

*Members of Standing Working Group for Mining Industry of the  
Advisory Committee for Work Safety and Health Protection at  
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# **CODE OF GOOD PRACTICE**



## **OF SHOT-FIRER**

*for preparation and execution of blasting works*

*Luxemburg*

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## PREFACE

The proven procedures (in English CODE OF GOOD PRACTICE) (hereinafter referred as "code") is a document offering minimal ethical (from moral point of view correct) and practical procedures, which are understood as „corresponding, officially accepted, particularly professional, expert and proven standards.“ It is especially determined to shot-firers<sup>1</sup> for designing, planning, preparation and execution of preparatory<sup>2</sup> and blasting works<sup>3</sup> with development, preparation and winning of minerals in underground and on surface (hereinafter referred as "mining").

Between the law and morality there is a narrow connection, however, between them there are also differences. The law regulates what the state is concerned in the given period of time, however, it can never address all situations, which might occur in practical life. It is generally known that where terminates the law, starts morality. In countries with legal tradition the states resolves by means of the acts the basic problems only. For this reason the priority and a larger wide of "catch" should be given to voluntary moral principles and rules whose observation is being determined particularly by a globalized competition and public<sup>4</sup>.

### **The code respects:**

- a) New and enhancing requirements on work safety and health protection in mining.
- b) Permanent need to use commercial explosives<sup>5</sup> in mining.
- c) New explosives and accessories of blasting technique<sup>6</sup>, introduced and used on European market.
- d) Public concerns related to undesirable effects of blasting works.
- e) Increasing interest in misuse of explosives.
- f) Persisting differences in legislation of blasting works among individual countries of the Community.

Before issuing the code, the established group of 19 experts from the member states of the Community (6 experts appointed after consultation with governments, 6 after consultation with groups of employers, 6 after consultation with groups of employees and 1 expert as a responsible representative of the Commission) laid down the following main objectives:

- a) Ensure up-to-date and efficient frame for all persons that are responsible for work safety and health protection in mining workplaces, where the explosives are in use.

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<sup>1</sup> Shot-firer means an authorized person, who is in charge and responsible for works connected with use of explosives for blasting works and for disposal of the explosives which failed during blasting works.

<sup>2</sup> Preparatory works means particularly direction finding, drilling, inspections, checks of the site assumed for use of explosives, including endangered areas.

<sup>3</sup> Blasting works mean such use of explosives which takes advantage of energy of inside chemical reaction of explosives (blast) and which includes a set of work procedures, especially explosives charging, preparation and charging of primers, making of firing circuit, firing of charges (shot) and blasting of charges (blast) at one workplace with one closure of safety circuit.

<sup>4</sup> Public can be understood as a group of subjects, which is connected with a certain common interest and which realizes such connection, as for example, citizens, customers and customers of competition, investors and competitive subjects, current and future employees, special-interest and lobbying groups, state administration and self-administration.

<sup>5</sup> Explosive means solid or liquid substance or mixture of substances, which is able to blast as a result of inside chemical reaction.

<sup>6</sup> Accessories of blasting technique means inexplusive devices used during blasting works (e.g., exploders, testers of firing circuits, firing feed lines).

- b) Advance in preventing from rise of injuries, occupational diseases and emergency events in use of explosives in mining.
- c) Eliminate the known hazards by incorporation of existing knowledge and its modification into the existing methods of developing, preparatory and mining works.
- d) Determinate procedures for preparation and performance of preparatory works and blasting ones in mining based on the new forms of work organization (outsourcing, in particular).
- e) Provide advisory aimed to establish the new more identical provisions of national legislation and unified awareness of professional groups, employers and employees in mining to accept preventive and remedial measures on local level.
- f) Support top consultations and collaboration among the governments, employer organizations and those working on improvement of competitiveness, work safety and protection of health, especially in performing the blasting works in mining.
- g) Prove and deepen confidence of:
  - customers (clients – mining organizations),
  - other public
 that every shot-firer, in designing, planning, preparation and execution of preparatory and blasting works, will always proceed in compliance with this code of good practice, thereby he will contribute to improve public opinion<sup>7</sup>.

### **To whom the code has been assigned?**

The code has been also drawn up with the objective to provide guidance to:

- a) Persons in administrative practice who participate in framing the specific provisions of national legislation and during inspections<sup>8</sup> require their fulfilment.
- b) Those professional groups, which care in operation practice to ensure unified awareness of their members, particularly shot-firers.
- c) Owners of mining organizations and those of organizations which carry out blasting works on supplier basis for needful incorporation of requirements having impact on their profit.
- d) Management of such organizations for analysing and managing all business and safety hazards.
- e) Employees for further deepening of culture and ability of further development and adaptation to recent challenges.

### **The code has been written provided that:**

- a) In countries, where the explosives are used in mining, every government of the member-states of the Community should be bound to have in place, enacted legislation and regulations:
  - for security of work safety and health protection in working and operation for use of explosives,
  - put under periodical controls for the purpose of its gradual unification in agreed terms.
- b) Legislation of this risky branch should pursue the following objectives:
  - adjustment of legal frame to recent forms of work organization, including its simplification,

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<sup>7</sup> Public opinion means an opinion that can be announced in public (among other people) without occurring any sanctions against the speaker.

<sup>8</sup> E.g., made by inspector, which means a person appointed by relevant authority on the basis of national regulation.

- putting emphasis on great importance of hazard prevention by supporting changes in workers behaviour and at the same time by motivating employers to accept approaches focused on permanent investigation and assessment of new possible hazards,
- permission of execution of blasting works,
- determination of requirements on shot-firers,
- determination of requirements on professional qualification and professional competency of authorized official persons, inspectors making checks, responsible representatives and other persons, who may be involved with explosives,
- determination of such number of the inspectors making checks, which enables to make a minimum of two complete and unannounced inspections every year of each mine or quarry, eventually other plant (workplace), where the blasting works are being carried out,
- authorization of the inspector making checks with sufficient authorities and other means so that he may ensure observation of national legislation,
- introduction of central system for shipment of reports about the results of checks, executed by inspectors and inspecting reports about results of other checks executed by representatives of the employees, to relevant institution that should subsequently take steps, which are adequate to content of these reports,
- introduction of central system by relevant national institution for monitoring of transported explosives, which shall ensure a harmonious system for unambiguous identification and monitoring of explosive during their entire lifetime within the area of one country,
- introduction of unified system for monitoring and assessment of hazards and dangerous situations,
- introduction of information system aimed to quick exchange of information among the countries of the Community, in particular about mortal or serious work injuries and about emergency events in use of the explosives,
- introduction of central system of monitoring and assessment of good practice for further professional preparation and education.

The code is not intended to substitute regulations, national acts or harmonized standards being accepted.

The provisions of this code should be considered as the basic requirements on health protection of the workers and on protection of the property. The code contains recommendations; more restrictive national or international regulations or agreements, instructions for use of explosives and accessories of blasting technique approved by the national authority as the case may be, have a priority over these recommendations.

The extent of the code has been structured in chronological sequence according to individual operations, which are to be made to bring the explosive to blasting<sup>9</sup>, in case of use of black powder<sup>10</sup>, to explosive burning<sup>11</sup>.

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<sup>9</sup> Blasting - means a sudden release of energy inducing blasting effects with a possible bursting of solid particles (the term "blasting" includes quick burning, detonation and deflagration).

<sup>10</sup> Black powder means a homogenous mixture of sodium nitrate or potassium nitrate with charcoal or with other carbon, with sulphur or without it.

<sup>11</sup> Explosive burning (deflagration) - means a type of explosive transformation in substance, which spreads by subsonic speed.

It regulates conditions put on the persons that can be involved with explosives, on site assumed for use of explosives, on explosives and accessories of blasting technique, on conditions of monitoring of undesirable effects of blasting works and on approaches to public. An indispensable part of the code is preparatory work, whose level of designing, planning, carrying out and evaluation can substantially influence the result of each blast. Cohesion and information transfer about knowledge of the place between the contractor of preparatory works and shot-firer (as a customer), with increasing share of outsourced works, is considered as most principal.

The code of good practice is presented largely favourably, only some incorrect procedures are mentioned at the end of the code in the Appendix No. 1.

Just a responsible attitude of the specific persons in different local conditions and technical possibilities will influence, how far the code may be observed.

From this reasons the Standing Working Group for Mining Industry of the Advisory Committee for Work Safety and Health Protection at the European Commission believes that observation of the code will enable to the shot-firers in particular to use explosives even safer and more effective and so ultimately will contribute to integrate national regulations and at the same time to strengthen competitiveness of united Europe as well.

The code was compiled by Dipl.Ing. Bohuslav Machek, Ph.D., central mining inspector of the Czech Mining Authority in Prague, in the course of the Czech Presidency of European Community.

## **1. REQUIREMENTS ON SHOT-FIRER**

### **1.1. To qualify for appointment of a shot-firer, the person should:**

- a) be older than 21 years of age.
- b) have successfully completed secondary school education.
- c) be emotionally stable personality.
- d) be blameless.
- e) be reliable<sup>12</sup>.
- f) be healthy capable.
- g) have practical experience (i.e., after achieving 18 years of age to work 3 years at workplace, where the blasting works have been regularly performed, out of which as minimum 1 year to work under leadership of an experienced shot-firer and under his leadership to participate actively in 50 blasts, minimally).

### **1.2. To be assessed as expertly competent person, he should:**

- a) pass out successfully a course, which should be approved by a national authority and include a theoretical and practical part<sup>13</sup> of education according to Appendix No. 2.
- b) pass out successfully an exam from professional competency in face of national authority, where he will prove theoretical and practical knowledge.
- c) be a holder of valid authorization.
- d) be able to carry out blasting works safely.
- e) pass out a periodical training (content of theoretical part of annual training is presented in Appendix No. 3).
- f) educate himself in the course of whole-life in recognized courses.
- g) comply with a periodical assessment of health capability by a general practitioner or specialist.
- h) comply with periodical assessment of competency by an employer, by public self-administration as the case may be.
- i) comply with periodical assessment of blamelessness by state authority.
- j) pass out periodical exams in face of professional company or national authority.

### **1.3. Shot-firer should always bear in mind:**

- a) to proceed in a ponderous and responsible manner to be always an example for others by his behaviour and work procedures.
- b) to comply all operations of blasting works with a permanent process based on repeated procedure in the following sequence:
  - 1. PLAN – to determine objectives and processes, which are needful, to achieve assumed result of the blast in compliance with requirements of legal directives, standards, employer and customer.
  - 2. DO – to carry out or exercise processes planned in advance and documented.
  - 3. CHECK – to monitor and measure the processes being executed in relation to objectives set forth, to register and keep informed about the results.
  - 4. ACT – to evaluate and carry out the measures for a permanent improvement of the assumed results of the blasting.
- c) He shall:

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<sup>12</sup> Ability to meet under all circumstances his commitments and act in compliance with expectation.

<sup>13</sup> Eventually, recognized by ESSEEM – European Shot-firer Standard Education For Enhanced Mobility



- permanently find a favourable approach to directives, national regulations, standards, codes and instructions of the employer and at the same time to honour a primary obligation to study them permanently,
  - have about one a warrant authorizing him to carry out blasting works and protect it from damage and loss.
- d) He shall observe these practical approaches in the following sequence:
1. Not to take a big risk for too little.
  2. Not to take a risk more than as much as he can afford to loose.
  3. Think of probabilities.

