some important standards for vehicles, machinery and technical equipment is available in Appendix 3.

In addition to the applicable statutes and regulations and what is described in this instruction, there may be specific corporate requirements, instructions and/or recommendations.

References

This instruction should be read together with SveMin's publication "**Fire safety in mines and underground constructions**", which clarifies requirements regarding the design of machinery and technical equipment in order to comply with the fire safety requirements of the industry. The appendices to the publication can be of great help when inspecting both new and existing equipment.

1. Part 1: Specifications for all machinery and technical equipment

Part 1 states general requirements for all vehicles, machinery and technical equipment.

Part 2 states supplementary requirements for certain types of vehicles, machinery and technical equipment. In the Appendices, there are check lists and further information.

1.1 General requirements

Vehicles, machinery and technical equipment should be designed with the best technology available.

All vehicles, machinery and technical equipment should at least comply with the essential requirements for health, safety and environment stated in Swedish laws and regulations.

When designing machinery, it is important to take into account the different groups of operators and their large variations in physical conditions.

The Transport Agency's requirements on the technical design is also applicable to road vehicles used within work areas, with the exception of inspection requirements for vehicles that are not registered for use on public roads.

Engines that do not emit combustion gases to the environment should as far as possible be used underground. Gasoline, ethanol or gas may not be used as a fuel for combustion engines underground, except for external emergency vehicles. (See AFS 2010:1)

For diesel driven combustion engines, see section 1.2 Engine systems.

1.1.1 Automated systems

Effects of automation on the work environment and safety should be considered in an early stage of the design process. Risk analyses and risk assessments are conducted for assessment of the effects and should be made in collaboration between the suppliers and users.

1.2 Engine systems

1.2.1 General

Diesel engines shall conform to the EU emission requirements, in accordance with the Transport Agency's regulations.

Engines for new work machines shall at least comply with the EU emission requirements under step 4 and/or Euro 6 in order to, with the latest technology available, comply with future limit values in the work environment.

When procuring new machinery, the mining and mineral industry requires that also work machines are equipped with vehicle mounted diagnostic systems for OBD (On Board Diagnostic) / OMD (On board Measuring Diagnostic), according to the same rules as for road vehicles, in order to verify that the engine complies with the promised requirements on exhaust values. The values shall be possible to read at the normal service occasions, by the ordinary service staff.

For used work machines or leased machines (contractors), the emission requirements shall comply with the requirements applicable when the machine was manufactured, but at least by the requirements in force five (5) years ago.

Before a vehicle is put into service underground, it shall be examined to ensure that the exhaust gas concentrations of carbon monoxide and particles comply at least with the current limits. Thereafter, examinations shall be made continuously. (See AFS 2010:1). The values shall be documented and made available.

The Transport Agency puts the following requirements on emissions from new private cars and light trucks.

Requirements – private cars (M) and light trucks (N1) with diesel engine

Note that the requirements for these are reported in the unit g/km

Stage	Year	Category	Weight kg	Limit value (g/km)					Note the unit
				NOx	NMHC	THC+NOx	CO	Particles	
Euro 5	2008	M	All	0.180	–	0.230	0.500	0.0045	
		N1	≤ 1 305	0.180	–	0.230	0.500	0.0045	
		N1	1 305 – 1 760	0.235	–	0.295	0.630	0.0045	
		N1	≥ 1 760	0.280	–	0.350	0.740	0.0045	
Euro 6	2014	M	All	0.080	–	0.170	0.500	0.0045	
		N1	≤ 1 305	0.080	–	0.170	0.500	0.0045	
		N1	1 305 – 1 760	0.105	–	0.195	0.630	0.0045	
		N1	≥ 1 760	0.125	–	0.250	0.740	0.0045	

The Transport Agency puts the following requirements on emissions from new machinery.

Requirements – heavy trucks

Stage	Year	Limit value (g/kWh)				Note the unit
		NOx	HC	CO	Particles	
Euro 4	2006	3.5	0.46	1.5	0.02	
Euro 5	2008	2.0	0.46	1.5	0.02	
Euro 6	2014	0.46	0.13	1.5	0.01	

Requirements – work machinery

Legal requirements for newly manufactured engines for work vehicles under stage 3 B					
Engine power (kW)	Year	Limit value (g/kWh)			Note the unit
		NOx	HC	CO	Particles
37-55	2013	4.7*		5.0	0.025
56-74	2012	3.3	0.19	5.0	0.025
75-129	2012	3.3	0.19	5.0	0.025
130-560	2011	2.0	0.19	3.5	0.025

Legal requirements for newly manufactured engines for work vehicles under stage 4					
Engine power (kW)	Year	Limit value (g/kWh)			Note the unit
		NOx	HC	CO	Particles
75-129	2014	0.4	0.19	5.0	0.025
130-560	2014	0.4	0.19	3.5	0.025

*) NOx + HC

1.2.2 Documentation of exhaust values

Emissions of the engine such as CO, NOx and particles must be declared for new machinery. Report in unit g/kWh according to standard ISO 8178-6.

1.2.3 Test method with empirical values

To obtain initial values, the exhaust measurements shall be performed on a machine before it is put into service underground for the first time and then in accordance with applicable authority regulations. The requirements also apply to machinery of contractors that are used for the first time in the working area.

The industry intends to establish a database for the implementation of empirical values.

1.3 Drive train

The driveline shall be protected from damage by protection at the bottom.

Joints and drive shafts shall be protected from damage from for example stones.

The transmission shall have temperature monitoring and a signalling device for over-temperature in the cab.

1.4 Hydraulics

Hydraulic systems shall comply with relevant requirements of the C standard for each machine type and if such does not exist according to the safety standard SS-EN ISO 4413. The system shall be designed and manufactured so that the components and piping requiring adjustment or maintenance are placed within easy reach and can be adjusted and maintained in a safe manner, for example by releasing pressure and securing from unwanted movement. In case these requirements cannot be fulfilled, maintenance and service information shall be supplied in accordance with SS-EN ISO 4413. Relevant marking of hydraulic hoses facilitates trouble shooting and shall also be included in the hydraulic diagram. Marking of hoses shall be at both ends and such that the marking is not altered or affected by wear, oil, grease or chemicals.

The code for the purity of the hydraulic system, specified in accordance with SS-ISO 4406, shall be reported (the purity increases the lifetime of the system).

Hydraulic tubes and hoses shall comply with the requirements in SS-EN 1809-1, which includes fourfold pressure security.

Hydraulic line/components shall be separated from hot surfaces that can reach 80% of the flash point of the hydraulic fluid.

Hydraulic systems shall be designed to avoid unnecessary oil spills in the event of leakage or line failure.

Hydraulic lines shall, after risk assessment, be covered/protected to prevent that the pressurised hydraulic fluid comes out and damages a person or hits a hot surface.

1.5 Pneumatic systems

Pneumatic systems shall comply with relevant requirements of the C standard for each machine type and if such does not exist according to the safety standard SS-EN ISO 4414.

1.6 Electrical requirements

Electrical systems shall comply with relevant requirements of the C standard for each machine type and if such does not exist according to the safety standard SS-EN 60204-1 and its normative references. Further requirements are included in SveMin's publication "Fire safety in mines and underground constructions". For equipment in potentially explosive atmosphere, the requirements for EX classified equipment may be applicable.

SveMin's requirement is that machinery suppliers apply the restrictive use of certain hazardous substances in electrical and electronic equipment as stated in the RoSH directive 2011/65/EU also for large-scale fixed installations and mobile machinery not intended for professional use on the road, even though the directive excludes those. Any deviations from the requirement must be reported.

Cable labelling should be at both ends and such that the labelling is not altered or affected by wear, oil, grease or chemicals.

Remember that there is a need for connection of additional equipment and ensure that there is space enough and sockets for connection of these.

Of course, risk assessments shall form the basis for classification and choice of electrical equipment.

1.6.1 Battery disconnecter

Vehicles shall be equipped with an easily accessible battery disconnecter. See instructions in SveMin's publication "Fire safety in mines and underground constructions".

1.6.2 Electromagnetic fields

Machinery shall be designed so that the machine operator is exposed to as low levels of exposure as possible. As limits for exposure and action levels, the strictest value of the directive 2013/35/EU or the national Swedish provision AFS 1987:2 shall apply. If there is a risk that the delivered equipment exposes the operator to electromagnetic fields, the supplier shall report the values.

