# MUSINGS OF A SAFETY PHILOSOPHER - RELATING TO BLASTING SAFETY

by
Ralph Dawson

## "ALWAYS AND NEVERS" - STORING EXPLOSIVES MATERIALS

LOCATION OF MAGAZINES

ALWAYS separate magazines from other magazines, inhabited buildings, highways, and passenger railways. See IME Safety Library Publication No. 2. "American Table of Distances".

*Probably the greatest challenge in the industry is the location of a magazine on construction sites; it takes special attention to get the typical "day box" as isolated as possible.*

NEVER allow combustible material to accumulate within 25 feet of the magazine.

NEVER allow any lighters, matches, open flame or other sources of ignition within 50 feet of the magazine. *This states the obvious—every explosive product will burn—and, in confinement, reach a temperature of detonation. There have been numerous tragedies from firemen "fighting" fires when the only known product was ANFO, and a detonation occurred.*

**The rule is simple NEVER "fight" a fire containing ANY product used for blasting. Fire extinguishers are carried on a vehicle for the purpose of extinguishing a fire in the engine area in the early moments and IF THE FIRE IS BROUGHT UNDER CONTROL PROMPTLY — BEFORE IT SPREADS TO THE CARGO AREA.**

CONSTRUCTION OF MAGAZINES

ALWAYS be sure magazines are solidly built and securely locked, in accordance with federal regulations, to protect from weather, fire, and theft. Protect from penetration by bullets and missiles, as required by the classification of the explosive material.

ALWAYS keep the inside of the magazine clean, dry, cool and well ventilated.

ALWAYS post clearly visible "EXPLOSIVES - - - - KEEP OFF" signs outside of the magazine. Locate signs so that a bullet passing directly through them cannot hit the magazine.

CONTENTS OF MAGAZINES

ALWAYS clean up spills promptly. Follow manufacturer's directions.

ALWAYS store only explosives materials in a magazine.

ALWAYS rotate stock so the oldest material in the magazine is the first out.

NEVER store detonators with other explosive materials.

NEVER use explosives materials which seem deteriorated before consulting your supervisor or the manufacturer.

NEVER exceed recommended storage time and temperature for explosives. Check with your supervisor or the manufacturer.

**NOTE: The Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms (BATF) regulates the industry in the area of storage. Blasters should be familiar with Code 27 CFR, Part 181.**

TRANSPORTING EXPLOSIVE MATERIALS

ALWAYS keep matches, lighters, open flame and other sources of ignition at least 50 feet away from parked vehicles carrying explosive materials.

ALWAYS follow federal, state, and local laws and regulations concerning transportation.

ALWAYS load and unload explosive materials carefully.

NEVER park vehicles containing explosive materials close to people or congested areas.

NEVER leave a vehicle containing explosive material unattended.

**NOTE. - The Department of Transportation, Office of Hazardous Material Operations (DOT) regulates the transportation of explosives. Blasters should be familiar with Code 49 CFR, Parts 107 and 171 through 178. More and more cities are designating specific routes for the transportation of explosives through them. The manufacturer's and distributor's know these routes but the contractor who may have occasion to transport explosives between nearby projects must also observe them.**

**These guidelines for storing and transportation are but a highlight of the most important rules. As the industry evolved toward new technology which provided less sensitivity to the potential for detonation of the most popular products, there has been an unfortunate relaxing of observing the basic rules.**

IT HAS PROVEN TO BE A CHALLENGE TO TEACH THAT ALTHOUGH THE PRODUCTS ARE SAFER TO STORE, TRANSPORT, AND USE, THEY ARE STILL DESIGNED TO EXPLODE, AND MUST DEMAND THE SAME RESPECT AS THOUGH IT WAS 100% NITROGLYCERIN.