**1.4. During performance of his function, in relation to customers, employers and other employees, the shot-firer should:**

- a) be particular in observing the work plan, which was agreed upon, and report changes having a substantial impact on execution of blasting works, and let these changes approve by manager or employer.
- b) keep whenever in disposal:
  - authorization in writing from his manager or employer (provided the shot-firer is not at the same time an employer) to carry out blasting works or authorization to carry out, direct or coordinate works,
  - documentation for execution of blasting works together with blasting log, drilling log, technical project of the blast, technological procedure of blasting works and with minutes of blasting,
  - appointment of other assistant personnel by the shot-firer in writing – persons, who will be involved with explosives during each blasting,
  - contracts with suppliers and customers, minutes, documents about familiarization, training and verification of persons, technical documentation and other documents about tests, inspections, declarations of accessories of blasting technique, explosives and from technical equipment being used, the certificates, authorization, instructions, decisions and national legislation.
- c) convince himself regularly that for preparatory and blasting works are used technical equipment, personal protective tools and only accessories of blasting technique, approved by a relevant national authority and which correspond to other requirements set forth in national legislation (declaration of conformity, regular checks, tests and reviews etc.).
- d) at workplace, where he is involved with explosives, use (be dressed in) protective working cloth, suitable protective footwear, reflective waistcoat, eventually highly visible clothing with fluorescent strips, gloves, helmet and vision protection (goggles or shield).
- e) have at the workplace in perfect condition the accessories of blasting technique and other instruments as watch, knife, pliers etc.
- f) in case of any doubts on competency of:
  - workplace,
  - explosives,
  - accessories of blasting technique,
  - himself alone and other persons that may be involved with explosives, inform without delay his manager or employer.
- g) be particular that:
  - explosive presents a dangerous chemical substance and during any handling with explosive any employee should be equipped with protective tools and

- protective working cloth, according to explosive nature and hazards evaluated by the employer (see Appendix No. 4),
- nobody is entitled to use other protective tools and protective cloth; only those, which were manufactured from the material with high insulation ability, can be used,
  - nobody is entitled to use dirty and damaged protective tools and protective cloth and those, where there is a doubt about their unexceptionable condition and that they do not correspond to other stipulated requirements on security of work safety and health protection,
  - everybody, who will be involved with explosives, should proceed with most caution, observe national legislation, instructions from the manufacturer or supplier of the explosive, instructions of the employer, operation documentation, administrative resolutions and other measures in order not to jeopardize his safety and that of other persons and property,
  - nobody is entitled within stipulated distance from the site, where handling with explosives takes place or the explosives are transported, carried through or kept, to use naked flame or heated objects, to smoke or use cell phone,
  - everybody, who discovers theft, loss or finding of explosives, is obliged without delay to inform accordingly his manager or employer,
  - from the gathered information shall be conducted, continuously supplemented as the case may be, the emergency plans about recent model situation of possible accidents during execution of blasting works.
- h) behave in a correct manner with his subordinated workers and managers.
- i) without delay keep his manager or employer informed:
- about recognized safety and health hazards, which rise in the course of performance of blasting works,
  - about recognized faults in applying the requirements on work safety and health protection at workplace, where the blasting works are being prepared or carried out, to request redemption (accordingly he should be entitled to suggest adequate measures),
  - if appropriate measures were not taken without delay to make good.
- j) be particular so that the employer might archive for a period of 10 years all evidence records and documentation related to execution of blasting works, namely even in case that the employer does not carry out blasting works any longer.
- k) openly keep informed managers, employer, eventually professional association, on dangerous situations, accidents, emergency events and injuries, which occurred during blasting works.
- l) investigate and show up reasons and circumstances of occurrence of emergency events, working injuries or death of employee at the workplace.

### **1.5. During performance of his function, in relation to his profession, the shot-firer should:**

- a) be a member of the professional association.<sup>14</sup>
- b) present proudly:
- liability for expert level of blasting works being carried out,

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<sup>14</sup> For example, in the Czech Republic, be a member of the Association for blasting technique and pyrotechnics (STTP) and in Europe, a member of the European Federation of Explosives Engineers (EFEE).

- liability for documentation conducted by him for performance of blasting works,
  - liability for protection of public interest, natural and cultural values,
  - effort on ensuring first rate raw material, mined for further adjustment or treatment,
  - obligation to observe national directives, regulations, standards and instructions of the employer,
  - obligation to inform manager or employer, eventually professional association, about any endangering of general externality, expert level of his work, eventually about unfair conditions of economic competition,
  - defence of interests of employer and customer, and he will conform to it his personal interest,
  - obligation, before the works are started, to have:
    - contractual relation concluded,
    - insurance with corresponding indemnification established,
  - responsibility for damages incurred during performance of blasting works,
  - interest to permanently supplement knowledge by keeping track of development of his profession and mining, the same thing to demand from his employees,
  - principle that in case of prejudice he will refuse to take part in hearing or in performance of the documentation for execution of blasting works, eventually performance of expert standpoints or reports,
  - obligation to withdraw from the order in case of breaching the values mentioned above.
- c) consult with the customer the measures to ensure the highest level of blasting works being performed.
- d) avoid damaging the economic competition by placing inadequate price quotes.
- e) not permit the blasting works and at the same to perform such works, in doing so he should not conduct expert standpoints and reports as well.
- f) stand loyally and take care of prestige and image of himself, employer and profession in face of the public.
- g) regularly communicate with a wider public with the following interests:
- deepening of both-sided relations of long-term character,
  - care for prestige and favourable image of the shot-firer and employer,
  - evaluation of individual serious or disputable causes,
  - analysis of relations among senior employees, management of the organization and employees,
  - strengthening of credibility,
  - preparation on critical situations and preventing from conflicts and misunderstandings,
  - harmonization of private and public concerns,
  - deepening of mutual respect,
  - care for both-sided communication,
  - analysis of future directions and anticipation of their consequences,
  - to find out feedback about public opinion, positions and expectations of the public.
- h) keep confidentiality about:
- features of explosives and their other possibilities of use than just for performance of blasting works,

- information on negotiations, especially with employer and customer, and without their consent not to apply this information to other orders or activities.
- i) present true information.
- j) on the basis of his practical experience, support information system (database of the recommended and non-recommended procedures during performance of blasting works) for comprehensive risk management and preparation of future shot-firers at national level.

## **2. PLANNING AND IMPLEMENTATION OF PREPARATORY WORKS**

### **2.1. Before designing of preparatory works is started, the shot-firer should :**

- a) find out by means of consultations and per possibility by preliminary inspection as follows:
  - assumed condition of the place of explosives use, of entire workplace and its close neighbourhood,
  - availability of documentation concerning structures, mines and quarries, building and technical type of construction of facilities and objects,
  - assumed impacts of the activities, which could influence preparation and performance of blasting works, including real possibilities of their monitoring,
  - assumed impacts of possible designs of variant solution of preparatory and blasting works.
- b) request completion, eventually development of necessary data for designing works.
- c) collect documented, actual and independent information, particularly within the range of:
  - assessment of the area and place, assumed for use of explosives,
  - condition of information in documentation of the facilities, mines and quarries, building and technical type of construction of the objects (e.g., utilities as water, electricity, crude oil, gas, drainage, telecommunication and other cables, sources of high-frequency energies),
  - activities under which the blasting works to be carried out,
  - assessment of designs of solution and implementation of preparatory and blasting works,
  - possibilities of restriction or suspension of the operated activities, usage of structures or facility for their good protection,
  - conditions of identified hazards<sup>15</sup> upon previous consultation, including their evaluation,
  - risk analysis of rise of damages by means of method „What when?“, particularly in responding a minimal range of the general questions in the following sequence:
    1. What is a threat of hazard, which has undesirable impact on safety, eventually may cause damage?
    2. What impacts of this threat can be?
    3. What costs to be spent for avoiding this threat?
    4. What costs to be spent for remedy of incurred damages?
  - results of eventual further expert or professional assessments and measurements,
  - evaluation of total estimated costs.

### **2.2. In selecting the explosive the shot-firer should:**

- a) select explosives and initiating system according to information, which were independently assessed, gathered and documented as per items presented below.
- b) in selecting the explosive<sup>16</sup> consider the following aspects:

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<sup>15</sup> Identification of hazards means a finding of danger to the extent of discovery of all sources of danger, their size and nature.

- conditions and recommendation determined by the manufacturer,
  - possibility to encounter extreme conditions,<sup>17</sup>
  - requested quantity and quality of disintegrated material,
  - characteristic, physical-mechanical features of disintegrated material, including their evaluation by recommended methodology<sup>18</sup>, based on knowledge of:
    - speed of propagation of longitudinal and cross waves,
    - specific weight,
    - strength in compression,
    - strength in tension,
    - impedance,
    - degree of erosion,
  - assumed necessary quantity of energy spent for material disintegration by recommended methodology, based on knowledge of:
    - type of explosive,
    - detonation velocity<sup>19</sup>,
    - impedance,
    - work ability,
    - sensibility,<sup>20</sup>
    - oxygen balance<sup>21</sup>,
  - even deployment of charges with respect to geometry of disintegrated part of the material,
  - time and way of charging,
  - specific consumption of explosives being achieved and designed per disintegrated tonne or cubic meter of rock,
  - specific consumption of explosives being achieved and designed per one meter of hole,
  - total costs being achieved and designed per disintegrated tonne of cubic meter of material.
- c) consider, in proposing solution with explosive selection:
- explosive impedance, which should approach impedance of disintegrated rock,
  - in compact tectonic undisturbed rocks select explosives with larger detonation velocity,
  - in tectonic disturbed rocks select explosives with larger working ability and smaller detonation velocity.
- d) give priority to use of mechanical charging, for example, by charging cars.

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<sup>16</sup> Until time of task completion of ESSEEM – European Shotfirer Standard Education For Enhanced Mobility in 2010.

<sup>17</sup> Extreme conditions mean those, including high or low values of temperatures and/or pressures and/or humidity, which are beyond the area of usability of testing method.

<sup>18</sup> For example, RMI – a rock mass characterization system for rock engineering purposes.

<sup>19</sup> Detonation means reactions proceeding through explosive material with speed, which is higher than sonic speed in reacting material.

<sup>20</sup> Sensibility means disposition of the explosive to outside impulses as stroke, flame, friction or temperature, pressure, humidity conditions leading to reaction or to deterioration of capacity.

<sup>21</sup> Oxygen balance means a chemical state of equilibrium in an explosive. It is achieved when the amount of oxygen is just sufficient for complete combustion, keeping CO and NO<sub>x</sub> at a minimum. Apart from minimizing toxic fumes, oxygen balance maximizes explosive performance (velocity of detonation and detonation pressure).

### 2.3. During selection of priming the charges and initiating system<sup>22</sup> the shot-firer should:

- a) in selecting initiating system, consider the following factors:
  - presence of undesirable energies, e.g., high-frequency, electrostatic or atmospheric energy,
  - conditions and recommendations determined by a manufacturer of explosives or detonators<sup>23</sup>,
  - possibility to encounter extreme conditions,
  - requirements on fragmentation,
  - permissible load of objects or utility networks by vibration,
  - parameters of holes,
  - time and way of charging,
  - total costs being achieved and designed per disintegrated tonne or cubic meter of the rock.
- b) give priority to use of initiating system with safety fuse<sup>24</sup> or detonating cord<sup>25</sup> or non-electrical initiating system<sup>26</sup>, provided effect of undesirable source of foreign electric power cannot be reliably excluded.
- c) in selecting initiating system, suggest solution, which should result from the knowledge:
  - increasing quality of required fragmentation can be ensured by electrical initiating system, non-electrical one (with the exception of that with detonating cord and safety fuse), while the best results can be achieved by use of electronic initiating system provided that in compact, tectonic undisturbed rocks, a network of holes will be denser along with smaller diameters (smaller partial<sup>27</sup> charge),
  - increasing requirements related to limitation of vibration effects can be ensured by use of electrical initiating system, non-electrical one (with the exception of that with detonating cord and safety fuse), while the best results can be achieved by electronic initiating system provided that in compact, tectonic undisturbed rocks, a network of holes will be denser along with smaller diameters.

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<sup>22</sup> Initiating system means, for example, priming the charges with safety fuse or detonating cord, non-electrical, electrical or electronic initiating system.

<sup>23</sup> Detonator means a subject formed by small metallic or plastic cup, which contains primary explosive exploder, e.g., lead azide, and secondary explosive one, e.g., PETN, or other combination of explosives, usually not exceeding the weight of 2 g.

Delay-action detonator means a set of detonator containing time delay device between activating and detonating part of the detonator (delay-action detonator can be electronic, electrical or non-electrical).

Instantaneous detonator - means a detonator without rated delay time.

Non-electrical detonator - a set of detonator activated by means of impulse tube or by other manner, which does not use electrical impulse as a primary manner of initiation.

Plain detonator - instantaneous detonator delivered without initiating source (plain detonators are normally activated by means of detonating cord, safety fuse, exploder or detonating tube).

<sup>24</sup> Safety fuse - a subject consisting of core made up by fine-grained black powder, which is surrounded by elastic fabric with one or more protective sheathing (safety fuse burns after ignition with speed determined in advance without any outside explosive symptoms).

<sup>25</sup> Detonating cord - a subject formed by core from detonating explosive (usually PETN) surrounded by outside elastic packing or sheathing by soft metallic tube (content of explosive charge in detonating cord can be within the range of 1,0 g/m to 200 g/m of detonating cord).

<sup>26</sup> Non-electrical initiating system is made up by priming charge (booster), detonating tube, detonator and primer of detonating tube.

<sup>27</sup> Charge, which is initiated separately or in time interval  $\geq 0,25$  s.

## **2.4. In selecting the stemming, the shot-firer should (use, ensure):**

- a) Sealing of every charge by stemming, which should be formed by:
  - water or other suitable mixture in wraps or without them,
  - sand, thrown to the hole under pressure (sand for stemming should contain at least 90% of the volume and be of 0,3 up to 3 mm gradation),
  - sand with plastic clay as bonding agent (as plastic mixture is considered that one, which can be shaped by hand),
  - workable clay.
- b) Exclusion of sealing of charges by means of drilling powder (stemming in holes of diameter more than 50 mm should be from crushed aggregate of size 4-16 mm).
- c) When using pneumatic equipment, insert between charge of explosive and stemming at least 10 cm long filler made from plastic clay or other suitable material.
- d) Minimum length of sealed part of the hole, which should be of same length as burden<sup>28</sup>.