1.7 Brakes and tyres

1.7.1 Brakes

According to the requirements of the mining and metal industry, work machines shall have two from each other independent systems, for example one brake on the axles and the other on the gearbox/drive shaft, designed according to the principle "fail-safe", for example such that the brakes are activated if the brake pressure is lost. The C standard of each machine specifies detailed requirements on the function of the brakes. See also SS-EN ISO 3450.

In addition to a main brake, the machine shall have a parking brake capable of keeping the machine stationary in the inclination stated in the C standard of the machine. Observe that the conditions at the workplace (for example inclination of more than 20°, surface characteristics, etc.) may require additional aids such as chocks, anchoring, etc. to keep the machine in position.

Note that also controls for activation of the brake shall be designed according to the principle "fail-safe".

1.7.2 Exhaust brake

If the engine has a low effect of the so-called engine brake, vehicles and machines that often run in long down gradients should, if possible, be equipped with an exhaust brake in order to relieve the main brake.

1.7.3 Tyres

Choice of tyre type is of great importance for the vibration level of the machine.

Suppliers of machines with larger tyre sizes, requiring lifting equipment, shall assign proper handling equipment for disassembly and reassembly of the tyres.

To minimise the effects of a tyre explosion and to reduce the risk of fire, it is recommended that work machines and vehicles used underground, with a tyre dimension larger than 12.00 x 24 and/or with tyres having an air pressure higher than 6.5 bar, have liquid-filled tyres. Tyres that are filled with liquid shall be filled with at least 70% liquid.

In conjunction with general risk assessments for machinery and vehicles with smaller tyre dimensions, it is appropriate to evaluate the risk of tyre explosions and the measure of filling the tyres with liquid.

1.8 Lighting

1.8.1 General

The lighting shall be designed with the best technology in order to provide good lighting conditions and energy-efficient lamps with low heat generation that also reduce the risk of fire.

All protections for lamp glass and reflectors shall allow for an easy cleaning.

1.8.2 Driving lights

All vehicles shall be equipped with dimmable driving lights (in both travel directions if the machine can operate in both directions).

1.8.3 Work lighting

All vehicles shall be equipped with appropriate work lighting. To increase safety when entering and leaving the vehicle, it shall be possible to turn on the lighting outside the cab both from the ground and from the cab. In addition to the harmonised C standards for specific machine types, the harmonised standard SS-EN 1837 specifies and provides guidance on the design of machinery lighting.

The lighting shall be designed with the best technology to provide good light conditions and energy efficient lamps with low heat generation.

All protections of lamp glass and reflectors shall allow an easy cleaning.

1.9 Operator cab

1.9.1 ROPS, FOPS and OPS

The cab shall be designed with protective structures that at least comply with the harmonised standard, to reduce the risk for the driver if the machine would overturn or roll over on the roof (ROPS, SS-EN ISO 3471), to protect the driver from falling objects (FOPS, SS-EN ISO 3449) and to prevent objects from entering the operator cab (OPS, the standard SS-ISO 8084 for forestry machinery provides indicative requirements for protection of the operator).

Protection against flying objects is a requirement for mining machinery such as loaders, scalers, drill rigs, equipment for boulder handling, etc.

Safety glass must withstand explosions and projectiles. For all glass with risk of penetrating objects, safety glass that at least comply with the requirements corresponding to SS-EN 1063 class BR4 or SS-EN 15152 section 6.2.6 with $v_p=450$ km/h is recommended.

All other glass shall be shatterproof.

Vehicles equipped with a roof hatch or a roof window shall be complemented with protection that gives the roof the same strength as on vehicles without roof hatch or roof window.

On articulated work machines, the steering control shall be de-activated when the machine is stationary and the door is open.

1.9.2 Ergonomics

To prevent strain disorders caused by the driver environment, it is very important that the workplace is designed in accordance with ergonomic principles, so that the operator is not subjected to wear, fatigue or stress. Repetitive work, where the same movements constantly are repeated, gives rise to a constant and uniform load that requires a carefully prepared ergonomic design of the driver's workplace. Pay particular attention to the design of the driver's seat; arm rests, head rest, adjustability, vibration damping, good visibility and the position of the control device. Control devices shall when they are of primary importance, i.e. used frequently or

continuously, be within easy reach and when they are of secondary importance, i.e. seldom used, be within normal reach. The dimensions of the zones of comfort, easy reach and normal reach, are stated in SS-EN ISO 6682.

Cab ergonomics should be as good as possible. The following factors, among others, should be considered:

- varying body size and strength of operators
- space for any personal protective equipment
- size of cab, allowing the operator free movement space for all parts of the body
- position and function of pedals, controls and instrument in view of adjustability of the machine to the predictable characteristics of the operator
- adjustments of seat, pedals and controls shall be easy to handle, intuitive and not require muscle strength. Some machine types may require a rotating seat with built-in controls
- choice and position of communication equipment
- camera if visibility is poor
- good entry with safe and properly positioned steps, handrails and handholds
- position of ventilation devices to prevent incorrect airflows
- possibility to clean the cab; nooks collecting dirt should be avoided

1.9.3 Climate and ventilation in driver cab

Consider the position of the ventilation devices in order to prevent incorrect airflows. Vehicles should be equipped with automatic climate control (EEC) and cab filters that reduce dust and particles, for example quartz. Vehicles in production should also have carbon filters that to a certain extent capture unburned hydrocarbons and NO₂. In the manual, state the exchange frequency for filters and other components reducing dust.

1.9.4 Noise in driver cab

The equivalent level of sound pressure during a normal operating cycle shall not exceed 75 dB(A), measured in the cab at new delivery because the environment in which the machines are used may have a negative impact on the sound pressure.

The noise level, and maintenance measures in order to maintain a low noise level, shall be stated at delivery. The noise reducing characteristics may degrade over time.

Production can in some cases run in 12 hours shifts. Consider the exposure time so that the limit for the daily noise exposure level is not exceeded.

1.9.5 Seat belts in vehicle

All vehicles and work machines shall be equipped with seat belts for the number of persons the machine/vehicle is designed for.

1.9.6 Air bags

Vehicles that can be equipped with air bags shall be delivered with air bags. The manual shall describe handling of the air bag during service.

1.9.7 Vibrations

Vibrations in the machines shall be as low as possible and must under no circumstances exceed the current regulatory action value. (See AFS 2005:15). The requirement primarily applies to whole-body vibrations, but where applicable also to hand and arm vibrations. The vibration levels shall be measured during normal production conditions. The result, and maintenance measures in order to maintain a low vibration level, shall be stated at delivery.

1.9.8 Emergency exit

There shall be an emergency exit from the cab, placed on another side than the normal exit.

1.10 Protective roof

Equipment used in locations without rock support (for example work platform, scissor platform) shall be provided with a protective roof. The dimensioning shall at a minimum be designed for a vertical static evenly distributed load of at least 100 kN distributed over the entire area. The protective roof can suitably be dimensioned for a vertical static point load of at least 10 kN distributed over an area of 0.01 m², positioned on the most unfavourable place of the roof. For protective roofs only used at a distance less than 0.5 m from the rock roof, the load mentioned may be decreased, but preferably not by more than half. For large roof heights, even stronger protective roofs than what the calculation above results in may be needed.

Calculated stresses in the protective roof, caused by the above mentioned loads, should not exceed the lower yield point of the construction material. It is important that its plastic deformation capacity is sufficient. The protective roof should cover at least 0.6 m² per standing and at least 1.2 m² per sitting person measured in the horizontal plane.

1.11 Visibility requirements

1.11.1 Warning light

Warning signals shall be unambiguous and easy to understand.

Work machines shall have warning lights in accordance with the requirements in the C standard for each machine type. Ensure that warning lights do not interfere with the vision ergonomics of the operator.

Passenger vehicles shall be provided with obstacle lights (steady or flashing red light), positioned so that they can be perceived from work machines. The recommended height is 2.2 – 2.6 metres. The obstacle light shall be activated also when the vehicle is parked and turned off and can preferably be a diode lamp to minimise the power consumption.