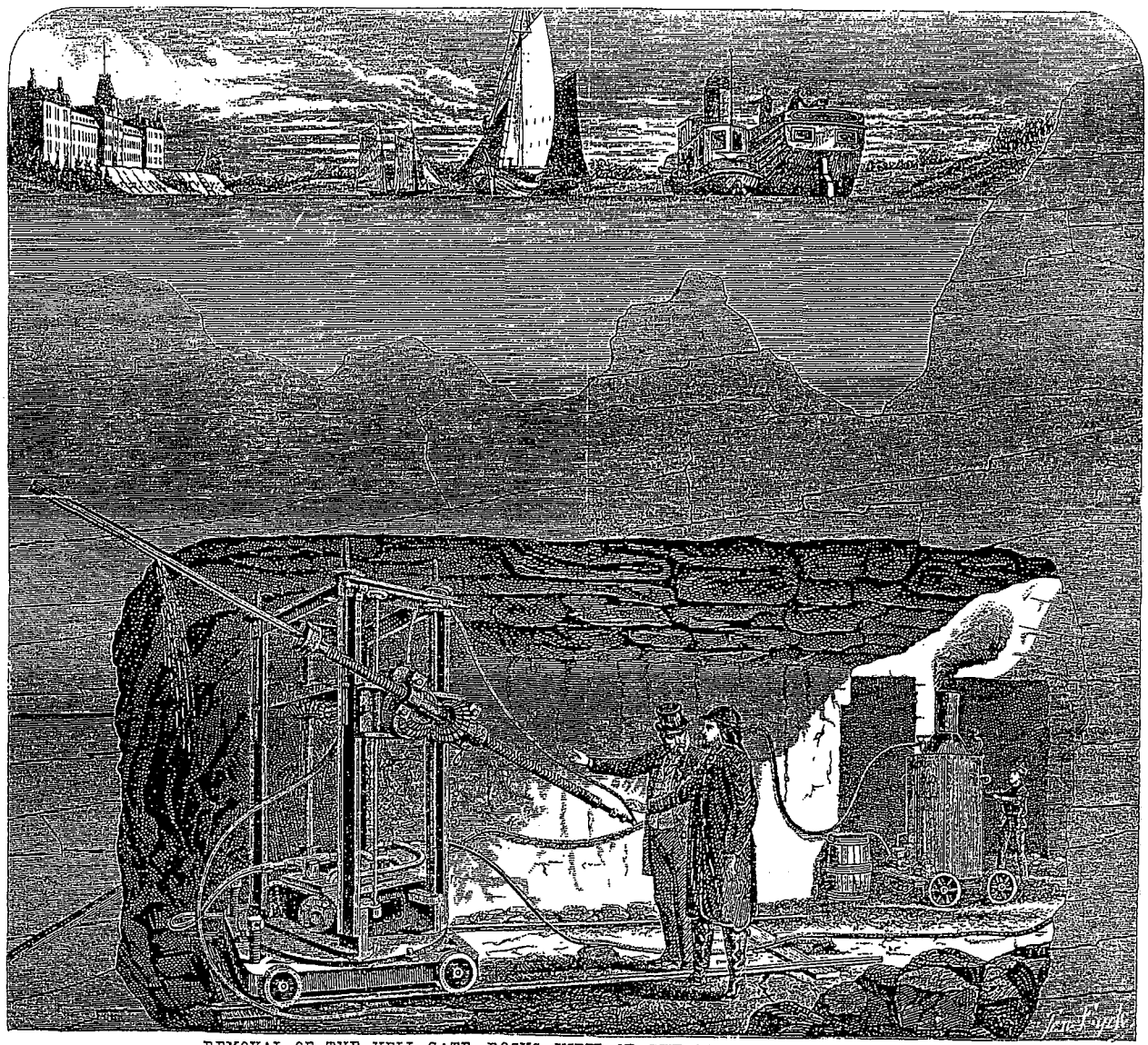
*>JEE<*

# EXPLOSIVES
# 100 YEARS AGO
## more or less

by Robert B. Hopler

As much as possible, items are reproduced exactly as originally printed: misspellings, and usages of terminologies now considered archaic have been retained.