## **2.5. During designing the works the shot-firer should:**

- a) propose technical solution according to independent assessment of condition presented in article 2.1., and in compliance with principles presented in articles 2.2.; 2.3. and 2.4.
- b) consider hazards within the range and sequence as follows:
  1. hazard identification,
  2. determination of value and importance,
  3. identification of threats and weaknesses,
  4. determination of weight of threats and degree of vulnerability against the given threat,
  5. design of solution,<sup>29</sup>
  6. determination of check of effectiveness of solutions being taken.
- c) ensure under contract in collaboration with his manager or employer the legal risks, particularly:
  - subject matter and content of the contract with suppliers of works,
  - contract about amount of insurance indemnification between mining organization and the supplier, insurance company as the case may be,
  - contract about ensuring of needed number of employees for performance of function of shot-firer, number of assistant personnel and necessary number of guards during execution of blasting works,
  - contract about range of responsibility of the shot-firer, coordinator and other persons that shall, for example, carry out checks of the workplace or fulfil other tasks,
  - contract, eventually determination in the subject matter of the contract, which would arrange among mining organization, supplier of blasting works and other subcontractors as follows:

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<sup>28</sup> Burden of charge - vector of the smallest resistance to the nearest free area.

<sup>29</sup> A part of hazard assessment is a resolution whether to accept or limit the hazard to an acceptable level (comprehensive process of hazard size investigation, determination of threat weight and degree of vulnerability against the given threat and resolution whether the hazard is or not admissible - acceptable). Admissible hazard means (acceptable) hazard reduced to the level, which can be tolerated by the organization, however, always with respect to legal obligations.



- handing over of the documentation, instructions, input parameters, resolutions etc., which are to be observed (e.g., resolution about permission of activities under which the preparatory or blasting works can be carried out, results of geological survey, mining plan, technological procedure for mining etc.),
  - obligation to keep mutually informed in writing about hazards and measures taken for protection from their incidence, which relates to performance of blasting works and to workplace,
  - mutual collaboration with ensuring of work safety and health protection for all workers at workplace,
  - mutual coordination of the measures aimed to safety and health protection of the workers and procedures leading to their ensuring,
  - contract with the suppliers or customers arranging a regular communication on mutual plans, needs etc., which may lead at least to acceptance of hazard on behalf of somebody else,
  - contract about protection of copyright incurred from duties resulting from employment (eventually, other rights related to intellectual property), property as a rule of the supplier (documentation for performance of blasting works),
  - determination of content of business confidentiality and other secrecy.
- b) develop for each workplace an integrated comprehensive procedure for execution of blasting works from the view of:
- required level of works,
  - coordination of works,
  - security of work safety and health protection and that of operation safety.
- c) determine one common safety circle at close workplaces during blasting works on the surface, where the safety circles 30 touch or overlap during simultaneous implementation of blasting works.
- d) propose a solution of blasting works on the basis of independent assessment of condition of objects in endangered area and hazards, which were documented, assessed and evaluated.
- e) conduct a document concerning the proposed solution, which shall be a part of preparatory works documentation (see Appendix No. 5, specified especially for holes larger than 50 mm on the surface), blasting technical design and technological procedure of blasting works in a minimum range of requirements presented in Appendix No. 6.
- f) sign the blasting technical design and technological procedure of blasting works as well as their every change along with further shot-firers that will carry out blasting works, according to blasting technical design and technological procedure of blasting works (so by his signature he will confirm accuracy of data, drawings and calculations).
- g) hand over the signed blasting technical design and technological procedure of blasting works to his manager of employer for authorization and performance of blasting works.
- h) after development of working or other technological procedure of preparatory works and upon mutual information exchange, mainly related to hazards, he should be informed, for example, by a sub-contractor of preparatory works, about actual term of works start-up.

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<sup>30</sup> Safety circle means a sector, behind which terminates endangered area.

- i) inspect the place of assumed use of explosives with that who will carry out the preparatory works (e.g., with a sub-contractor).
- j) agree with a sub-contractor a manner of continuous inspection of quality of preparatory works being executed (although there is a general principle that for quality of preparatory works is responsible that who executes them).
- k) monitor continuously information, documented by the sub-subcontractor, on course and results of preparatory works.
- l) inspection result, which was performed, and handing-over of required parameter as well as result of preparatory works being actually performed, should be recorded in writing.
- m) according to documented results of preparatory works and assessment of recent associated known hazards, make a decision, whether it is necessary to make changes in blasting technical design and in technological procedure of blasting works.

## **2.6. Before drilling operation is started and during its course, the shot-firer should:**

- a) inspect carefully the area with that who will carry out the drilling operations.
- b) In the course of inspection of the place:
  - check capacity and readiness of the workplace, namely for possible presence of misfires<sup>31</sup>, burnt out charges and remains of explosives in holes<sup>32</sup> after foregoing blasting works.
  - compare geological conditions of the workplace with those presented in the geological documentation and assumed conditions, presented in technical design of the blasting,
- c) check, whether the holes, which were drilled to other purposes, and those related to burnt out charges and remains of the holes (which must not be re-drilled, deepened and charged), have been marked.
- d) hand over the design of drilling pattern so that the holes might be founded safely, drilling pattern be as simple as possible (preferably the same lengths and pitch of the holes) and at the same time, the explosive could do an assumed job in them.
- e) adjust drilling pattern to local conditions according to requirements presented in Appendix No. 5.
- f) check, whether the holes have been ensured against contamination, eventually closed off by plug or by other determined manner.
- g) check, whether time schedule of drilling operations and other data, presented in drilling log, are observed.
- h) check, whether the determined parameters are continuously recorded, namely changes of geological conditions and parameters of holes, into drilling log, eventually, whether the required drilling samples are being kept.
- i) inspection result, which was performed, and handing-over of required parameters as well as result of preparatory works being actually performed should be recorded. The minutes should contain terms presented in Appendix No. 5.
- j) be particular so that the preparatory works might be always completed before the stipulated date of commencement of blasting works, however, prior to evacuation of manipulation area at the latest.

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<sup>31</sup> Misfire means a condition, when explosive does not do assumed job or when discovery of remains of unexploded explosives occurs in the workplace.

<sup>32</sup> Hole means a borehole designed for charging of explosives for blasting work with the exception of holes of drilling and geophysical survey and those for mining of crude oil and natural gas.

### **3. TRANSPORTATION AND CARRYING OF EXPLOSIVES TO WORKPLACE**

#### **General requirements on transportation and carrying of explosives:**

- a) Transportation and carrying of explosives are considered to be that of dangerous things. Therefore, according to local conditions, operating instructions and safety sheets of explosives, the documented procedure for transportation of explosive should be determined in advance by that who performs the transportation and carrying of explosives.
- b) The documented procedure for transportation of explosives should include minimum terms, presented in Appendix No. 7:
- c) Transportation of explosives along the traffic routes on the surface can be performed only by vehicles, which meet requirements determined by national directive (preferably according to ADR)<sup>33</sup>.
- d) Before the transportation or carrying of explosives is started, namely from the store of explosives to the workplace, where is assumed their use, the shot-firer should determine in advance the quantity and type of explosives.
- e) Everybody, prior to any handling with explosives, should, in addition to quantity and integrity of wraps, check their consumer time period,<sup>34</sup> eventually, whether undesirable changes of the packaging are not taking place<sup>35</sup>.
- f) Transportation and carrying of explosives cannot be started before a consignee (forwarding agent) took over actual quantity of explosives in writing, including data concerning unambiguous identification of explosives for monitoring and registration of the movement of explosives, and confirmed their correctness by his signature.
- g) Transportation and carrying of explosive in the area of quarry or mine, eventually of premises, should be made only upon foregoing shot-firer instruction and under his permanent supervision.
- h) Explosives can be carried solely within inside areas of organization premises.
- i) Explosives can be only transported and carried in sales or shipping wraps, determined by the manufacturer.
- j) Explosives can be only carried in closed wraps.
- k) Bags or boxes are considered to be the closed wraps as well.
- l) Detonators should be carried by a shot-firer, only.
- m) Other explosives are carried by the shot-firer and by assistant personnel under shot-firer supervision, only. Assistant may carry explosives even without shot-firer supervision, if he carries them in bag or box, while the key to them is kept in shot-firer possession.
- n) Provided the shot-firer carries detonators, he may together carry not more than 10 kg of explosives, namely separate from detonators.
- o) One person should not carry more than 25 kg of explosives.

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<sup>33</sup> European agreement on international road transportation of dangerous things (ADR).

<sup>34</sup> Consumer time period means the time, through which the explosives or equipment can be stored or kept in stipulated conditions prior to use or disposal without becoming dangerous or inconsistent with their performance specification.

<sup>35</sup> Fragmentation means such chemical reaction, which is not a detonation and which leads to substantial changes of substance features.

#### **4. KEEPING OF EXPLOSIVES AT WORKPLACE**

##### **Requirements on keeping explosives at workplace:**

- a) At workplace in depository<sup>36</sup> should be kept only assumed quantity of explosives to be consumed in the course of one blast or during one shift.
- b) Explosives may be kept only in depositories of explosives and only for a period of presence of employees at workplace, where the explosives to be used.
- c) The quantity of kept explosives and conditions for common keeping of detonators should be determined by national directive.
- d) Detonator should be always separated by a suitable wall, preferably they should be kept in separate depository.
- e) The shot-firer or in his absence a foreman or chief of the workplace will ensure a proper and safe keeping of explosives, including their theft and misuse prevention.
- f) The depository should be located in a little busy place and in such distance from the workplace, in order not to hamper the traffic and not to be endangered by effects of blasting works.
- g) Encased store of explosives should be locked or protected by other suitable manner from entry of unauthorized person and labelled with safety signs indicating warnings, commands and prohibitions, which result from national directives.
- h) If there are located more depositories near the place of consumption and the partition between the depositories, which prevents from direct transfer of detonation, has not been built, the distance between them should be determined by national directive.
- i) The shot-firer should return the explosives, which were not consumed during blasting works, to storage of explosives. Just under exceptional circumstances the shot-firer may put them to other shot-firer of the same organization; such act should be written to their records with indication of abandonment date, quantity of explosives, according to their names and assigned identification data, and with signatures of both shot-firers.
- j) Explosives from misfires, those that were discovered or damaged and primers cannot be stored to the depository of explosives.

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<sup>36</sup> Depository of explosives can be (a) case made from wooden boards of 30 mm thickness at least or from steel sheet of 2 mm thickness at least, (b) box embedded to side of underground work, (c) mining car or (d) container.

## **5. GENERAL REQUIREMENTS ON IMPLEMENTATION OF BLASTING WORKS**

### **5.1. Before the preparation of blasting works is started, the shot-firer should:**

- a) have such conditions in place, created by the manager or employer, so that he might carry out the blasting works only under his personal direction and with requested number of assistant personnel.
- b) have an authorized deputy ensured, who is able whenever to substitute him in all acts of preparation and execution of the blasting in assumed term.
- c) be in a position or to have an effect on putting other subjects, other persons as the case may be, to cooperation within the entire time of execution of blasting works.
- d) check, before any blast is started, whether assumed conditions, presented in documentation for implementation of blasting works, did not change.
- e) require all data and information on persons that can stay only with his awareness at the workplace and that will provide him with necessary cooperation<sup>37</sup>. He should keep a record about these persons with the range of the article 5.2, item f).
- f) give an instruction to start preparation of blasting works as late as:
  - after making certain that:
    - preparatory works have been completed,
    - sufficient time reserve has been created for the case of unexpected problems,
  - when there is a realistic presumption that the blasting is not made in time from 22.30 p.m. to 5.00 a.m., with the exception of premises, whose technology requires a continuous running in this time as well.,
  - after making certain that no sudden weather changes are not reported, which could influence a preparation of blasting works,
  - after making sure about good visibility, which should be ensured within the entire period of preparation and performance of blasting works,
  - that any of the persons, who will be involved with explosives, will not work more than 1 hour of overtime, with the exception of misfire disposal.
- g) inspect the workplace, mainly the place of assumed use of explosives and manipulation area<sup>38</sup> and check quality of preparatory works to the extent, stipulated in technological procedure of blasting works and record the result of the check to a blasting log (other minimum terms are presented in Appendix No. 8).
- h) make sure in the course of inspection that:
  - the workplace corresponds to conditions set in documentation,
  - needed number of employees is available,
  - assistant personnel and other persons are competent to carry out preparation of blasting works,
  - needed accessories of blasting technique, explosives and other tools or necessary endowment of the workplace are available,
  - another shot-firer and other persons are familiar with determined procedure of works and can perform in a safe way individual acts according to

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<sup>37</sup> Assistant of shot-firer means a person, who will be involved with explosives.

<sup>38</sup> Manipulation area means an area determined for safe preparation of blasting works made up by the workplace and its nearest neighbourhood.

- documentation for implementation of blasting works, eventually conditions of permission of blasting works, measures connected with coordination of works,
- recording of work progressing is ensured so that efficiency of taken measures may be continuously checked (precautionary measures for eventual claims, emergency events, for clarification of their causes and possibility of their occurrence),
- i) give instructions for determination of manipulation area by safety tables and fencing as easily identifiable prohibited zones.