Machines running in automatic mode shall have a visual warning lamp when it starts and when it is running in automatic or remote control mode (except if the remote control is run from a place adjacent to the machine). Section 2.1 Remote-controlled machinery specifies requirements on the colour of the warning lights.

1.11.2 Reversing alarm

Vehicles that are regularly used in the working area shall be provided with warning signals with sound and light when reversing. After risk assessment, exemption can be made so that only sound or light signal is used. Passenger cars and light trucks can be exempted from the requirement on reversing alarms.

1.11.3 Side marking

Side markings shall comply with the requirements of the applicable regulation for reflective devices for vehicles on the road.

1.11.4 Warning pennant

In working areas where warning lights (obstacle lights), with steady or flashing light, is not sufficient to attract attention, smaller vehicles shall be provided with a warning pennant with fluorescent paint at a height that can be perceived by the driver of the work machine.

1.12 Stop functions

1.12.1 Disconnect and lock

Machinery shall be equipped with devices for disconnecting and discharge of energy. The solution shall comply with relevant requirements of the C standard for each machine type and if such does not exist according to the safety standard SS-EN 1037.

Machinery shall be designed so that disconnecting and locking makes the equipment de-energised. This applies also to stored energy, for example potential energy, air pressure, hydraulic pressure and electrical energy. It shall be easy to see that the machine has been properly shut off and does not have any hazardous energy stored. The interlock shall be possible to lock with a padlock. Clear instructions on how to disconnect and lock shall be provided with the machine.

Lighting circuits can by advantage be provided with separate power supply to facilitate service and maintenance work. These shall in such case be equipped with separate disconnect and lock functions.

1.12.2 Emergency stop

See instructions in SveMin's publication "Fire safety in mines and underground constructions", section 7.5.2.3. Observe that the design and symbol of the emergency stop device shall comply with SS-EN ISO 13850 section 4.4.5 and 4.4.6.

1.12.3 Engine shut-off

See instructions in SveMin's publication "Fire safety in mines and underground constructions", section 7.5.2.4.

1.13 Fire safety

Fire safety for the equipment shall comply with applicable authority and insurance requirements as well as with SveMin's publication "Fire safety in mines and underground constructions". All vehicles shall be classified and equipped in accordance with these requirements and at delivery undergo fire safety inspection according to the check list in "Fire safety in mines and underground constructions". Thereafter, the inspection shall be made annually.

The fire safety requirements apply also to vehicles and work machines that temporarily are used in the working area, for example machinery rented or leased for shorter or longer time and also for contractor's vehicles and work machines.

Fire classified materials must never lose the protective properties due to external influences such as age changes, solvents or other effects.

1.14 Access routes

The design of access routes to the operator cab and to service and maintenance points is important for mining machines. Risk assessment shall be made and the access routes shall be designed to eliminate the risk for damage by falling, squeezing, etc. Necessary securing points, in accordance with SS-EN 795, shall be provided for fall protections. The access routes shall be designed to withstand the anticipated environments and to be easily cleaned so that, for example, no mud, snow or ice accumulates.

Safety rails shall be provided along open sides of bridges and walkways, if required by the height above the ground. Fixed safety rails can be replaced by retractable safety rails or handrails and handles to ensure easy transport from workplace to workplace. If there is no harmonised C standard for the specific type of machine, the harmonised standards SS-EN ISO 2867 and SS-EN ISO 14122-1 through -4 provide guidance on the design of safe access routes.

Mark ladders and steps as well as securing points for fall protection in different colour, preferably in fluorescent colour.

1.15 Signs and markings

Signs with information and warnings on machinery should preferably be provided by understandable standardised symbols or pictograms. Written information and warnings shall be in Swedish.

1.16 Documentation

1.16.1 General

The supplier shall always prepare a technical construction file. The content is specified in each directive, for example in the Machinery Directive Annex 7.

User manuals, instructions for operation and maintenance as well as training shall be in Swedish. Observe that diagrams for electricity, hydraulics and pneumatics are comparable with operating instructions and that the same requirements apply for them. They shall be easy to follow and read.

Clear instructions on how to disconnect and lock shall be provided with the machinery. The instruction shall describe how to de-energise the equipment. This applies also to stored energy, for example potential energy, air pressure, hydraulic pressure and electrical energy.

It is important that components that are critical for the safety and reliability of the equipment are specified. Also specify how control, service and replacement of the critical components should be made and at which intervals.

When procuring equipment, it is important to ensure the availability of user manuals, instructions for operation and maintenance and training in other languages than Swedish, in order to meet the employer responsibility when hiring foreign workers.

1.16.2 Ergonomics

The documentation shall include ergonomic guidance on the prevention of disorders, injuries and risks, for example adjustment of seat, controls, maintenance, etc.

1.16.3 Risk management, calculations and detail drawings

The delivered equipment may be part of a facility to be CE marked and/or to be subject for future redevelopment. Whoever finally establishes the "EC Declaration of Conformity" for the assembled equipment must in the "Technical construction file" have access to risk management, calculations and detail drawings of safety-critical details.

In these cases, the delivered documentation, unless otherwise agreed, shall include the supplier's risk management for the equipment; that is, risk identification, risk assessment and evaluation. Furthermore, the detail drawings with calculations, test results, etc. required to verify that the equipment complies with the essential health and safety requirements shall be delivered. These detail drawings, unless otherwise agreed, are only for information and will not be used by the customer for manufacturing.

1.16.4 Chemical substances

Well before the delivery, the documentation of all chemical substances included in the equipment shall be reported, with a safety data sheet for each substance in Swedish.

In accordance with the Machinery Directive requirement 1.7.4.2 r), s), the documentation shall provide information on how adjustments and maintenance operations shall be carried out by the user and what preventive maintenance measures to take. Furthermore, the documentation

shall specify how adjustments and maintenance operations can be carried out safely, including the protection measures that should be taken during these operations. In addition to these requirements, the supplier shall document the risks that the release of chemical substances in the event of fire or repair work may involve.

1.16.5 Pressure vessels

The delivery shall include documentation on the pressure vessels and the simple pressure vessels included in the equipment and how inspection of these shall be performed. Indicate whether third-party inspections are required and the frequency of the inspections.

See also Appendix 1: Documentation for procurement.

1.16.6 Spare parts list

The spare parts list shall identify the critical and unique spare parts and specify the delivery time for these.

1.17 Maintenance and service

1.17.1 General

The design and planning for maintenance and service are of great importance for the performance of the product or system. Both planned and not planned maintenance should be considered.

Example of measures that make maintenance easier:

- It shall be easy to disconnect and lock, to de-energise the equipment and to see that the machinery has been properly shut off and does not have any hazardous energy stored.
- Loaders, containers, loading platforms, booms or other elevating machine parts under which it may be necessary to work shall be provided with a mechanical locking device, preventing accidental movement.
- To prevent strain disorders, it is very important that access to maintenance points is designed in accordance with ergonomic principles.
- Choice of material to facilitate the handling, for example lighter materials instead of steel.
- Tip-up/mobile cabs.
- Service openings shall be easy to open, remove and put back again.
- When needed, there shall be fixed footsteps.
- Filters, belts, wearing parts, lamps and other parts in need of frequent service shall be placed in such a way that they can be replaced without the peripheral equipment having to be dismantled.
- Components making up whole units shall be organised in modules that can be handled easily.
- If special tools must be used to follow the manufacturer's instructions, these shall be included in the delivery or there shall be a reference as to where it is possible to purchase such tools.
- Necessary measuring points with quick coupling shall be available for the connection of instruments.
- Lifting aids, such as eye bolts and clearly marked lifting points, shall be available on heavier equipment.
- On heavier machinery, permanently mounted jacks may be a valuable aid.
- There shall be ladders, platforms and walkways with handrails on the machinery, if such is required to ensure safe maintenance. For drill rigs, underground machinery on rubber wheels and earth-moving machinery, the requirements are stated in the harmonised standard SS-EN ISO 2867.

- Components such as contactors, breakers, valves, sensors, hose couplings, nipples and filters shall comply with the generally accepted standards and also be possible to adapt to user preference; "internal standards".