Scientific American
New York
May 20, 1871



REMOVAL OF THE HELL GATE ROCKS—VIEW OF THE DIAMOND DRILLING MACHINE.

RBH Note: the diamond drill, now utilized primarily for prospecting and sampling, began its industrial life as both a machine for those uses and to drill blastholes in mines and civil projects. Historically, it fits the niche between the steam drill and the modern pneumatic drill.

**Nature**
**October 15, 1896**

BLOWN-OUT shots are responsible for a large proportion of the explosions in coal mines. By a blown-out shot is meant a blast which has failed to effect a rupture of the coal owing to the hole for it having been drilled in a wrong position, or owing to the coal not having been properly prepared by holeing or under-cutting. The gaseous products produced by the combustion of the powder are driven violently into the roadways, mixed with the gas distilled from the coal; and this, with the clouds of dust raised at the same time, provides all the conditions for a disastrous explosion. The Commission appointed to inquire into the cause of the explosion at the Brunner Coal Mine, New Zealand, in March last, have, after full consideration of the evidence, concluded that the primary cause was a blown-out shot fired, contrary to the rules of the mine, in a part of the mine where no work should have been in progress. The coal gas evolved from the surrounding coal is held to have been ignited as the result of the shot, and the flame then spread throughout the dry portions of the mine. The disaster was accentuated by the explosion of the coal dust raised by the concussion along the main road and working-places, which explosion appears, in some cases to have been locally intensified by small quantities of, fire-damp. No direct evidence was obtained by the Commissioners that the explosion was commenced by an accumulation of fire- damp, or that its extreme violence was due to the combustion of fire- damp mixed with coal-dust.

**North of England Institute of Mining and Mechanical Engineers-Transactions**
**December, 1896**

THE DANGER OF EMPLOYING SAFETY-FUZES FOR BLASTING IN FIERY MINES.*

BY BERGASSESSOR F. WINKAUS.†

For the past eighteen months, so called "safety-fuzes" and "safety-igniters" have been employed in the mining district of Westphalia, in order to ensure greater security in blasting in fiery and dusty mines. The object of this safety-fuze is to prevent the fuze from burning through sideways and throwing out sparks, as happens with ordinary Bickford and guttapercha fuzes : this object is attained by covering the core of powder, not with jute or india-rubber, but with several layers of cotton thread, and afterwards passing the fuze through liquid tar or a bath of colouring-matter in order to make it still more impervious.

The igniters that have been chiefly used are those of Norres and Roth ; the principle of both of these consists in lighting the fuze inside a metallic cap, which is nipped on to the end of the fuze, and which is supposed to stifle the jet of flame thrown out when the fuze is lit. In the Norres igniter, a small percussion-cap is used to light the fuze, and is exploded by a wire placed inside the metal cap. A part of the flame-jet from the fuze can, however, strike through the hole pierced in the cap for the passage of the wire, and can thus ignite fire-damp, as has been shown by experiments in gaseous mixtures containing 6 and 9 per cent. of fire- damp. The cap must therefore be enclosed in a wooden hood when the wire is withdrawn.

In the Roth igniter, a small glass bulb filled with sulphuric acid and a pill composed essentially of a mixture of sugar and chlorate of potassium are enclosed in a metal capsule closed at one end. When the glass bulb is broken, the action of the acid on the pill produces a tolerably sharp flash of flame, which ignites the powder-core of the fuze. It is essential that this igniter shall be very carefully nipped on to the fuze and completely enclose it, otherwise the flame of the igniter is apt to escape between the cap and the fuze, and may cause ignition of the fire- damp.

The employment of these methods of ignition has, however, been found dangerous in several respects.