## **5.2. During preparation of blasting works the shot-firer should:**

- a) give instruction for transportation of explosives to workplace and commencement of handling with them after evacuation of manipulation area.
- b) take such procedure so that it might be prevented from undesirable fall or stroke of explosives during manipulation with them, namely during discharge of explosives from transport means.
- c) ensure from organization point of view that one person could manually load or unload all at once not more than 30 kg of explosives.
- d) check observance of no entry of unauthorized persons, with the exception of control bodies.
- e) keep a record about handling with explosives in manipulation area and about employees or control bodies that perform works there or enter into it.
- f) The record should include:
  - name and surname of the employees and date of birth,
  - place, day, time of establishing and termination of manipulation area or safety circle,
  - type of performed work,
  - purpose of entry and time of stay of employees and other persons, including indication of name, surname and date of birth,
  - unambiguous identification of explosive, which were handled with, including indication of places of assumed use,
  - minutes of emergency situations<sup>39</sup>.
- g) ensure that for the whole period there is always at least one assistant along with the shot-firer in manipulation area until his departure to blasting place.
- h) ensure so that a strict prohibition of food, drink and smoking might be observed for the whole period of preparatory works and performance of blasting ones.

## **5.3. During preparation of priming<sup>40</sup> charges the shot-firer should**

- a) exclude their preparation by other assistant than by the shot-firer.
- b) be within manipulation area only.
- c) ensure that nobody would put explosives into pockets of working cloth.
- d) stipulate a number of primers and make them ready for blasting being prepared on the instant prior to charging,

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<sup>39</sup> Incident means an event associating with works, during which occurred or could occur to injury, health damage or emergency situation (regardless of seriousness). Emergency situation is not an accident. Accident is understood an unplanned, sudden, undesirable event, caused by failure of human factor, technical equipment or material and/or by natural effects, which results in serious damage of health or death of persons, eventually of farm animals, environmental or property damage, including production losses.

<sup>40</sup> Priming - charge of explosive used as donor charge for energy enhancement of delivered acceptor charge.

- e) stipulate and ensure the most indispensable, safe distance or separation of detonators from primers of explosives.<sup>41</sup>
- f) use undamaged wooden, brass or other suitable sparkless tools.
- g) use a minimum force in forming a hole to the primer for detonator.
- h) make the primer ready by easy insertion of base of the detonator in the direction to centre of gravity of primer.
- i) safeguard every primer so that the release of the detonator might not occur in the primer.

#### **5.4. During charging the holes the shot-firer should:**

- a) At first let to verify by a person, that will charge, a continuity and length of the hole to minimize a possible discontinuity of the blast or its shortening and consequently overfill of the hole by quantity of explosives, prepared in advance.
- b) stipulate a sequence of the holes being charged.
- c) use for charging a suitable wooden tamping rod, which were checked and which should have ends in vertical position to longitudinal axis, diameter at least that big to avoid failure of the packaging and length exceeding the longest hole designed for charging.
- d) be particular that:
  - the primer has been charged first and manually,
  - the primer has been placed to bottom of the hole and the bottom directed at a longer part of the charge,
  - no part of the body has been uselessly exposed against hole orifice longer than for a necessarily needed period, namely during making a stemming as well.
- e) use exceptionally the latter primer in holes where breakdown of the charge cannot be excluded or otherwise technically ensured.
- f) ensure that from diameter of hole 102 mm and more the cartridges could not be dropped down on the primers by free fall.

#### **5.5. During charging the holes by charging cars or by other charging equipment the shot-firer should:**

- a) verify, whether the charging car or other charging equipment, including charging hose and attendance, meet requirements determined by national directive.
- b) make sure, whether markings of charging hose includes type identification of charging hose and dimensions, including type of explosive, which was designed for, particularly, whether initiation for friction and occurrence of electrostatic charge during charging cannot happen.
- c) when charging powdery explosives, the charging hoses with a resistance of 1-30 kΩ/m to be used.
- d) be particular that the charging hose was clearly distinguishable from other hoses to avoid a replacement with other used charging hose, which can be, for example, used along with antistatic plug as a charging bar.
- e) ensure that explosives, manufactured by charging car or by other equipment, will be charged directly to holes only.

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<sup>41</sup> Cartridged explosive means explosive closed into cartridge (usually of cylindrical shape), made up by paper, cardboard, plastic or other material and used in this form.

### **5.6. During stemming the charges the shot-firer should:**

Check parameters of stemming material, technology of making and determined parameter of stemming, namely length.

### **5.7. During priming the charges and initiating systems the shot-firer should:**

- a) execute and manage all acts connected with priming the charges and initiating system.
- b) be particular so that the damage and replacement could not occur and that utility and reliability could be ensured during their preparation, deployment and safeguarding.
- c) after closing the safety circle, leave last the place of charges last, check initiating system and after its checking, perform initiation – shot-firing.

### **5.8. During priming the charges with safety fuse or detonating cord initiating system the shot-firer should:**

- a) prevent from mutual combination of safety fuse initiating system<sup>42</sup> with detonating cord one<sup>43</sup>.
- b) ensure so that safety fuses or detonating cords:
  - might be used in surface workplaces,
  - could not be used in explosive environment,
  - might be prevented from strokes, friction and thermal stress,
  - might be always cut from roll at coil prior to insertion to the hole,
  - might be in holes without connections,
  - might be always in initiating system without twists and loops,
  - free ends would not be de-coiled, folded or inserted into holes either.
- c) ensure so that:
  - uncovered end of safety fuse, which to be ignited, could not encounter water and humid environment either,
  - safety fuse might be minimally 120 cm long and stick out 20 cm from the hole,
  - safety fuse might be always that long that time of burning<sup>44</sup> may ensure enough time for safe departure with his assistant to a shelter,
  - cuts at notched safety fuse might be equally off from each other and in such a number that their number was at least by half higher than number of initiations (ignitions),
  - safety fuse might be initiated only when all charges are ready for shot-firing,
  - he always initiated safety fuses with one assistant, while each of them should perform mostly 5 initiations (ignitions) during one blasting,
  - his assistant might check time, which lapsed from initiating first plain detonator,
  - gradual initiation of safety fuse might proceed in direction of departure from manipulation area,
  - one safety fuse might be ignited during initiation by consumer primer,

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<sup>42</sup> Safety fuse initiating system consists of priming charge, safety fuse and primer.

<sup>43</sup> Detonating cord initiating system consists of priming charge, detonating cord, (delay driver) and primer.

<sup>44</sup> Burning period means that of detonating cord of specified length, in seconds.



- safety fuse might be always cut from coil of safety fuse, used for blasting and not be longer than 50 cm,
- d) ensure that:
- every connection of detonating cord initiating system might be safeguarded by textile strip, twine or connecting link so that the connection may be firm and that overlap of detonating cords in the connection may be minimally 10 cm long,
  - detonator for initiation of detonating cord initiating system might have a sufficient initiating ability and connection be placed not less than 10 cm from end of detonating cord (preferably safeguarded by textile strip, twine or connecting link, while detonator bottom must be pointed in direction of movement of detonating cord blasting),
  - detonating cord could not be used in materials, where it might cause fire or blasting, eventually change of features of charged explosives,
  - every branching of detonating cord might be performed by apposition of detonating cords to each other in assumed direction of blasting movement and their firm connection in length of at least 10 cm or with bundles,
  - no part of detonating cord could not approach to each other (inadvertently as well) within a distance less than 30 cm.

### **5.9. During priming the charges with non-electrical initiating system the shot-firer should:**

- a) initiate non-electrical system by primer<sup>45</sup> of shock tube<sup>46</sup> or by electrical<sup>47</sup> or electronic<sup>48</sup> detonator.
- b) during initiation of system by detonators, ensure that initiation of all detonators might occur before first priming a charge takes place.
- c) ensure that detonator may be always oriented by bottom in direction to a longer part of the charge and by bottom in direction of assumed movement of impulse wave.
- d) during timing calculation, reckon with speed of impulse wave in shock tube about 2000 m/s.
- e) locate the primers in all holes identically to one place.
- f) ensure so that shock tubes of detonators of primers might stick out from the hole minimally 0,6 m.
- g) ensure so that shock tubes in all interconnections might be put in to the same distance.
- h) proceed always in one direction (either to start from zero or from the last time stage).
- i) be particular so that shock tubes could not be strained, i.e., when ordering tube length to take into account minimum reserve of 0,6 m.
- j) make a consequent visual check of connection correctness.

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<sup>45</sup> Primer of shock tube - equipment considered for delivery of sparkle or other similar energy impulse, of coating from explosive material inside non-electrical shock tube so that it may initiate it.

<sup>46</sup> Shock tube - tube usually provided with deposition of explosive at internal side able for activation to transfer impulse wave from one end of the tube to latter by constant speed, which does not have outside explosive effects.

<sup>47</sup> Electrical detonator - a set of detonator activated by electric power.

<sup>48</sup> Electronic detonator - a set of detonator, where delay time is achieved by means of electronic circuit, activated by electrical or non-electrical impulse.

- k) ensure not to shorten shock tube in initiating system, with the exception of cutting off for testing of blasting machine.
- l) be particular so that:
  - tubes might be conveyed directly in direction to hole,
  - tubes might be slightly strained,
  - tubes could not be exposed to a possible damage, especially by rock fall or vehicle overshooting,
  - humidity could not get to tube, which would cause its malfunction,
  - not to have in hand any part of tube.

**5.10. During priming the charges with electrical system<sup>49</sup> the shot-firer should:**

- a) be particular so that firing supply line, supply conductors of detonators and connecting conductors:
  - might have along the entire length undamaged insulation and connections be reliably insulated by plugs,
  - and all connections be clean, tight and insulated particularly from water and ground.
- b) connect in the same initiating circle<sup>50</sup> the detonators, whose electrical features are identical from the view of prescribed exploding electric power.
- c) connect in initiating circle such electrical detonators originating from one manufacturer with the same firing current<sup>51</sup> and firing impulse<sup>52</sup>.
- d) make short-circuit ends of supply conductors of detonators, provided they are not insulated all the way to end.
- e) disconnect or strip the insulation of ends of supply conductors of detonators only closely before they are connected in firing circle<sup>53</sup>.
- f) leave individual circles and firing supply line disconnected only before connection in firing circle.
- g) have, during execution of blasting works, the blasting machine<sup>54</sup> permanently by him, unless it is equipped with removable device but for which it cannot be put into operation.
- h) have the removable device during execution of blasting works by him.
- i) ensure so that the firing supply line, supply conductors of detonators, exploders, connecting conductors:
  - might not touch metal or other electrically conductive subjects with the exception, presented by a manufacturer in service instructions,
  - might be away at least 30 cm from other electrical lines.

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<sup>49</sup> Electrical initiating system consists of priming charge and firing circle.

<sup>50</sup> Initiating circle is composed of firing circle connected with blasting machine ready for shot-firing.

<sup>51</sup> Firing current - constant direct current needed for reliable activation of electrical detonator, in amperes (A).

<sup>52</sup> Firing impulse - electric power falling on unit of electrical resistance of a set of detonator, which activates electrical detonator or electrical explosive equipment, specified in mJ/ohm.

<sup>53</sup> Firing circle means a circle assumed for connection with blasting machine, consisting of firing supply line, electrical or plain detonators or exploder, supply conductors of detonators and any enlargement of them by means of connecting conductors, including plugs.

<sup>54</sup> Blasting machine - equipment designed for delivery of electric power into circle of electrical detonators for their initiation.

Sequence blasting machine - that one, which includes means for control of sequence of priming (ignition) of electrical detonators that are connected to it.

- j) check from the firing place the connection correctness and resistance of initiating circle by tester of exciting circle<sup>55</sup>.
- k) find reason and remove defect, if he discovers larger deviation between calculated and measured resistance of initiating circle than 10%.
- l) counterbalance a resistance among individual branches at parallel connection, if he discovers a difference of 10% and more.
- m) only once for security of utility and reliability of initiating system:
  - extend a firing supply line and connecting conductors,
  - use connecting conductors<sup>56</sup>.

**5.11. During priming the charges with electronic initiating system<sup>57</sup> the shot-firer should:**

- a) observe similar principles as for electrical initiating system for firing circle (composed of circle for connection with firing unit, consisting of firing supply line, electronic detonators, supply conductors of detonators and any enlargement of them by means of connecting conductors, including plugs or testing unit or programming one),.
- b) prevent from combination of initiating electronic system with initiating electrical one.
- c) prevent from application of blasting machine for delivery of electric power into circle of electrical detonators.
- d) ensure:
  - that electronic initiating system could not be used in explosive environment,
  - that testing unit<sup>58</sup> and programming unit<sup>59</sup> could not be plugged, when connecting in detonators or circle.

**5.12. For protection of priming the charges and initiating systems the shot-firer should:**

- a) find out, by measuring, the values of sources of undesirable energies, and these compare with requirements of national legislation aimed at protection of electrical or electronic system against effects of sources of undesirable energies.
- b) realize all measures for protection of electrical or electronic initiating system before any act with detonators is made in manipulation area.
- c) inspect placing, labelling and condition of firing supply line, in particular.
- d) verify, by controlling measurement of firing supply line, the values determined by a manufacturer, parameters determined in technological procedure of blasting works as the case may be.
- e) against electrostatic energy:

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<sup>55</sup> Tester of exciting circle - equipment considered for measuring, check or testing of initiating circles at outside place, usually before performance of the attempt of initiation of detonators by blasting machine.

<sup>56</sup> Connecting conductors - electrically insulated conductors, which can be connected between firing supply line and supply conductor of detonator (connecting conductors to be used normally only once as they are located too close to explosive devices and usually are damaged by blasting). Maximum resistance of initiating circle (Re) means maximum electrical resistance of specific configuration of initiating circle of electrical detonators.