1.17.2 Other items to consider

- It shall be possible to perform all daily checks in a normal working position from the ground, ordinary operating platform or its access.
- Material should be chosen and designed with the objective of increasing the service intervals; with components of "good quality" and long life time.
- Fluid reservoirs and drainages shall be designed in such a way that it is possible to empty and clean them without causing spillage over person, machinery or environment. There must be a sign with necessary information, such as type of media, quality and other requirements.
- In case of uncertainty or doubt – user manual (in Swedish) shall be available in the cab for guidance.

1.18 Training requirements

Training is an important part of the delivery. The manufacturer shall provide the relevant categories of staff with in-depth practical and theoretical training on the design and function of the product, including protection and safety rules. Consider that the different categories of staff may require adaption of the objectives, program and training materials.

The training may include the following categories of staff:

- Instructors/Supervisor
- Engineers
- Maintenance staff
- Mechanics
- Electricians
- System technicians
- Operators and operating staff

The training shall also include ergonomic guidance to prevent disorders, injuries and risks, such as adjustment of the driver environment, handling of peripheral equipment, etc.

2. Part 2: Supplementary requirements for certain types of equipment

In addition to the general requirements in Part 1, supplementary requirements for certain types of vehicles, machinery and technical equipment are stated in this section.

2.1 Remote-controlled machinery

Remote-controlled machinery shall in addition to the corresponding C standard for each machine type comply with the requirements in SS-ISO 15817 "Earth-moving machinery – Safety requirements for remote operator control systems". See also requirements for remote-controlled machinery in SveMin's publication "Fire safety in mines and underground constructions".

According to the standard SS-ISO 15817, automatically controlled machines shall have a visual warning device; warning lights or flashing lights, placed on the machine so that it can easily be seen from all sides by anyone approaching the machine. The warning lights should have different colours uniquely indicating the current state or operation mode of the machine. SveMin advocates the examples of the standard; Green – Automatic system is activated, Yellow – Automatic operation is on-going, Red – Indicates fault in automation/stoppage.

The meaning of the signals shall be described in the user manual. If possible, the signal description should also be posted at the workplace.

2.2 Charging vehicles

To prevent strain disorders, charging vehicles should be provided with mechanical hose feeding, also for charging from sill.

Charing vehicles carrying igniters and explosives shall be provided with safe storage facilities for these.

Declare the pressure vessels and the simple pressure vessels included in the equipment and how inspection of these shall be performed.

See also section 2.6 Machinery intended for lifting persons.

2.3 Drill rigs

2.3.1 General

The construction shall comply with the applicable requirements in the C standard SS-EN 16228-1 through 7 "Drilling and foundation equipment – Safety" and its normative references (Replaces SS-EN 791 "Drill rigs").

The control consoles for additional equipment (e.g. crane, telfer) included in the machinery shall be compatible with each other.

2.3.2 Diamond drilling equipment

The design and planning of the workplace around the diamond drilling equipment is important for the work environment of the operators and a risk assessment shall be made for each new site. The size and design of the niches are important parts of the work environment.

The level of noise from the rotation and the sound from the drill pipe in the rock should be minimised.

In the diamond drill equipment, the hydraulic aggregate shall be equipped with noise-reducing walls. A silenced operator cab shall be included in order to minimise the damaging effects of noise. The operator station should be provided with vibration isolators to avoid that vibrations are transmitted from the machine to the operator station.

The lighting shall be good, at the operator station as well as at the location as such.

For handling of drill pipes, the drill rig shall be equipped with automatic drill pipe change.

For handling of the inner tube and core, the drill rig shall be equipped with a winch.

The rotating drill string shall be safeguarded and when the guard/curtain is mounted on the machine, it shall stop the operation when opened. It should also be possible to rotate the string at reduced speed when the safeguard is open.

The storage of drill pipes shall be designed to minimise the risk for strain disorders. The machine should be delivered with a pipe rack that allows both horizontal and vertical storage, preventing the pipes from falling out.

Relocation of the machine to a new working place and adjustments in the niche shall be made with integrated mechanical solutions. Also the risks when anchoring the machine should be eliminated.

To facilitate maintenance and service, the machine should be provided with lift a lifting device that enables secure handling.

2.3.3 Raise boring equipment

The design and planning of the workplace around the raise boring equipment is important for the work environment of the operators and a risk assessment shall be made for each new site. The size and design of the niches are important parts of the work environment.

In the raise boring equipment, a silenced operator cab shall be included in order to minimise the damaging effects of noise. The operator station should be provided with vibration isolators to avoid that vibrations are transmitted from the machine to the operator station.

The lighting shall be good, at the operator station as well as at the location as such.

Handling of additional equipment shall be possible in a safe and ergonomically acceptable way.

2.4 Rock transport vehicles

The construction shall comply with the applicable C standard for the machine type (see the standards SS-EN 1809-1, SS-EN 474-1 and SS-EN 474-6) or where appropriate the requirements of the Transport Agency for heavy vehicles on the road.

The vehicle shall have an audible and/or visual warning indicator in the cab, which is activated if the loading platform/basket is completely or partially raised when the transmission is engaged.

2.5 Loaders

The construction shall comply with the applicable C standard for the machine type (see the standards SS-EN 1809-1, SS-EN 474-1 and SS-EN 474-3).

Loaders where the driver's seat is not in the travel direction shall be equipped with a rotating seat with integrated controls.

2.6 Machinery intended for lifting persons

2.6.1 General

The constructions shall comply with the relevant requirements on man baskets in the C standard for the machine type or, if such does not exist, in accordance with the C standard SS-EN 280.

In case of power supply failure, the machine shall be designed such that an incapable operator located in the platform can be rescued quickly. The design shall also allow a capable operator himself, in case of emergency, to bring the personnel basket to a safe position and leave the basket without danger.

When designing work baskets and booms to work platform it is important to consider the risks of falling objects, such as falling rock.

The work platform shall be provided with marked anchor points for safety lines that comply with SS-EN 795. The securing points shall be placed so that the operator is prevented from falling over the railing of the work platform. Protection shall be provided to prevent hand injury on the operator manoeuvring the controls, for example when the work platform is moving close to other objects. (See SS-EN 280).

The access to the work basket/platform shall have an ergonomic design in order to avoid accidents.

According to AFS 2010:1 "Rock and mining work", persons shall be protected against falling rock, for example by a protective roof. (See section Protective roof.)

To reduce emissions, it is advantageous to provide the equipment with the ability to connect an alternative power supply other than the diesel engine of the vehicle.

2.6.2 Lifting of persons

Lifting of persons with loader, forklift, crane, etc. is regulated by the Work Environment Authority provisions AFS 2006:6, AFS 2006:7 and AFS 2006:4.

For the use of such equipment, special documented training is required.

2.7 Passenger vehicles

Passenger vehicles, such as light trucks, shall be equipped in accordance to section **Fel! Hittar inte referenskälla. Fel! Hittar inte referenskälla..**

Vehicles intended for underground use that are equipped with a roof hatch or a roof window shall be complemented with protection that gives the roof the same strength as on vehicles without roof hatch or roof window.

2.8 Belt conveyors

2.8.1 Legal requirements

Belt conveyors shall comply with current product directives: the Machinery Directive, the Low Voltage Directive and the EMC Directive and, depending on the equipment, with any other applicable product directives. In the harmonised standard SS-EN 620, the essential health and safety requirements of the first three directives have been interpreted into detailed technical requirements. If the entire conveyor is manufactured in accordance with the standard, it is assumed to comply with the essential health and safety requirements of the product directives that are specified in the standard. Additional requirements may apply.

The design of the belt conveyor shall be preceded by a risk assessment, where the properties of the conveyed material, tare weight of the conveyor, belt speed, surrounding environment, access routes, predictable operation and maintenance measures, predictable misuse, etc. are considered.

A risk assessment should by means of grading the risk as a function of the severity of damage, the probability that damage will occur, and the possibility to avoid damage show the measures to be taken (risk evaluation).

2.8.2 Industry requirements

The safety of belt conveyors shall comply with the level of safety expressed in the standard SS-EN 620 and in this instruction. The requirements in SS-EN 620 and in this instruction are also applicable for use underground in Sweden. For potentially explosive atmospheres, there are

additional requirements. Remember that belt conveyors in Sweden can operate in much lower or higher ambient temperatures than what the standard covers and that the conveyors for that reason must be adapted to the current temperature ranges.