<sup>57</sup> Electronic initiating system consists of priming charge and firing circle.

<sup>58</sup> Testing unit means an operational testing device designed in electronic initiating system for testing of electronic detonators and/or initiating circle; this testing device should not be able to initiate electronic detonator.

<sup>59</sup> Programming unit - equipment used on site for programming a delay period and/or addressing of programmable electronic detonator; this equipment can test also electronic detonator, however, it should not be able to initiate it.

- ensure that all concerned employees might remove eventual electrostatic charge by contact with grounded subject before every preparation of detonators and primers for blasting with any part of initiating system and always after every breakdown of these works,
  - discharge any electrostatic charge by contact of firing supply line with grounded subject before connection in any part of firing circle,
  - connect to ground pneumatic equipment for charging the explosive or stemming and all equipment from conductive materials in manipulation area so that bleeder resistance might not be higher than  $10^6$  ohms (conductive parts of equipment (rails, piping etc.) should not be used for grounding).
- f) against atmospheric electrical energy:
- not give instructions for preparation of electrical or electronic initiating system, provided there is a possibility of storm occurrence,
  - during occurrence, approaching a storm as the case may be, and provided it is possible,
    - terminate charging and prepare a part of electrical or electronic initiating system for initiation – firing by procedure, presented in the article 7.13,
    - terminate charging and leave a part of electrical or electronic initiating system with a disconnected firing supply line in evacuated, endangered area<sup>60</sup> and reasonably proceed according to the article 7.13,
- g) against outside distribution of electrical energy of high and very high voltage:
- not use electrical or electronic initiating system at the surface within a distance less than 250 m from outside distributions of electrical energy of high and very high voltage or from railway electrical devices, unless they are disconnected,
- h) against high-frequency energy:
- have ends of firing circle all the way to connection with blasting machine disconnected in the vicinity of source of high-frequency energy,
  - have in a safe distance the access roads labelled with tables with sign: "Banishment of high-frequency source. Explosion hazard".
- i) measure continuously, eventually, monitor sources of undesirable energies before the firing is made.
- j) immediately stop handling with explosives in manipulation area during unexpected change of conditions (discovery (detection) of presence of source of undesirable energies).

### **5.13. For evacuation of endangered area the shot-firer should:**

- a) determine a safety circle.
- b) agree a manner of acoustic or other signals, which should be well perceivable within entire endangered area.
- c) select such signals that their replacement could not occur and that their importance and differentiation from other signals might be distinguished by public.
- d) ensure the safety circle by sentries or by other suitable manner so that it might be prevented from entry of disinterested persons into endangered area.
- e) in time instruct sentries about:

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<sup>60</sup> Endangered area means a sector, where to excess, which is determined by the legislation, operate undesirable effect of blasting works, particularly fly rock, vibrations, air-blast wave and harmful gases.

- rights and duties of the sentry, particularly that he is responsible for evacuation of allocated sector of endangered area by the shot-firer and for closure of safety circle,
  - a manner of advising a shot-firer that safety circle was violated or other fact, which could jeopardize safety of persons or property,
  - a manner of ensuring of mutual communication among sentries and their deployment (the manner of notice - distress signal should differ from all other signals).
- f) check equipment of the sentry, namely whether it has a functional communication device, whistle, if he knows a sense of warning signals agreed upon as the case may be.
- g) hand over to every sentry against signature a written authorization with instructions for other persons. The written authorization with instructions should contain:
- determined manner of labelling the sentry,
  - range of the written authorization of the sentry,
  - determined manner of equipment of the sentry,
  - description of the allocated sector of endangered area,
  - rights and duties of the sentry determined by national directive,
  - instructions of other persons, determined by national directive, who are obligated to obey instructions of the sentry.
- h) before initiation of the charge – shot-firing and always before check of initiating system or before commencement of firing the safety fuses, give instructions for evacuation of endangered area and closure of safety circle by launching warning signals in two stages, during first stage, launch the warning signal twice, during second one, once:
- first stage means a command for departure of all disinterested persons from endangered area and departure of sentries to the determined post,
  - second stage to be given after recognition that endangered area has been completely evacuated and secured by sentries and that the charges are ready for firing,
- i) initiate charges that firing might follow as a rule one minute after second stage of warning signal.
- j) consider other appropriate manner (safety circle and signals) at the workplaces, where the persons cannot enter (workplaces in underground, in factory halls, in fenced areas etc.), provided he ensures their safety or safety of property.

**5.14. When selecting principles for shelter of persons, posts of sentries and firing place, the shot-firer should:**

- a) stipulate such procedure of works that other persons might be in shelter or out of the endangered area before the safety circle is closed at the latest.
- b) guarantee that no other person can initiate charges.
- c) exclude a location of the shelter in assumed main direction of the blasting (it is effective also for opposite direction).

**5.15. After the blasting is completed, the shot -firer should ensure:**

- a) a waiting time, which should be:

- during priming the charges with safety fuse initiating system, namely regardless of the way of its ignition, at least 10 minutes (measuring of waiting time from the last explosion, while during use of safety fuse the shot-firer and his assistant calculate the explosions independently on each other and if their numbers differ or do not correspond to a number of blasted charges, the waiting time should be extended as during misfire),
  - during priming the charges with a different initiating system - at least 5 minutes,
  - under suspicion that the misfire occurred, the waiting time should be extended to 30 minutes,
  - further adjusted, provided the waiting time is not sufficient for needed dilution of fumes of the explosion to the level, determined by national directives.
- b) disconnection of firing unit from supply line, namely also at the time, provided the misfire occurred.
- c) removal of the equipment from firing unit, which can put it into operation.
- d) inspection of the workplace after expiration of waiting time, when:
- along with foreman or chief of the workplace he checks air composition (especially concentration of carbide monoxide and oxides of nitrogen) before entering the workplace,
  - he finds out result of blasting works, mainly within the range of assumed effects of the blasting, exclusion of misfires, presence of unexploded explosives etc.,
  - foreman or chief of the workplace finds out a capability of the workplace for further safe work.
- e) release of safety circle after discovery that there is no danger from explosives and that concentration of fumes does not exceed the values, determined by national directive, and instructions for launching a warning signal, which terminates blasting works (the way of notice – a terminating warning signal should differ from all other signals).
- f) minutes of the course and results of every blasting to be developed and one execution to be inserted into blasting log (see Appendix No. 8).
- g) minutes of the blasting (minimum terms are presented in Appendix No. 9).
- h) storage of firing unit at the secured place, which prevents from unauthorized use (the shot-firer should have the removable equipment by him or at other secured place).

## **6. MISFIRES**

### **6.1. Before disposing the misfires the shot-firer should ensure:**

- a) that employees, if they discover the misfire or remains of unexploded explosives during works, might suspend the works and without delay advise the shot-firer (in his absence the closest manager).
- b) that, after advising or recognition of the misfire at the workplace, it might occur to urgent disposal of the misfire (preferably by that shot-firer, who performed foregoing blasting works).

### **6.2. During disposal of misfire the shot-firer should ensure:**

- a) manipulation area and safety circle according to the article 5.13.
- b) selection of the work procedure from the following methods, their combinations as the case may be:
  - by elimination of misfired charge,
  - by restoration of freely accessible part of firing circle,
  - by use of new priming charge after foregoing removal of stemming of the charge,
  - by non-violent extraction of freely accessible cartridges and primer in remains of the holes,
  - by firing the charge in new hole,
  - by use of concussion charge at non-explosive environment,
  - by flushing of powdery or liquid explosives or blow out of cartridged explosives.
- c) careful examination of the disturbed rock pillar and check calculation of size of the charge (only new priming charge should not be counted towards most highly admissible mass of the charge).
- d) inspection of the workplace according to the article 5.15 and removal of eventual remains of unexploded explosives.
- e) disposal of remains of explosives according to chapter 11.
- f) additional record to minutes of blasting that should include:
  - causes of misfire,
  - method of misfire disposal,
  - method of disposal of remains of explosives,
  - result of hearing of repeated misfires or larger quantity of misfired explosives, doubts concerning quality of explosives with a manufacturer or supplier as the case may be,
  - proposal of measures being taken for further blasts to avoid misfire repeating.

## **7. SPECIFIC REQUIREMENTS ON IMPLEMENTATION OF BLASTING WORKS BY MEANS OF BENCH BLASTING**

### **7.1. Before the preparatory works are started, the shot-firer should:**

- a) where in the rock, the holes of diameter more than 50 mm are anticipated to be drilled, ensure to perform alignment of the assumed place of use of explosives (initial line of sight) according to Appendix No. 5,
- b) propose such drilling pattern so that the movement of drilling rig and charging car not less than 3 meters from the bench crest might be excluded.

### **7.2. Before preparation of blasting works is started, the shot-firer should:**

After termination of preparatory works for blasts at the surface, where in the rock the holes of diameter more than 50 mm were used, ensure that alignment of the charges (holes) might be performed according to Appendix No. 5 (final line of sight).

### **7.3. Size of endangered area should be safeguarded by the shot-firer according to maximum values of impingement of rock pieces from the blasting place:**

diameter of hole in	maximum distance
50 mm	400 m
75 mm	500 m
100 mm	650 m
125 mm	750 m



## **8. SPECIFIC REQUIREMENTS ON IMPLEMENTATION OF BLASTING WORKS BY MEANS OF BLACK POWDER**

### **8.1. Before the preparation of blasting works is started the shot-firer should:**

Pay a specific attention to limitation of manipulation area, which should not have, from the view of enhanced sensibility of direct explosives (black powder), a smaller horizontal distance than 50 m from the place of assumed use.

### **8.2. During charging the holes the shot-firer should:**

- a) to holes, fissures and cracks, provided the direct explosives fall into them by dead load:
  - pour a powder by means of hopper (made from sparkles material), whose tube reaches all the way to bottom of the area being charged; at the same time the shot-firer should ensure to avoid shaking with the hopper or its fierce sliding,
  - proceed so that spillage of the powder might not occur beyond the charged area,
  - remove from the vicinity of the charged area the metal articles before the charging is started,
  - stuff, before charging the hole, its bottom in length of at least 10 cm, provided it was discovered that there had remained fragments of drill, which cannot be removed.
- b) charge the charges of black powder only manually minimally one hour after drilling the hole (this period can be shortened by cooling of the hole by means of flushing of compressed air).

### **8.3. During sealing the charges the shot-firer should (use, ensure):**

Stemming manually by tamping rod, only.

### **8.4. For evacuation of endangered area the shot-firer should:**

Before charging the primary<sup>61</sup> explosives, give instructions for evacuation of endangered area and closure of safety circle according to the article 7.8.

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<sup>61</sup> Primary explosive - explosive sensitive to sparkle, friction, flame and which is able to initiate in non-sealed condition (primary explosive is usually used in detonator for explosive initiation of secondary filler).

## **9. SPECIFIC REQUIREMENTS ON UNDERGROUND BLASTING WORKS**

### **9.1. General requirements on use of explosives in hazardous conditions and in risky environment:**

- a) National authority should stipulate more specific conditions for determination of:
  - types of hazardous conditions and risky environment (examples of classification of non-gaseous<sup>62</sup>, gaseous and coal mine or quarry, eventually, according to extreme temperature conditions, environment with danger of gas explosion<sup>63</sup>, powder or outburst),
  - features of explosives, which can be used in hazardous conditions or in risky environment,
  - verification of hazardous conditions and risky environments,
  - verification of features of explosives.
- b) Individual types of explosives for use in hazardous conditions and in risky environment should be permitted prior to first use by national authority.

### **9.2. Before preparatory works are started the shot-firer should:**

- a) at workplaces in underground, which are away from each other in any direction less than 30 m, determine a method of timely notice of employees that the blasting works to be performed at one of the workplaces.
- b) suggest to the manager or employer an instant of cessation of one of the workplaces, provided both workplaces are approaching within a distance of less than 10 m.
- c) stipulate further needed measures for blasting works, provided coalface to worked-out areas or temporarily abandoned part of underground area is approaching within a distance of 10 m.
- d) in underground, suggest to use safe explosives with active oxygen balance
- e) in coal mines:
  - suggest use of:
    - mine-safe explosive instead of rock explosives and instead of mine-safe explosive to use mine-safe explosive of higher category of safety,
    - detonators designed for risky environment with danger of explosion.
  - suggest such procedure that:
    - charges of mine-safe explosives in holes could not approach to other charges or other non-sealed holes within a smaller distance than 30 cm in coal and in stone,
    - distance among charges of rocky plastic explosives and that among other rocky plastic explosives might not be smaller than,

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<sup>62</sup> Non-gaseous mines are these, where methane concentration did not achieve in any ventilated mining work 0,1% and where neither after cessation of ventilation for a period of 24 hours the methane concentration achieved 1% and concentration of other flammable gases or fumes (hereinafter only "gases") 25% of lower limit of ability to explode. Gaseous pollutants of mining fires are not considered for mine classification.

<sup>63</sup> Gaseous mines are coal mines with the exception of lignite mines and other ones, which do not meet requirements presented in above reference 61. Gaseous mines are classified in II. or I. class of danger. Mines of II. class of danger are all mines with danger of outburst of rocks, coal and gases. Other gaseous mines are these of I. class of danger.

- during use of rocky explosive at the workplace, where we can assume a coal presence, it might be pre-bored at least by one borehole in direction of the nearest, assumed presence of coal,
- pre-bored holes might be at least by 1 m longer than other holes,
- in case of recognition of coal presence by hole, only mine-safe explosives might be used during blasting works,
- holes for rocky explosive might be founded in such way that the charge of rocky explosive would not approach coal bed<sup>64</sup> within a distance less than 30 cm,
- use of concussion charges might be excluded, with the exception of use of them charges in water wraps during secondary blasting of stone pieces,
- stemming within entire length might fill cross-section of the hole,
- stemming in wraps might have a diameter mostly by 5 mm smaller than that of the hole,
- water stemming in wraps might be formed at least from two separate parts bounding to each of approximately same length,
- individual parts of stemming might not be shorter than 20 cm and that at self-locking stemming one piece can be in length of 40 cm at least,
- mine-safe explosive of relevant category can be used and that time interval between explosion of adjacent charges cannot be larger than 60 ms, when approaching the hole within a distance of 3 m to coal bed,
- coal dust in mining works can be disposed and coal and that easily flammable masses within a distance of 25 m from the place of assumed use explosives can be removed,
- coal dust in mining works, which approached within a distance of 10 m from the place of assumed use explosives, might be disposed and that coal and easily flammable masses within a distance of 25 m in all directions might be removed,
- in stopes and coalfaces, where it is not possible to irrigate effectively coal post and, where coal is not removed, the area can be sprayed by water at least within a distance of 25 m to both sides from assumed use of explosives and in direction to clunch that far, provided it is possible to make it safely,
- concentration of fumes might be measured in the blasting place before charging the holes, immediately before departure to the firing place, at firing station closely before firing performance and after performance of blasting during inspection of the workplace,
- in mining works, in which the blasting works are carried out in holes of diameter more than 50 mm, efficient water screen operating within the entire profile of the work can be created at a suitable place, however, farthest 15 m,
- in mining works, in which the blasting works are carried out in holes of diameter more than 50 mm, the length of stemmed part of the hole in centimetres might not be smaller than sixtuple of square power of hole diameter in centimetres, however, not less than 100 cm; nevertheless the water stemming in packaging should be minimally from three separate, approximately same parts.

f) in non-gaseous mines and gaseous ones of I. class:

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<sup>64</sup> Coal bed from the view of approaching a rocky explosive means that of thickness of 1 cm and more.

- suggest use of:
    - dust seal mine-safe explosives and anti-gas mine-safe ones of I. category in gaseous mines of I. class of danger,
    - detonators designed for risky environment with danger of explosion.
  - suggest such procedure that:
    - adjacent charges, which are in the zone of mutual interference and which mutually cooperate during enlargement of free area (blasting cut), might be initiated in gaseous mines of I. class of danger with a delay time interval mostly 100 ms.,
    - distances of charges of explosive from the nearest free might not be smaller than 30 cm.,
    - in gaseous mines of I. class of danger the uncharged borehole up to 50 mm diameter, which is more closely than 30 cm from the charged hole, might be sealed at the orifice by stemming in length of at least 40 cm, in case of larger diameters, at least 100 cm.
    - in gaseous mines of I. class of danger the holes might be sealed all the way to their orifice,
    - for secondary blasting of broken coal in non-gaseous mines only dust mine-safe explosive or mine-safe explosive of higher category of safety and in gaseous mines of I. class of danger only mine-safe anti-gas explosive of I. category or mine-safe explosives of higher category of safety might be used,
    - for secondary blasting of broken coal the charges can be of maximum 0,2 kg weight and placed in holes.
- g) in coal gaseous mines of II. class of danger and in mines with danger of outburst of coal and gases:
- suggest use of:
    - mine-safe anti-gas explosive of II. category or III. one,
    - detonators designed for risky environment with danger of explosion.
  - suggest such procedure that:
    - rocky explosives might be used at workplaces in stone, where sum of all coal beds does not exceed 20 cm and the charge of rocky explosive does not approach the coal bed within a distance less than 20 cm,
    - mine-safe anti-gas explosives of I. category or higher category of safety might be used at workplaces in stone, where sum of all coal beds exceeds 20 cm,
    - mine-safe anti-gas explosives of II. or III. category might be used at the workplaces, if some of the charges is located in coal, at a separate blast of stone enlarging with a heading round being broken out beforehand and with a simultaneous blast in coal and in stone,
    - where it is assumed to use in rock the holes of more than 50 mm diameter, the blasts might be performed separately from the others,
    - for blasts, where it is assumed to use in rock the holes of more than 50 mm diameter, the mine-safe anti-gas explosives of I. category might be used,
    - detonators, which have as short as possible delay time, might be used, while time interval of duration of the complete blast should not exceed 450 ms at charges in stone and 400 ms at those in coal,
    - adjacent charges, which are located in zone of mutual influence, and which mutually cooperate in enlargement of free area (blasting cut), might be

initiated with delay time of 60 ms at the highest; other adjacent charges with 150 ms at the highest,

- during blasting work, where can be applied rocky, dust and mine-safe anti-gas explosives of I. category, the detonators with as short as possible delay time might be used,
- for blasts, where it is assumed to apply in rock the holes of more than 50 mm diameter, the mine-safe anti-gas explosives of I. category and delay-timed detonators, for example, DeD-S, might be used, provided there are not coal beds at the workplace and explosive charges do not approach the coal bed within a distance less than 1 m, and if methane concentration does not exceed 0,5%,
- distance of coal bed from the workplace and explosive charges might be examined by pre-bored holes,
- holes might be founded in such way that the charge of rocky explosive, dust explosive or mine-safe anti-gas explosive of I. category would not approach free area within a distance less than 30 cm; during use of mine-safe anti-gas explosive of II. category or III. one in stone not less than 20 cm,
- uncharged holes up to 50 mm diameter, which are more closely than 30 cm from the charged hole, might be sealed to orifice by stemming in length of at least 40 cm before firing, in case of larger diameters at least 100 cm,
- cartridges of mine-safe anti-gas explosive of II. and III. category can be charged if located in joint packaging, only,
- during application of mine-safe anti-gas explosives of II. and III. category only soft stemming might be used, while the stemming is made up by water and suitable mixture in packaging and without packaging the materials in the form of paste or gel,
- soft stemming in packaging might be of at least 40 cm length and be self-locking and located closely behind the charge,
- discharging holes might be stemmed, before charging the holes for blasting works, by non-flammable materials to depth, which exceeds at least by 1 m that of the hole being charged, and that other holes might be sealed at least along the length of 0,5 m from their orifice,
- firing place and place for safe shelter of employees in long mining works might be within a distance of at least 200 m from blasting place,
- before firing in sinking, all employees might be called back from the mining work being excavated and that a place for safe shelter and firing place might be at the surface or already at open level in base through air current not less than 200 m from blasting place,
- in mining works, where blasting works can initiate outburst or other geodynamic effect, the holes in accompanying rocks might be bored only after drilling of all holes in coal, that total charge of every advance per round might be fired at once, that before firing the charges all employees might be called back from excavated mining work regardless of its length or from coalface and from other mining works along direction of through air current all the way to end of fresh winds, that firing place and place for safe shelter of persons might be at least 10 m in base air current before coalface or exit of separately ventilated mining work into through air current, however, not less than 200 m from blasting place,
- waiting time after blasting might be 30 minutes at least.

**9.3. Specific requirements on transportation of explosives and persons to workplace in underground:**

- a) People walking and other transportation along the route, through which explosives are transported, should not be allowed to happen all at once, with the exception of carrying of explosives to workplace; nevertheless, it should be necessary to take steps not to endanger persons and operation in cross-routes.
- b) Transport routes in underground, through which explosives are transported, should not be simultaneously made available to other transportation or persons that do not take part in transportation of explosives; in doing so the measures should be taken so that the persons neither transportation could be endangered in cross-routes.

**9.4. In selecting the principles for shelter of persons, stations of sentries and firing place, the shot-firer should:**

Ensure a distance of shelters of persons, stations of sentries and firing place from blasting place at least:

- 30 m in wall coalfaces and stopes, provided no persons stay in direction of possible effect of blasting works,
- 150 m in long parts, provided all persons can take safe shelter (in side corridors, stalls, behind protective shields etc.),
- 200 m in other cases.

**9.5. After blasting the shot-firer should ensure:**

Exclusive lock of the workplace against entry of unauthorized persons, provided the inspection is not performed immediately after expiration of waiting time.

## 10. **EMERGENCY EVENTS**<sup>65</sup>

### **During emergency events the shot-firer should:**

- a) remain cool.
- b) evaluate what dangers still threaten.
- c) keep his employer or manager informed about the event.
- d) stay at site, safeguard the area where the event occurred (e.g., by disconnection of energies), provide and eventually send for first aid to persons afflicted with the event and provide cooperation for elimination of spreading even.
- e) leave the workplace in case of threat of himself and move to designed meeting place (designed, for example, by emergency plan, inspection service).
- f) provide cooperation in the course of clarification of causes and circumstance of event occurrence.
- g) after investigation of causes and circumstances of occurrence of emergency event, conduct a repeated analysis and risk assessment for further implementation of blasting works. In preventive measures he should note:
  - identification of hazard sources (dangers),
  - determination of possible types of events and their causes, which may result in emergency event,
  - estimation of impacts of possible types of emergency events on human health and lives, farm animals, environment and property,
  - estimation of probabilities of different types of emergency events,
  - determination of exposure (risk degree),
  - evaluation of admissibility of risk of occurrence of emergency events.

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<sup>65</sup> Emergency event during preparation and implementation of blasting works is understood every unplanned even evoked by human activity, natural effects and also an accident, which results in injury or other damage on human health, property or harm on environment.

## **11. ENVIRONMENTAL ASPECTS**

### **From the view of approach to environment the shot-firer should:**

- a) before first use of explosives and after agreement with his manager of employer, keep informed actively the concerned public about:
  - plan and progress of implementation of blasting works,
  - all undesirable effects of blasting, which can occur,
  - specific methods of elimination of undesirable effects,
  - associating measures and preparation for risky situations.
- b) bear always in mind that:
  - care for bilateral communication with public is the most effective defence against everyone, who decided to defend environment,
  - foregoing technological delay and time losses cannot be eliminated by shortening preparation and implementation of blasting works, hurry is in most cases connected with setback, emergency events, claims and loss of order,
  - implementation of blasting works can offend others above previous exposure adequate to conditions,
  - experience clearly indicated that most people react negatively and with irritation, provided the works are commenced without their previous notice.
- c) dispose packaging from explosives immediately after termination of blasting works.
- d) dispose accumulated packaging from explosives after blasting always in compliance with requirements of national legislation and service instructions of a manufacturer.
- e) during disposal of packaging by burning, always carefully check, whether they do not contain remains of explosives.
- f) execute destruction of damaged explosive, for examples, related to misfires, in distant places in compliance with requirements of national legislation and service instructions of a manufacturer.
- g) during designing a secondary disintegration of boulders, the shot-firer should promote at his manager or employer in the first place that hydraulic hammer might be used against charges in holes and trying charges.



**UNWORKABLE PROCEDURES OF THE SHOT-FIRER**

**During performance of his function the shot-firer should avoid as follows:**

- a) to participate knowingly or take part in irregular tenders or accept order placed according to irregular tender.
- b) to authorize another shot-firer to perform blasting works without having previous consent of the customer.
- c) to discriminate directly or indirectly other shot-firer, for example, in that he will take over documentation in progress for performance of blasting works without his awareness and consent.
- d) to criticize in unfair manner and embrace anybody in his favour.
- e) to misuse knowledge to his inadequate benefit and enriching.
- f) in his contacts with the public the shot-firer should abstain from „cardinal sins “, such as:
  - letting the media to inform the public only of some negative events of the past associated with blasting works,
  - underestimating, in his professional short-sightedness, the significance of public relations, even though being well aware that the favourable position of public authorities will be required for any permission of blasting works in the future,
  - adopting a parochial philosophy based on the idea that public relations are worth one's involvement only if it can be useful,
  - pretending he might become invisible for the public, if required; that is why, in his actions, he often shelters himself behind his superiors, employer or the state administration, for a time, at least,
  - being passive in reacting to problems - the published adverse information.
  - he does not inform with a pro-active approach the neighbourhood about hazards associated with blasting works to be performed and available technical possibilities of their decreasing, elimination as the case may be.