The need for safety equipment shall be assessed, on a case by case basis after risk assessment, if the inclination and the amount of transported goods could be a danger to persons or equipment if the driving force stops.

To prevent that the conveyor belt rolls forwards or backwards, inclined conveyors, for which the transported goods by its movement or potential energy increases the speed, shall have safety equipment that comes into operation if the driving force stops. The safety equipment shall consist of two independent safety devices, such as backstop and disc brake.

The dimensioning of the safety equipment is made by the conveyor supplier.

2.8.3 Protection

This section is the industry's interpretation of the harmonised standard SS-EN 620+A1:2010 and gives guidance to risk reduction of mechanical hazards at nip points. (There may be other risks not covered in this section.)

Mechanical hazards at nip points shall be safeguarded in the manner specified in the harmonised standard type C, SS-EN 620. In the standard, the dangerous nip points at the points of contact between the conveyor belt and the rotating pulleys have been identified to the in-running side on certain specified idlers and pulleys. See item 16 in the figure below. All points of contact between the conveyor belt and the rotating pulleys are not considered dangerous nip points. A dangerous nip point is defined by that the belt cannot lift from the idlers or pulleys to produce a clearance of at least 50mm where the belt touches the periphery of the idlers.

The lifting of the belt can be restricted by fixed parts, such as around crossbars, guide plates and loading and unloading areas, at convex curves and at the transition between flat and troughed belt, where the belt is reversed or deflected and other places where the pressure between the belt and idlers becomes high; i.e. is influenced by means other than the belt and the conveyed material.

2.8.3.1 Definitions

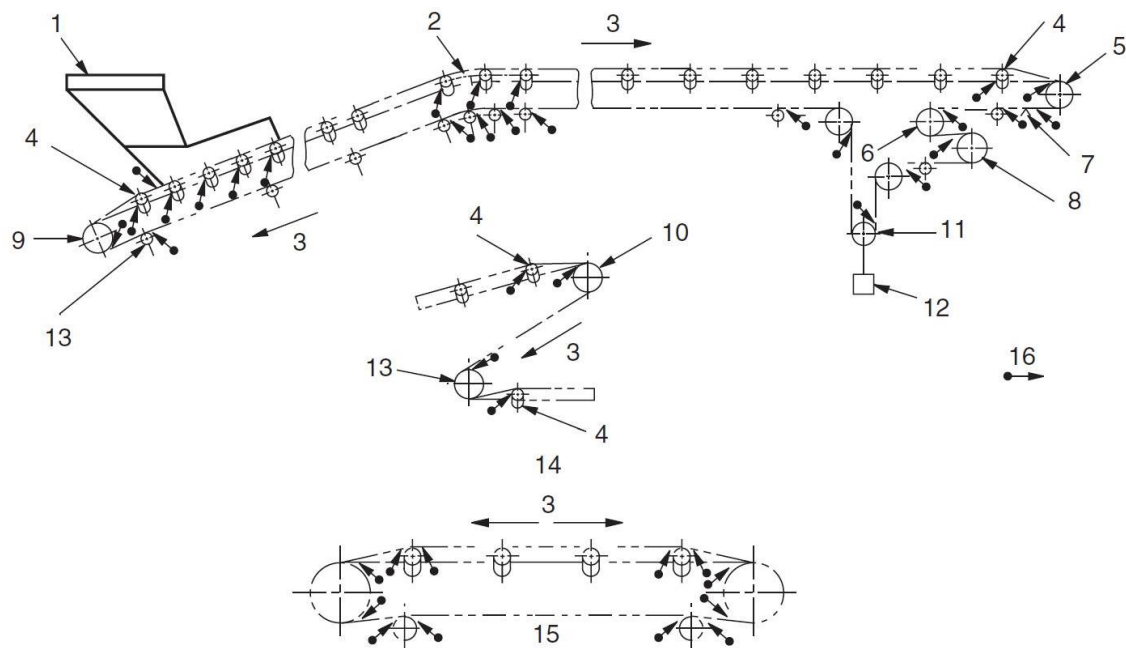
Selected definitions from the safety standard SS-EN 620:

Nip point: dangerous point which occurs on the in-running side at the line of contact between the conveyor belt and rotating pulley and in certain cases between belt and an idler roller or a fixed part (see Figure 1).

Working area: area where persons work at, or operate conveyors under normal conditions (inspection, maintenance and cleaning are excluded).

Traffic area: area which is accessible or reachable by all persons without opening a guard, activating a trip device or using additional means.

The industry's interpretation of "all persons" = non-authorised persons.



Key

- | | |
|--|-----------------------------|
| 1 Feed hopper | 9 Tail pulley |
| 2 Idlers at convex curve (brow) position | 10 Tripper discharge pulley |
| 3 Direction of belt travel | 11 Take up pulley |
| 4 Transition idler | 12 Gravity take-up weight |
| 5 Head pulley | 13 Bend pulley |
| 6 Snub pulley | 14 Typical tripper |
| 7 Scraper | 15 Reversible belt |
| 8 Drive pulley | 16 Nip point |

The dangerous nip points, identified and marked (16) above, shall be safeguarded if they normally are reachable by the staff. (Illustration taken from SS-EN 620, Figure 1.)

2.8.3.2 Working principle for risk reduction

- **"Working areas"** are inventoried and protection needs are risk assessed.
A working area can be a place where work is conducted directly at the conveyor belt, for example a sampling place.
- **"Traffic areas"** are identified by risk assessment.
A traffic areas can be where non-authorised persons pass by, for example external visitors during guided tours.
- **Other areas**, not defined in the standard, are risk managed according to established risk management methods (since the standard specifies where protection is required – not where it is not required).
 - When a risk is identified, decide on means to reduce the risk.
 - In case of an identified risk, determine what the protection measure should protect against
 - 1) predictable misuse; e.g. slip, stumble, or fall
 - 2) deliberate action; e.g. intentionally getting to the hazardous area

- Select the appropriate measure(s) based on what the measure should protect against and depending on the weighted risk level. Appropriate measures are made according to the so-called three step model:
 - 1) remove the risk by construction, 2) protect against the risk, 3) warn/ inform/ train/ personal protection against remaining risk

2.8.3.3 *Risk situations*

Below are three examples of situations with risk for entanglement, drawing-in or trapping in nip points at pulleys and idlers because of unpredictable misuse (unintentional and/or intentional) caused by the design of the belt conveyor.

Situation A: Fall towards the conveyor by slipping, stumbling, or falling during passage along the conveyor on a gangway.

Situation B: Crawling under or climbing over the conveyor because of a long conveyor for passage to the opposite side of the conveyor.

Situation C: Loosing a valuable object on or below the conveyor during passage of the conveyor.

2.8.3.4 *Design of guards*

It is important that the choice of guard and the design of the guard are preceded by risk assessments, so that the guard itself does not cause any additional risk. To preserve the respect for the guards, these shall be perceived as motivated. It is important that guards are designed so that routine adjustments, lubrications and maintenance can be performed without opening or removing the guard. Guards should be designed so that it is possible to visually inspect the belt conveyor during operation. Furthermore, the design of the guards shall make it possible to clean spillage without removal of the guards, for example by a gap or opening that complies with the requirements in SS-EN 620. The guards shall be very quick to disassemble and re-assemble, easy to handle, modularly designed, and only exceptionally designed for a specific placement.

Where a conveyor passes above an area where someone may be, there shall be adequate protection against falling objects, such as return idlers (e.g. catching trough) or belt failure (e.g. by a protection plate, wire mesh, etc.).

2.8.4 Protection adjacent to walkways

2.8.4.1 *Walkway at angle to belt conveyor*

Belt conveyors should be provided with guards in the area where the walkway connects to a walkway along the belt conveyor or where a stairway or a ladder leads up/down towards the belt conveyor.

2.8.4.2 *Walkway along belt conveyor*

Determine which walkways are needed for transfers in the plant. Perform risk assessments on where guards need to be installed along these walkways. The guards must not involve any new risks. Other possible walkways, which in risk assessment have been assessed unsuitable as walkways, shall be closed off by a latched gate/door preventing passage.