**CONTENT OF THEORETICAL AND PRACTICAL EDUCATION OF APPLICANT FOR SHOT-FIRER LICENCE**

- a) History:
  - of blasting works from invention of black powder in the world,
  - of first use of explosives in Europe and in member-states of the Community.
- b) Terminology:
  - basic terms related to standards and national directives dealing with explosives,
  - basic terms related to mining,
  - equivalent terms in English, German and Russian.
- c) Basic features of explosives:
  - classification of explosives,
  - basic characteristic features and terms of explosives,
  - classification of explosives and their characteristics,
  - testing of explosives,
  - products from explosives,
  - possibility of use of explosives and products from them,
  - structural composition of products from explosives, including examples of the most suitable use,
  - explosive as chemical substance,
  - explosive as hazardous substance,
  - explosive as resource of public threat.
- d) Essentials of law and selected terms related to national and European legislation:
  - regulations and directives,
  - international contracts and agreements,
  - constitutional law,
  - commercial law,
  - civil law,
  - trade law,
  - labour law
  - financial law,
  - administration law,
  - mining law,
  - water legislation,
  - construction lien,
  - law of real property,
  - handling with explosives.
- e) Bases of shot-firer ethics.
- f) Organizations using explosives, professional associations and organizations of public administration:
  - overview of the largest mining organizations in Europe and in member-states of the Community,
  - overview of the largest supplier organizations, which manufacture drilling technique, means of blasting technique and carry out further associating service activity and produce or use explosives,

- overview of professional associations and chambers that associate organizations performing extraction of minerals or blasting works,
  - European structures,
  - organizations of public administration of member-state of the Community,
  - territorial self-administration,
  - state administration,
  - state mining administration,
  - other administration over use of explosives.
- g) Bases of economics:
- activities associated with business start-up,
  - business legal forms,
  - basic economic terms (capital cycle, costs, revenues, reserves, profit, tax),
  - fundamentals of enterprise and business undertaking,
  - business effectiveness,
  - specifics of mining organizations and those that implement blasting works,
  - bases of business economics of organizations that implement blasting works.
- h) Bases of geology and theory on materials:
- basic marks and terms related to geological, mine-measuring and civil engineering documentation,
  - equivalent terms and marks in documentation of countries of EU in English, German and Russian,
  - classification of rocks and overview of their basic characteristic features for winning (extraction),
  - igneous rocks,
  - sedimentary rocks,
  - metamorphic rocks,
  - basic knowledge of terms from structural geology related to winning,
  - basic knowledge of terms from stratigraphy related to winning (bedding sequence, series of strata, secondary structures),
  - physical and mechanical features of rocks and earths,
  - mechanical features of rocks and earths,
  - disintegration ability,
  - stability,
  - drilling ability,
  - effects of possible modifications of features of rocks and earths in relation to safety aspects in mining,
  - theory on materials, where it is possible to use explosives (e.g., concretes, metals, wood, powdery masses), including overview of their basic characteristic features,
- i) Means of blasting technique:
- means of blasting technique related to electrical initiating system,
  - means of blasting technique related to electronic initiating system,
  - means of blasting technique related to detonating cord initiating system,
  - means of blasting technique related to safety fuse initiating system,
  - means of blasting technique related to non-electrical initiating system,
  - Ohm's law and bases of electrical engineering,
  - testing of means of blasting technique and initiating systems.
- j) Technology of preparatory works:

- drilling works,
  - types of drilling,
  - machinery for drilling,
  - examples of suitable selection of machinery for drilling and drilling tools in different environments,
  - further processes of disintegration in stone quarries,
  - machinery for secondary disintegration,
  - loading,
  - machinery for loading,
  - transportation of masses.
- k) Selected types of application of explosives in mining:
- mining blasts:
    - technology of performance of long mining works,
    - selected methods used for winning,
    - ventilation of mining works,
    - specific conditions for implementation of mining blasts (danger of explosion of gases, fumes and dust, bumps, outburst of gases),
    - blasting works during of ways of long mining works,
    - blasting works in wall stopes and in coalfaces,
    - blasting works without breaking,
    - blasting works as resource of prevention against occurrence of outbursts and mining bumps.
  - surface winning:
    - technology of ways of mining works,
    - selected winning methods and their specifics,
    - bench blasting,
    - surface blasts,
    - disintegrated blasting works,
    - blasts for coarse and noble stone-cutting production.
  - adjustment of mining cross-sections and sinking.
  - secondary blasts during surface winning,
  - disintegration of rock boulders,
  - implementation of blasting works in specific cases:
    - blasting works during boring and geophysical survey,
    - blasting works during mining of gases and hydrocarbon.
- l) Bases of direction finding and designing:
- bases of measuring works,
  - bases of designing,
  - charge and determination of its size,
  - types of charges (e.g., concentrated, column, divided, space, concussion, rectified, chambered),
  - assessment of selection of explosive (e.g., presence of water, period of water exposure, presence of cavities, acoustic impedance of disintegrated materials) for assumed blasting result,
  - basic calculation formulas and principles of calculation of sizes of charge - burden, snatching,
  - effect of charges-discard, slipping, softening, adverse blasting effects and protection against them,
  - cooperation of charges,

- principles of timing of initiating systems,
  - possibilities of influence and measuring of fragmentation,
  - protection against undesirable initiation,
  - practical training from blasting technique.
- m) Implementation of blasting works:
- legal regulations of handling with explosives,
  - legal regulations of conditions for business undertaking within the range of the term - use and storage of explosives,
  - conditions for issue of certificate of shot-firer,
  - terms of application for issue of permission,
  - legal regulations and specifics of individual administrative procedures in administrative proceeding at associated activities,
  - decision on permission of blasting works,
  - documentation for implementation of blasting works,
  - research, development and testing of explosives,
  - production and processing of explosives,
  - application, destruction and disposal of explosives,
  - storage, acquisition, transfer, import, export, transit and transportation of explosives,
  - conditions for transportation of explosives,
  - prohibited acts with explosives.
- n) Work safety and health protection:
- legal regulation of work safety and health protection,
  - general rights and duties of the employees,
  - position of shot-firer and other employees, including rights and duties in specific conditions,
  - general rights and duties of senior employees at individual managing stages,
  - rights and duties of senior employees at individual managing stages,
  - legal regulation of liability of employees and senior ones at one workplace,
  - protective means and tools,
  - bases of providing of first-aid,
  - work injury,
  - emergency events,
  - analyses of actual emergency events,
  - compensation for damage,
  - business bureaucracy versus administrative load of entrepreneur,
  - requirements on form and content of periodical training of shot-firers.
- o) Undesirable effects:
- legal regulations of undesirable effects according to national regulations:
    - noise,
    - dust,
    - vibrations,
    - fly rock.
- p) Managing of hazards:
- terms - hazards and its legal regulation,
  - classification of hazards,
  - business risks,
  - safety risks,

- methods of identification of hazards,
  - analysis and risk management,
  - basic principles for providing information on hazards in all managing stages,
  - risk prevention at workplaces and coordination,
  - analysis of the most frequent and actual hazards during blasting works.
- q) Guidance and managing:
- methods of guidance and managing the employees,
  - organization structures of the enterprise,
  - well proven persons and their responsibility,
  - management of accidental and distress situations.
- r) Management system according to ISO standards:
- application of quality management system,
  - quality management system,
  - management system of environmental protection,
  - safety management system,
  - TQM and further trends in management system according to ISO standards.
- s) Bases of communication with neighbourhood:
- individual elements of neighbourhood of the enterprise and their mission (state, municipality, civil associations, competition, customer, media, public opinions, etc.),
  - importance of neighbourhood and its impact on organization,
  - avoidance of conflicts of interest with individual elements of neighbourhood,
  - assessment of objects,
  - resolving of stimulations and claims with individual elements of neighbourhood.

**CONTENT OF THEORETICAL PART OF PERIODICAL TRAINING OF THE SHOT-FIRER**

- a) Latest technologies applied in blasting works, explosives and accessories of blasting technique.
- b) Technical conditions, service instructions and safety sheets of applied explosives and accessories of blasting technique.
- c) Selected features of chemical substances for safe implementation of works, especially from the view of their explosive and fire safety and hygienic protection.
- d) Documentation for implementation of blasting works within the range of work and technological procedures in relation to winning of mineral and implementation of blasting works.
- e) Restricting conditions of the decision permitting blasting works and associated measures, which are determined for protection of all-society interests before undesirable effects of blasting works for individual workplaces.
- f) Internal instructions, issued by employer, which make provisions for environmental management system, organization scheme, responsibility rule, range of use of protective means and tools within the bounds of corresponding hazards, which may occur in workplaces, in particular.
- g) Place of storage of operational documentation for implementation of individual activities, during which the blasting works are permitted.
- h) Contractual conditions for implementation of blasting works by supplier manner.
- i) Identified hazards, dangerous factors and processes of work environment and conditions, their causes and sources.
- j) Measures on the basis of sought and evaluated hazards, which were taken for their removal, protection against their incidence as the case may be.
- k) Coordination and cooperation during security of work safety and health protection for employees of more employers at one workplace.
- l) Suitable information and instructions related to security of work safety and health protection and on measures taken for fighting firers, providing first-aid and evacuation of physical persons in case of emergency events.
- m) Results of performed inspections in foregoing period, which concerned storage of explosives, their safeguarding and handling with them, knowledge and observance of regulations on explosives, in particular.
- n) Results of inspections of level of work safety and health protection being performed, particularly condition of production and working means and endowment of workplaces and level of risk factors of working conditions, observance of method and manner of finding and evaluation risk factors, for example, check of records (at least once a month to carry out a check of quantity, way of storage, reception and distribution, reception and consumption of explosives).
- o) Information on classification of workplace from categories point of view.
- p) Measures, which were taken after investigation of emergency events and work injuries (with development of work accident rate at workplace and in organizations as well as with resources and causes of work injuries, measures aimed to their decreasing).
- q) Bases of providing first-aid within the following range:
  - what manner of providing of first-aid is ensured during work injuries,

- how is ensured and determined, according to type of activity and size of workplace, the needed number of employees, who organizes providing of first-aid, and ensures a calling of health rescue service, fire-fighting rescue department, police and organization of evacuation of employees, in particular,
  - physical checks of endowment of specific workplaces with means for providing first-aid.
- r) Legal regulations, which relate to security of work safety and health protection, expert presumptions and requirements on performance of employees using explosives in mining within the range of specific provisions.
- s) Rights and duties of employees and senior ones.
- t) Undesirable effects of blasting works and their impacts on neighbourhood.
- u) In the course of periodical training:
- all papers should be available,
  - raised questions should be answered,
  - information, remarks and suggestions should be listened to,
  - it should be verified by exam, whether shot-firers meet requirements set for performance of the function and whether they are holders of valid authorizations,
  - evaluation of the training should be made.



**EXAMPLES OF IDENTIFIED HAZARDS**

***During evaluation of hazards the shot-firer should start from reality:***

- a) Explosives are hazardous chemical substances and resource of health hazards.
- b) Danger of explosion threatens during any improper handling with explosives.
- c) Threat of employees and public occurs:
  - during improper selection of quantities of applied explosives,
  - during use of explosives in unsuitable conditions,
  - when explosives are not safeguarded against theft.
- d) Any accumulation of functions reduces a level of implementation of blasting works and position of shot-firer.
- e) Any margin of dangerous act or situation<sup>66</sup> at workplace, which is left without intervention, is not admissible (i.e., to stop any work, which is not safe).
- f) Implementation of blasting works in mining is exposed to further statistically evaluated effects, during which just in mining of its own it occurs most frequently to injuries, and thereby to emergency events as well. It concerns particularly:
  - closed or narrow areas,
  - working in heights,
  - manual lifting and manipulation,
  - disconnection of resources of energies and technical equipment,
  - vehicles,
  - personal protective means,
  - small tools,
  - order at workplace,
  - works in water or its vicinity.
- g) Employees at workplace, where just shot-firer comes to perform blasting works, know always mostly about all potential difficulties.
- h) No manager or employer has ever dismissed from employment any shot-firer, who stopped and take 1-2 minute time-out to think over further work procedure by means of answers to the following questions:
  - What can be spoiled?
  - What happens, when it spoils?
  - What can I do to prevent from it?
- i) Nobody wishes any heroes.
- j) Competency of employees and technical equipment are considered in general along with risk prevention to be the most important and critical factors of the results achieved in the area of work safety and health protection.
- k) Risk prevention is based on careful plan and on proper implementation of planned work procedure.
- l) Less hazard, less hazardous conditions and behaviour, fewer injuries averted in the last instant, minor injuries and other accidents means better works and at the end

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<sup>66</sup> E.g., dangerous event (almost accident) means a threatening unplanned event (however, which has not happened) evoked by human activity or other effects and which can lead to life threat, health, environment or property.

of the day a zero number of serious injuries, death accidents and emergency events.

**BASIC TERMS OF DOCUMENTATION OF PREPARATORY WORKS**

**Minimum terms of initial line of sight of the place assumed for use of explosives:**

- a) lay-out of the place in scale 1 : 250 up to 1 : 500
- b) list of coordinates of permanently stabilized minimum 2 points, including introduction of topography,
- c) list of coordinates of punctual field showing basic mining and geological data,
- d) list of coordinates with introduction of:
  - number and coordinate of point (with marking of height system),
  - marking manner in terrain,
  - date of alignment,
- e) type and number of applied measuring apparatus and tools,
- f) name, surname and signature of contractor of initial line of sight.

**Minimum terms of drilling pattern of the place assumed for use of explosives:**

- a) lay-out of the place of drilling works at segment of mine map with indication of coordinates of orifice of every hole
- b) description of known geological conditions being considered
- c) number of holes
- d) numbering of holes
- e) length of holes
- f) diameter of holes
- g) pitch of holes
- h) direction of holes
- i) distance of holes with one another
- j) admissible deviations of parameters of holes
- k) way of check of drilling operation and parameters of holes
- l) way of holes safeguarding
- m) way of labelling of incomplete or crashed holes
- n) estimated term of drilling works completion
- o) estimated term and way of handover of holes and that of evaluated results of drilling works.