Primarily, the conditions along the walkway that involve increased risks of reaching dangerous nip points should be eliminated, since one can stumble, fall, slip or get hooked to protruding parts. These could for example be:

- differences in level or protruding objects in the walkway floor
- stairways or ladders in the walkway
- the walkway width is perceived as narrow
- protruding parts in the walkway

- spillage makes the walkway slippery or uneven
- the inclination of the belt conveyor

For inclined belt conveyors, a handrail can reduce the risks by offering support for walks downwards and upwards and by directing the pedestrian traffic to the side of the walkway where the handrail is installed.

2.8.4.3 *Workplace adjacent to belt conveyor*

Perform risk assessments whether guards need to be installed on belt conveyors at workplaces adjacent to conveyors in operation. Workplace refers to for example inspection panels in feed hoppers, sampling locations, vulcanisation locations, etc.

2.8.4.4 *Clearances in conveyor bridges*

To obtain a good work environment and safety, conveyor bridges and areas around the conveyors shall be larger than specified by the European standard SS-EN 620. It is also necessary to consider the space requirements for splicing and repair of the conveyor belts, since the work may have to be performed also when adjacent conveyors are in operation. All walkways, stairways, steps or platforms shall have a minimum clear width of 800 mm and the minimum clear height shall be 2 100 mm. Only in exceptional cases, after risk assessment, the width can be reduced to 600 mm if the walkway is only occasionally used and the reduction is limited to a short distance, for example at a pillar. For passages where the width of the walkway is perceived as narrow, the need for guards close to the walkway shall be risk assessed.

Otherwise, the harmonised European standards, SS-EN ISO 14122-1 through -4, specify requirements on the access to machinery (stairways, ramps, walkways, work platforms, guardrails, etc.) complying with the safety requirements in the Machinery Directive.

2.8.5 *Belt quality*

According to SveMin's publication "Fire safety in mines and underground constructions", conveyor belts in underground constructions shall always be of self-extinguishing quality. For belt conveyors in buildings and walkways, belts of self-extinguishing quality are also recommended. Refer to the publication for more requirements and information on fire safety of belt conveyors and walkways.

2.8.6 *Ergonomic advice*

To facilitate the handling during maintenance and repair of e.g. carrying idlers, return idlers and/or pulleys, the possibility of using lightweight materials should be considered (while maintaining operational reliability and strength).

3. Appendices

3.1 Appendix 1: Documentation for procurement

Delivery of documentation is equivalent to delivery of other equipment. The documentation required by provisions, directives and harmonised standards shall be in Swedish. Tenders shall clearly indicate if the documentation intended to be delivered with the equipment in any way deviates from the specifications detailed in this chapter.

Summary of the documentation

Document	Note	Reason/deficiency
<i>Machinery:</i>		
<ul style="list-style-type: none"> <input type="checkbox"/> List of drawings <input type="checkbox"/> Machinery layout <input type="checkbox"/> Calculations <input type="checkbox"/> MTBF-MTTR statistics <input type="checkbox"/> Commissioning documents <input type="checkbox"/> Commissioning documents, settings <input type="checkbox"/> Test reports <input type="checkbox"/> Documentation of exhaust values <input type="checkbox"/> Empirical values/ baseline values for exhaust measurements <input type="checkbox"/> Measurement values for electromagnetic fields <input type="checkbox"/> Apparatus list <input type="checkbox"/> Wiring diagrams <input type="checkbox"/> Component specification <input type="checkbox"/> Component location <input type="checkbox"/> Layout drawing <input type="checkbox"/> Cubicle locations <input type="checkbox"/> Unit specifications <input type="checkbox"/> Power supply <input type="checkbox"/> Control voltage distribution <input type="checkbox"/> Diagrams (electricity, control, regulation, pneumatics, hydraulics, flow) <input type="checkbox"/> Deviations from the requirements of the RoSH Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment <input type="checkbox"/> Marking of hydraulic hoses in hydraulic diagram <input type="checkbox"/> Code for the purity of the hydraulic system <input type="checkbox"/> List of all chemical substances included in the equipment <input type="checkbox"/> Documentation on the pressure vessels and the simple pressure vessels included in the equipment, how inspection shall be performed and interval <input type="checkbox"/> Assembly drawing <input type="checkbox"/> Design drawings <input type="checkbox"/> Installation document <input type="checkbox"/> Electrical earthing diagram <input type="checkbox"/> Wiring document <input type="checkbox"/> Spare parts list (type, make/brand, order number and original supplier) 		

Document	Note	Reason/deficiency
<i>Safety documentation (certifications):</i>		
<input type="checkbox"/> Technical file (TCF, Technical Construction File) <input type="checkbox"/> Status report <input type="checkbox"/> Noise and vibration levels <input type="checkbox"/> Risk identification, risk assessment and evaluation <input type="checkbox"/> Analysis of measures to be taken <input type="checkbox"/> Methodology description <input type="checkbox"/> EU Declaration of conformity <input type="checkbox"/> Declaration of incorporation of partly completed machinery <input type="checkbox"/> Documentation from third-party inspections and/or verifications		
<i>Maintenance documentation (Operator manuals/instructions):</i>		
<input type="checkbox"/> Maintenance instructions, including instruction on assembly and dismantling <input type="checkbox"/> Instructions for maintenance (service, repair and preventive maintenance) <ul style="list-style-type: none"> <input type="checkbox"/> Clear instructions on how to disconnect and lock and how to de-energise the equipment, also stored energy <input type="checkbox"/> Risks that the release of chemical substances in the event of fire or repair work may involve <input type="checkbox"/> Specification of important components that are critical for the safety and reliability of the equipment and how control, service and replacement of these should be made and intervals <input type="checkbox"/> Maintenance measures to maintain a low noise and vibration level <input type="checkbox"/> Installation instructions <input type="checkbox"/> Test description for the verification of correct operating and safety functions <input type="checkbox"/> Function verification		
<i>Operator's manual:</i>		
<input type="checkbox"/> Functional descriptions <input type="checkbox"/> Man-machine description <ul style="list-style-type: none"> <input type="checkbox"/> Ergonomic guidance to prevent disorders, injuries and risks <input type="checkbox"/> Normal operating conditions <input type="checkbox"/> Exceptional operating conditions <input type="checkbox"/> Printouts <input type="checkbox"/> Trouble shooting		
<i>Manual, service and maintenance instructions for incorporated control systems:</i>		
<input type="checkbox"/> System description <input type="checkbox"/> Functional description <input type="checkbox"/> Start, restart and stop		

Document	Note	Reason/deficiency
<input type="checkbox"/> Commissioning documentation <input type="checkbox"/> User manual, including instructions for the operator with description of the software and the operator interface <input type="checkbox"/> Test record describing functional test, service and maintenance for: <ul style="list-style-type: none"> <input type="checkbox"/> Communication <input type="checkbox"/> Verification of safety, control, regulation and monitoring functions <input type="checkbox"/> Trouble shooting and replacement of units <input type="checkbox"/> Circuit diagrams <input type="checkbox"/> Logic circuits <input type="checkbox"/> Parameter specification <input type="checkbox"/> List of verifications (software, hardware and documents)		
Software design documents:		
<input type="checkbox"/> List of documents <input type="checkbox"/> System requirements and functional descriptions <input type="checkbox"/> Software structure, specification <input type="checkbox"/> Program module, test specification <input type="checkbox"/> Program module, specification <input type="checkbox"/> Program validation <input type="checkbox"/> Safety validation <input type="checkbox"/> Installation documentation <input type="checkbox"/> Maintenance documentation <input type="checkbox"/> Trouble shooting documentation <input type="checkbox"/> Operation documentation		

Start-up/Training

Tenders shall include a training program. Remember that it may be necessary to repeat/follow up training sessions!

The training may include the following categories of staff:

- Instructors/Supervisor
- Engineers
- Maintenance staff
- Mechanics
- Electricians
- System technicians
- Operators and operating staff

The training shall also include ergonomic guidance to prevent disorders, injuries and risks, such as adjustment of the driver environment, handling of peripheral equipment, etc.