**Minimum terms of drilling log:**

- a) applied equipment and tools for drilling works
- b) date of commencement of drilling works
- c) process of performance of drilling operations according to individual shifts
- d) sequence and drilling process of individual holes (from the view of drilling speed, drill-ability of rocks etc.)
- e) actual location and process of individual holes
- f) evaluation of admissible deviation of the stipulated parameters of holes

- g) description of discovered geological conditions, including unexpected changes (fractures, well cavities, fissures, fillers, change of hardness, occurrence of water, gases etc.)
- h) number of holes
- i) numbering of holes
- j) length of holes
- k) diameter of holes
- l) pitch of holes
- m) direction of holes
- n) distance of holes with one another
- o) way of check of drilling operation and parameters of holes
- p) way of holes safeguarding
- q) way of labelling of incomplete or crashed holes
- r) name and surname of a person who performed drilling works
- s) actual term of drilling works completion
- t) way of evaluation of drilling samples
- u) name and surname of a person who evaluated drilling samples
- v) actual term and a way of handover of holes and that of evaluated results of drilling works
- w) evaluation of geological conditions with comparing description of anticipated geological ones
- x) lay-out of the place of performed drilling works at segment of mine map with an indication of coordinates of orifice of every hole
- y) name and surname of a person who evaluated the geological conditions.

**Minimum terms of final line of sight of the place assumed for use of explosives:**

- a) method of data verification recognized during initial line of site concerning lay-out of the place
- b) range of selected check of parameters of holes (minimally within the range of measurement of length and pitch of the hole)
- c) evaluation of executed measurements, including check, for example, by development of characteristic cross-sections in profiles with marking of burden.
- d) design of manner of elimination of eventual differences in recognized data and suggestion of measures to be taken

**BASIC TERMS OF DOCUMENTATION OF BLASTING WORKS**

**During blasting works the documentation of them should include as follows:**

- a) Basic necessary data on performed activities, during which the blasting works to be carried out in a minimum range:
  - final order or other manner of legalization,
  - project and operational documentation of the activities, during which the blasting works shall be permitted, performed as the case may be,
  - basic data on works progressing,
  - basic data on existing structures and objects in endangered area being assumed,
  - terms of completion,
  - basic data on:
    - place of implementation of blasting works (e.g., construction, quarry, mine),
    - geological conditions (geological documentation with indication of anomalies, e.g., presence of karst effects, sockets, changes of resistance, disintegrated rocks, anticipated presence of water, level of underground waters),
    - condition of objects to be built up, removed or maintained,
    - condition of object and facilities before use of explosives,
  - list of all known hazards resulting from activities, during which the blasting works to be permitted, performed as the case may be,
  - map of surface conditions with indication of procedures of preparatory and development works, winning or other structures.
- b) evaluation of hazards associated with preparatory works for blasting (e.g., direction finding, drilling, inspections, checks of the place, where explosives are intended to be used, including endangered area).
- c) evaluation of hazards resulting from, and associating with the place of explosive use and explosives of their own (labour-law and civil-law relations (e.g., within the range of hazards of ergonomic nature during preparation of primers and charging; hazards incurred if the planned time of blasting cannot be determined in advance)), and evaluation of hazards incurred in contact of explosive with skin or breath of fumes.
- d) evaluation of hazards connected with undesirable effects of applied explosives (e.g., hazard of unforeseen fly rock; hazard of seismic effect, hazard of air-blast wave, hazard of fumes being generated during explosion by explosive burning or detonation, hazard of possible misfire, hazard of discovered unexploded charges of explosives or detonators).
- e) result of independently assessed condition of all objects in endangered area.
- f) result of assessed and evaluated hazards.
- g) working and technological instructions for activities, during which the blasting works to be performed.
- h) documents concerning insurance, which correspond to the amount of estimated financial indemnification for remedy of eventual damages recognized by risk analysis.

- i) specification of conditions, under which the blasts can be undertaken repeatedly, and under which changes the blast should be performed according to modified technical designs of blasting operation and technological procedure of blasting works.
- k) concluded contracts, e.g., about coordination of works, notification of changes, fulfilment of terms, and about continuous evaluation of other activities and associated hazards.

**Technical design of blasting operation should include:**

- a) independent technical evaluation of condition of rock environment, material, objects, where explosives are intended to be used as well as objects located in endangered area, which could be jeopardized by any undesirable blasting effect with consideration and evaluation of all hazards,
- b) technical report with giving reasons for project design,
- c) calculation of sizes of charges, including values of partial coefficients,
- d) calculation of security of electric, electronic or combined firing circle,
- e) firing circle pattern,
- f) method of solution aimed to reduction of undesirable effects of blasting works on neighbourhood,
- g) specification of measures for security of work safety and health protection during blasting operation,
- h) further necessary data according to nature of blasting operation,
- i) lay-out of the area, which contains:
  - firm metrical points , including coordinates,
  - safety circle,
  - station of sentries,
  - station of firing place,
  - characteristic profiles and cross-sections.

(Illustration method and scale of drawing should enable to get sufficiently accurate data for calculation of charges, determination of their location for preparatory works and for eventual disposal of misfire)

**Technological procedure of blasting works should include:**

- a) determination of explosives and means of blasting technique,
- b) determination of technological procedure of implementation of blasting works,
- c) restrictive conditions of blasting operation,
- d) drilling pattern,
- e) manner of labelling and check of boreholes performed for other purposes and holes after burnt out charges or remains of holes after previous blasting works,
- f) range of quality check of preparatory works,
- g) anticipated consumption of explosives at the workplace within one blast, within one shift as the case may be,
- h) measures for evacuation, safeguarding and labelling of manipulation area,
- i) way of protection of neighbourhood against undesirable effect of blasting operation,
- j) needed number of employees, including shot-firers,
- k) layout of the blasting place and its nearest neighbourhood within the range of endangered area and with determination of manipulation area,
- l) safety circle and way of its evacuation and closure,
- m) means for announcement of warning signals and distress signal,

- n) way of announcement of warning signals,
- o) principles for determination of distances of shelters of persons, stations of sentries and firing place,
- p) principles and requirements on shelters of employees,
- q) principles for determination of firing place,
- r) inspection method of holes before charging, including a manner of eventual removal of impurities or water from holes designed for charging,
- s) waiting time,
- t) deployment and size of charges,.
- u) scheme of initiating system,
- v) place and moment for priming the charges by electronic initiating system by means of testing unit or programming one,
- w) priming method,
- x) safeguarding of machinery and electrical equipment endangered by undesirable effects of blasting operation,
- y) way of sealing of charges, including length and type of applied stemming at every hole,
- z) structure of charges, including indication of primer lay-out, intermediate stemming etc.,
- aa) dealing with misfire, including a way of its disposal and assumed types of misfires and methods recommended for their disposal with respect to technology of implementation of blasting works and local conditions,
- bb) authority and liability of employees participating in blasting works,
- cc) conditions for eventual division of explosive cartridges,
- dd) conditions for dropping down the cartridges, when there is a primer in the hole,
- ee) conditions for charging the primers by an assistant,
- ff) application of more primers in the charge.
- gg) priming the charge by a number of detonators,
- hh) location of depository of explosives at workplace.

**Further specific minimum terms, which should be included in blasting technical design at underground workplaces:**

- a) project of ventilation, which should specify a calculation of quantity of deleterious fumes,
- b) measures and time needed for reduction of fumes concentration to the level determined by national regulation,
- c) technical measures against incursion of explosive fumes to intake air flow,
- d) place, where firing is made from and its protection against fumes and manner of air control for a period of preparation of blasting works and after them,
- e) evidence by calculation or by needed preliminary tests as the case may be, that seismic vibrations of blasting will not have a impact on important underground works, including place of firing and surface objects in exposure, which would jeopardize their safe operation and other protected interests.

**TRANSPORT RULES FOR EXPLOSIVES TRANSPORTATION**

**Procedure for transportation and transfer of explosives should include:**

- a) needed safety and operational instructions, namely transport route, machinery or transport means, the smallest distances between them,
- b) method of:
  - notification of transportation of explosives to a driver or attendance of machinery in advance,
  - labelling of transport means mostly by blue light,
  - safeguarding of the means with load that it could not be left without control,
  - security of 90% admissible load of transport means or machinery for explosives being transported, including packaging,
  - security of indispensable accessories of blasting technique, which is necessary to be simultaneously transported with explosives in the same part of transportation means,
  - transportation together with explosives of most urgent number of persons designed only for loading and unloading of explosives and for attendance of transport means, which should not exceed mostly a half number of persons allowed for transportation of persons,
  - separate placing of detonators from other explosives so that it might be prevented from transfer of detonation,
- c) the largest weight of load of explosives and their placing, including fastening against shifting, mutual pushing, upset or falling out from loading area, while packaging with explosive should not exceed height of hinged sides of transport means,
- d) constructional design of loading area,
- e) maximum speed during transportation,
- f) range of control to be made by a driver before every loading of explosives, provided the vehicle for transportation of explosives is used for other purposes, in particular, whether it is empty and clean,
- g) range of control to be made by a driver after completion of transportation of explosives so that explosives or their packaging with their remains could not be left on loading area,
- h) range and frequency of inspection of transport routes, transport means or machinery, place of loading and discharging, statement number, safeguarding of machinery,
- i) in schedule of enhanced maintenance of vehicles used for transportation of explosives should be included intervals among inspections with respect to capacity utilization, type, output and local condition of vehicle operation,
- j) needed number of employees for transportation and carrying,
- k) determination of professional competency of the employees and determination of their liability for transportation and carrying, method of handling with explosives,
- l) procedure in negotiation of traffic accidents and prohibited acts.



**BLASTING LOG**

**Shot-firer keeps a log, where he records all facts that are important for assessment of condition of preparatory and blasting works within the range of one blasting like, for example:**

- a) initial line of sight,
- b) drilling pattern,
- c) drilling log,
- d) final line of sight,
- e) charging plan,
- f) design of scheme of initiating system,
- g) calculation of blasting parameters, disintegrated quantity of raw materials, size of undesirable effects,
- h) results of physical checks of the workplace performed by a shot-firer,
- i) written authorization with guidance and signature about taking over by a sentry,
- j) registration data on employees and persons in manipulation area,
- k) minutes of incidents,
- l) minutes of blasting.

**MINUTES OF BLASTING**

**Minutes of blasting should include the following minimum information:**

- a) video-recording with introduction of condition of place before blasting on the surface, course of blasting and results of blasting, where the holes of diameter more than 50 mm were used,
- b) result of inspection of holes before charging, including method of eventual removal of water or other impurities from holes designed for charging,
- c) number of charged and uncharged holes, including introduction of reasons,
- d) number and type of applied detonators,
- e) quantity and type of applied explosives,
- f) identification data of explosives,
- g) size of partial charges and of total charge,
- h) structure of charges, including introduction of lay-out of primer, intermediate stemming etc.,
- i) length and type of applied stemming at every hole,
- j) scheme of initiating system,
- k) how was disposed with unexpended quantity of explosives,
- l) results of measurement of undesirable effect of blasting,
- m) whether misfire did not occur, its disposal as the case may be,
- n) transparent list of eventual damages,
- o) results of inspections and suggestion of measures taken for further blasting.

## **MULTI-LINGUAL DICTIONARY OF BASIC TERMS**

**Shot-firer should besides mother language manage in English, German, French, Spanish, Portuguese and Russian as well as in other languages of neighbouring countries the following basic terms:**

### **CZECH:**

střelmistr  
trhací práce  
výbuch  
detonace  
detonační rychlost  
explosivní hoření  
výbušnina  
spotřební doba  
náložkovaná trhavina  
černý prach  
zápalnice  
bleskovice  
detonační trubička  
rozbuška  
zážehová rozbuška  
příslušenství trhací  
techniky  
roznětnice, palník  
interval zpoždění  
stupeň zpoždění  
záběr  
extrémní podmínky  
zážehový proud  
zážehový impuls  
vývrt  
nadměrný kus  
clonový odstřel  
vrtné schema  
zálom  
rozlet horniny  
zplodiny výbuchu  
nebezpečný prostor  
nabíjecí plán  
trhlina  
nálož trhaviny  
důl  
lom  
hornina  
odhoz  
bezpečnost  
nehoda  
riziko

### **ENGLISH:**

shot-firer  
blasting works  
explosion  
detonation  
detonation velocity  
deflagration  
explosive  
shelf life  
cartridged explosive  
black powder  
safety fuse  
detonating cord  
shock tube  
detonator  
firing detonator  
accessories of blasting technique  
  
blasting machine, exploder  
delay time  
delay number  
burden  
extreme conditions  
firing current, series  
firing impulse  
hole  
boulder  
bench blasting  
drilling pattern  
cut  
fly rock  
fumes  
hazardous area  
charging scheme  
crack  
explosive charge  
mine  
quarry  
rock  
rock throw  
safety  
incident  
risk, hazard

### **GERMAN:**

## **NOTES**