3.2 Appendix 2: Checklist for delivery control

Checklist for delivery control		
Machinery/equipment	Note	Reason/deficiency
CONSTRUCTION/DESIGN		
1. Operator's position with and without cab 1.1 Location 1.2 Dimensions 1.3 Design (ergonomic) 1.4 Protection structures: FOPS, ROPS 1.5 Type control 1.6 Test certificate 1.7 Emergency exit 1.8 Other		
2. Access routes 2.1 Design/dimensions (stairways, ladders, bridges) 2.2 Location of handrails/footsteps 2.3 Lighting 2.4 Other		
3. Operator's seat 3.1 Design (ergonomic) 3.2 Location 3.3 Adjustment options 3.4 Mounting of seat 3.5 Vibration damping/isolation 3.6 Seat belts 3.7 Other		
4. Operating/Control devices 4.1 Visible/identifiable 4.2 Properly marked 4.3 Location 4.4 Movement conforms to its effect 4.5 Resistance to movement 4.6 Starting devices 4.7 Stopping devices 4.8 Choice of operating/control means 4.9 Power supply 4.10 Software 4.11 Other		

Checklist for delivery control		
Machinery/equipment	Note	Reason/deficiency
CONSTRUCTION/DESIGN		
5. Indicator devices, instruments, signals 5.1 Design 5.2 Location 5.3 Readability 5.4 Control of function 5.5 Other		
6. Specific corporate requirements?		

Checklist for delivery control		
Machinery/equipment	Note	Reason/deficiency
INDUSTRIAL HYGIENE		
7. Noise 7.1 Audio data from the supplier/manufacturer 7.2 Other		
8. Vibrations 8.1 Vibration data from the supplier/manufacturer 8.2 Other		
9. Electric and magnetic fields 9.1 Data from the supplier/manufacturer 9.2 Other		
10. Lighting 10.1 Appropriate for the work to be done 10.2 Location 10.3 Lighting intensity		
11. Gases – dust 11.1 Substances are enclosed/removed 11.2 Emission control system 11.3 Other		
12. Climate 12.1 Protection against cold/heat 12.2 Control of climate conditions (temperature, humidity, airflow) – climate control system 12.3 Cab filter 12.3 Other		
13. Visibility 13.1 Visibility forwards and backwards 13.2 Camera 13.3 Rear-view mirror adjustments 13.4 Windshield wipers 13.5 Other		
14. Specific corporate requirements?		

Checklist for delivery control		
Machinery/equipment	Note	Reason/deficiency
ACCIDENT PREVENTION HEALTH AND SAFETY REQUIREMENTS		
15. Mechanical risks 15.1 Stability 15.2 Anchoring devices 15.3 Durability of materials (fatigue, ageing, corrosion and wear) 15.4 Accessible parts of the machinery – no sharp edges, angles or uneven surfaces 15.5 Protections – protective devices 15.5.1 Design 15.5.2 Proper location 15.5.3 Fixed protections – opened with tools 15.5.4 Protections that can be opened - latching		
16. Fire safety 16.1 Fire safety inspection 16.2 Cables 16.3 Fuel system 16.4 Fire, fire extinguishing system 16.5 Portable fire extinguishers 16.6 Electrical supply 16.7 Extreme temperatures 16.8 Batteries, location		
17. Other risks 17.1 Static electricity 17.2 Installation/assembly errors 17.3 Explosion		
18. Maintenance and service 18.1 Positions for adjustments, lubrication and maintenance 18.2 Connections for diagnostic trouble shooting 18.3 Access 18.4 Disconnection of power supply (disconnect/lock) 18.5 Special equipment – special tools 18.6 Tool adjustments 18.7 Towing device 18.8 Securing points for fall protections 18.9 Handling – anchor points for lift equipment 18.10 Other		

Checklist for delivery control		
Machinery/equipment	Note	Reason/deficiency
ACCIDENT PREVENTION HEALTH AND SAFETY REQUIREMENTS		
19. Information och warnings 19.1 Signs 19.2 Audible signalling device 19.3 System of light signals 19.4 Marking (CE, serial or type designation, year of manufacture) 19.5 Instructions 19.6 User manual 19.7 Other		
20. Integration of safety 20.1 Operates according to design 20.2 Risks eliminated – Construction and production stage 20.3 Discomfort, fatigue and mental stress 20.4 Constraints due to protective equipment considered 20.5 Material and products		
21. Specific corporate requirements		

3.3 Annex 3: Examples of standards for mining machinery

In procurement, design, manufacturing and supply of vehicles, machinery and technical equipment, it is important to identify the directives and harmonized standards that apply to the machine. Mining machineries are of course covered by the Machinery Directive (MD) 2006/42/EC, but also other directives and regulations may apply to machinery and technical equipment for example; Low voltage directive (LVD) 2006/95/EC, Directive on electromagnetic compatibility (EMC) 2004/108/EC, Pressure equipment directive (PED) 97/23/EC, Simple pressure vessels directive (SPVD) 2009/105/EC, Directive on Radio and telecommunications terminal equipment (RTTE) 99/5/EC, Directive on Noise emission in the environment by equipment for use outdoors 2000/14/EC, and other directives.

The directives specify the essential requirements that products must meet in general terms. In the harmonized standards related to the product directives specifies the basic requirements in detailed technical terms. In the harmonized standards key product requirements are set out.

Listed below are **examples** of some important standards for mining machinery. Most standards in the list are approved by the EU, so-called harmonized standards, linked to specific product directives which if followed completely give presumption (are presumed to comply) with the essential requirements of applicable product directives such as Machinery Directive 2006/42/EC and its implementation in the Swedish legislation, AFS 2008:3 "Machinery". However, if the manufacturer, in whole or in part, does not follow a harmonized standard, the manufacturer must document and prove that the alternative solutions offers at least equal level of protection as the corresponding harmonized standard.

Lists of current harmonized standards to different product directives are regularly updated and current lists are published on the European Commission website;

http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/index_en.htm

Harmonized C standards

Safety standards for machine types

Designation	Title
EN 474-1	Earth-moving machinery - Safety - Part 1: General requirements <i>(The standard's Appendix F sets out additional requirements and exceptions for earth-moving machinery intended to be exclusively used in underground working)</i>
EN 474-2	Earth-moving machinery - Safety - Part 2: Requirements for tractor-dozers
EN 474-3	Earth-moving machinery - Safety - Part 3: Requirements for loaders
EN 474-4	Earth-moving machinery - Safety - Part 4: Requirements for backhoe loaders
EN 474-5	Earth-moving machinery - Safety - Part 5: Requirements for hydraulic excavators
EN 474-6	Earth-moving machinery - Safety - Part 6: Requirements for dumpers
EN 474-8	Earth-moving machinery - Safety - Part 8: Requirements for graders
EN ISO 2867	Earth-moving machinery - Access systems
EN 16228-1	Drilling and foundation equipment – Safety – Part 1: Common requirements
EN 16228-2	Drilling and foundation equipment – Safety – Part 2: <u>Mobile drill rigs for civil and geotechnical engineering, quarrying and mining</u>
EN 16228-3	Drilling and foundation equipment – Safety – Part 3: <u>Horizontal directional drilling equipment (HDD)</u>
EN 16228-4	Drilling and foundation equipment – Safety – Part 4: <u>Foundation equipment</u>
EN 16228-5	Drilling and foundation equipment – Safety – Part 5: <u>Diaphragm walling equipment</u>
EN 16228-6	Drilling and foundation equipment – Safety – Part 6: <u>Jetting, grouting and injection equipment</u>
EN 16228-7	Drilling and foundation equipment – Safety – Part 7: <u>Interchangeable auxiliary equipment</u>

Harmonized C standards

Safety standards for machine types

EN 1889-1	Machines for underground mines - Mobile machines working underground - Safety - Part 1: Rubber tyred vehicles
EN 1889-2	Machines for underground mines - Mobile machines working underground - Safety - Part 2: Rail locomotives
EN 1804-1	Machines for underground mines - Safety requirements for hydraulic powered roof supports - Part 1: Support units and general requirements
EN 1804-2	Machines for underground mines - Safety requirements for hydraulic powered roof supports - Part 2: Power set legs and rams
EN 1804-3	Machines for underground mines - Safety requirements for hydraulic powered roof supports - Part 3: Hydraulic control systems
EN 12001	Conveying, spraying and placing machines for concrete and mortar - Safety requirements
EN 280	Mobile elevating work platforms - Design calculations - Stability criteria - Construction - Safety - Examinations and tests

Harmonized B standards

Group standards for safety

Designation	Title
EN ISO 4871	Acoustics - Declaration and verification of noise emission values of machinery and equipment
EN ISO 3411	Earth-moving machinery - Physical dimensions of operators and minimum operator space envelope
EN ISO 3449	Earth-moving machinery - Falling-object protective structures - Laboratory tests and performance requirements
EN ISO 3457	Earth-moving machinery - Guards - Definitions and requirements
EN ISO 3471	Earth-moving machinery - Roll-over protective structures - Laboratory tests and performance requirements
EN ISO 6682	Earth-moving machinery - Zones of comfort and reach for controls
EN ISO 6683	Earth-moving machinery - Seat belts and seat belt anchorages - Performance requirements and tests
EN ISO 13732	Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces
EN 547-1	Safety of machinery - Human body measurements - Part 1: Principles for determining the dimensions required for openings for whole body access into machinery
EN 547-2	Safety of machinery - Human body measurements - Part 2: Principles for determining the dimensions required for access openings
EN 547-3	Safety of machinery - Human body measurements - Part 3: Anthropometric data
EN 614-1	Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles
EN 614-2	Safety of machinery - Ergonomic design principles - Part 2: Interactions between the design of machinery and work tasks
EN 953	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards
EN 1037	Safety of machinery - Prevention of unexpected start-up
EN 1837	Safety of machinery - Integral lighting of machines
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 4413	Hydraulic fluid power - General rules and safety requirements for systems and their components

Designation	Title
EN ISO 4414	Pneumatic fluid power - General rules and safety requirements for systems and their components
EN ISO 11161	Safety of machinery - Integrated manufacturing systems - Basic requirements
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN ISO 13849-2	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
EN ISO 13850	Safety of machinery - Emergency stop - Principles for design
EN ISO 14122-1	Safety of machinery - Permanent means of access to machinery - Part 1: Choice of a fixed means of access between two levels
EN ISO 14122-2	Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways
EN ISO 14122-3	Safety of machinery - Permanent means of access to machinery - Part 3: Stairs, stepladders and guard-rails
EN ISO 14122-4	Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders

Harmonized A standards

Basic safety standards

Designation	Title
EN ISO 12100: 2010	Safety of machinery - General principles for design - Risk assessment and risk reduction

Other standards

Other guiding standards that are not harmonized

Designation	Title
EN 1063	Glass in building - Security glazing - Testing and classification of resistance against bullet attack
EN 15152	Railway applications - Front windscreens for train cabs
prEN 1804-4	Machines for underground mines - Hydraulic powered roof supports - Safety - Part 4: Electro-hydraulic control systems
CEN/TR 614-3	Safety of machinery - Part 3: Ergonomic principles for the design of mobile machinery
ISO/TR 14121-2	Safety of machinery - Risk assessment - Part 2: Practical guidance and examples of methods
ISO 8084	Machinery for forestry - Operator protective structures - Laboratory tests and performance requirements
ISO 12510	Earth-moving machinery - Operation and maintenance - Maintainability guidelines
ISO 15817	Earth-moving machinery - Safety requirements for remote operator control
EN 795	Personal fall protection equipment. Anchor devices

3.4 Appendix 4: Manufacturer's and user's responsibility

Manufacturer's responsibility

All machinery and technical equipment delivered are covered by some of the EU product directives and shall be CE marked. This means, among other things:

1. It is the responsibility of the manufacturer or the manufacturer representative to ensure that machinery, production lines and other work equipment comply with the imperative EU directives, and with the applicable harmonised standards, in force at the time of the initial operation and delivery.
2. The manufacturer or retailer shall systematically look for hazards, analyse the risk/risks and assess what the consequences are when the risk/risks occur or might occur.

The manufacturer or retailer shall use risk assessment to primarily improve the design to avoid the risks, or if that is not possible, provide the machinery, production line or other work equipment with protection devices, or mark the equipment with warning signs as well as issue warnings in the manual. Note that organisational solutions to technical risks are not suitable as a permanent solution. Instructions and training are not sufficient when technical solutions are possible.

The procurer/customer shall be given the opportunity to take part of the manufacturer's risk assessments, which are conducted under the management and full responsibility of the manufacturer.

3. The manufacturer shall always prepare a technical construction file. The content is specified in each directive, for example in Annex 7 in the Machinery Directive. User manuals, instructions for operation and maintenance as well as training shall be in Swedish.

If there are any particular risks involved with the use, maintenance or service, these risks shall be clearly stated in the manual and on the machine.

4. The manufacturer shall make a written declaration of conformity in Swedish for each applicable directive. This declaration of conformity, which is supplied to the customer, shall also specify the harmonised standards that have been applied, fully or partly, in order to comply with the legislation and imperative requirements for the design, manufacturing, function and documentation; that is, for the hardware, software and documentation.
5. Finally, the manufacturer shall provide a visible evidence of having met all requirements. This is done by applying the CE mark to the work equipment close to the name of the manufacturer or the manufacturer's representative.

User's/procurer's/machine owner's responsibility

The user should perform a thorough delivery and safety inspection to verify that the machine is safe before it is put into service. Never assume that a machine is safe just because it is CE marked! The CE mark only indicates that the manufacturer considers that the machine complies with the requirements of the specified directives.

Before the machine is put into service, check for the existence of:

- CE mark on the machine
- Declaration of conformity in Swedish
- Operating instructions in Swedish and in original. The instructions shall describe how the machine is installed, put into service, operated and maintained.

Then examine the machine thoroughly. Often, safety deficiencies can be detected directly and with a little thought and by taking the time to go through the machine, more is detected. The Machinery Directive Annex 1 provides the essential health and safety requirements that must be complied with. Risk lists and requirements in the harmonised standards may be helpful during the inspection. Experience from and comparison with other similar machines also provides guidance.

Immediately notify the manufacturer of even the smallest safety defect.

Partly completed machinery

If the delivered machinery is a so-called partly completed machinery, which not is a complete machinery, it means that it does not comply with all the requirements in the Machinery Directive and that it must not be put into service before the final machinery, into which it is integrated, has been declared in conformity to the Machinery Directive and has been CE marked. Any electrical equipment of the partly completed machinery shall, however, be CE marked according to the Low Voltage Directive and the EMC directive.

When partly completed machinery is included in the delivery, it is important to clarify who is the final manufacturer that will CE mark the whole assembly.

Furthermore, relevant technical documentation must be provided with the partly completed machinery, to ensure that it can be safely assembled to a final machine.

The procurer should in the tender ensure that the final manufacturer, who will do the CE marking, has access to the risk assessment of the partly completed machinery.

According to the Machinery Directive, the partly completed machinery shall be accompanied by assembly instructions, to ensure that it is correctly assembled. Furthermore, it shall be accompanied by a "Declaration of Incorporation of partly completed machinery", which shall state the requirements in the Machinery Directive Annex 1 that have been applied and complied with.

It is the responsibility of the manufacturer of the partly completed machinery to prepare a technical construction file. The content is specified in Annex 7 in the Machinery Directive.

Modification of existing machinery

If the machinery is modified, remember:

- Modifications or reconstructions may affect the original CE marking.
- For all modifications, the possible impact on the safety of the machinery must be investigated and documented.
- It is the responsibility of the one who modifies or reconstructs a machine to ensure that the machine is safe also after the modification. This applies even if the modification is made at the request of the customer/machine owner.

4. Document history

Revision Date	Comment
2015-10-19	<ul style="list-style-type: none">• Section "1.6 Electrical requirements" clarification on the RoHS Directive 2011/65/EU• New section added "1.7.2 Exhaust brake", section "Tyres" new number 1.7.3• The last sections from "Lighting" moved to new section "1.8.1 General", new section numbers "1.8.2 Driving lights" and "1.8.3 Work lighting"• Addition to "2.1 Remote-controlled machinery" clarification on visual warning device• Updated reference to standards in section "2.3.1 General"• New last section about warning for raised loading platform added to "2.4 Rock transport vehicles"• Addition to "2.6 Machinery intended for lifting persons" that anchor points shall be marked• Section "2.8 Belt conveyors" with underlying sections has been revised and complemented with sub-headings 2.8.3.1 through 2.8.3.4• Appendix 2 complemented with sub-headings from item 15.• Appendix 3 revision of list with examples of standards for mining machinery• New chapter "4 Document history" added• Other changes: correction of spelling errors