In seven known cases, in which 1 miner was killed and 8 others more or less severely injured, the shot exploded at the very moment that the igniter was fired or a few seconds afterwards. Investigation of all these accidents showed that there had been no negligence on the part of the workmen. In every case, tarred safety-fuzes, 40 to 50 inches in length, were used, and they were fired in six cases by Norres, and in one case by Roth igniters according to the printed instructions. The cause of these ignitions can, according to all appearances, only be that the fuze suddenly burnt through its entire length. The assumption that such burning through could be caused by absence or deficiency of the core of the fuze is not admissible owing to the method of manufacture that is employed. After a series of investigations initiated by the owners of the Consolidation pits, near Schalke, and continued in the experimental drift of the Westphalian Miners' Association, the following phenomena must rather be regarded as indicating the cause of these accidents.

If a piece of the black tarred safety-fuze with double cotton covering (manufactured by Messrs. Bruckner and Zschetsche, Minden) be ignited and then nipped at any place with a pair of pliers and $^1/_2$ inch wide and provided with grooves, the pressure being maintained until the core has burnt past the nipped portion, the fuze almost invariably bursts open below the nipped spot with a loud report and with the projection of sparks. At times a longer or shorter piece of the fuze is thus exploded and then it continues to burn quietly. Not unfrequently, it would be observed that the explosion involved the whole of the yet unburnt end of the fuze, about 40 inches long, when a violent detonation would be accompanied by sparks flying out along the whole length of the fuze, as also from its end, so that the flame had suddenly traversed the entire length of 40 inches of fuze. The same phenomenon can be produced by pressing the burning fuze against the floor with the foot. It is essential that the pressure shall be continued even after the powder core has burnt past the nipped spot, so that the hollow space produced inside the fuze by the burning of the core shall be again closed. If this be not done, the fuze continues to burn quietly. For example, the fuze could not be made to explode by nipping it between two planed surfaces of cast- iron by means of bolts ; but an explosion was immediately produced when the iron surfaces were drawn up more tightly after a portion of the fuze had burnt away, so that it was closed up completely behind the burning portion.

When these experiments were repeated with a fuze covered with gutta-percha, this invariably burnt through immediately behind the nipped spot with the projection of a few sparks ; no explosion, was, however, observed. When the fuze consisted of an inner jute covering with a

firm outer covering of tarred cotton (manufactured by the Tonganer Company), explosions again took place below the nipped spot, but were limited to a local rupture of the fuze accompanied by sparks and report. The fuze of the same makers, with double covering of cotton tarred and covered with talc, however, burnt through up to a length of 47 inches.

The above described phenomena furnish an explanation of the production of explosions of fuze. Two classes of fuze may be distinquished, one in which the burning of the core does not destroy the outer covering, and the other in which the covering partly burns away with the core. With fuzes of the first kind, as the core burns away, a hollow tube is formed which allows the gases formed by the burning of the core to escape outwards, that is to say by the already burnt end. If this tube be now closed, as happens when the fuze is nipped as above described, the products of combustion are prevented from escaping ; they, therefore, collect in the burnt out portion of the fuze until the pressure generated overcomes the resistance of the envelope and bursts the latter, accompanied by the phenomena of an explosion. If the resistance of the walls be too great, the explosion extends to the unconsumed portion of the core, which at once explodes and flashes out violently. This explanation shows why long ends of fuzes only exploded when fuzes with stout cotton covering were tested, whilst in the case of fuzes with weaker jute covering, merely local explosions were produced.

With fuzes of the second class, where the covering is partly burnt and destroyed, such explosions cannot be caused, because the gases evolved from the powder can escape freely through the damaged covering.

In the practical employment of fuzes, this distinction between the two kinds must be still much more strongly accentuated. Here the fuze is firmly encased, for the whole or the greater part of its length, in the stemming. In fuzes with indestructible covering, there is only the tube, left by the burning of the core, available for the escape of the gases. The obstruction of this must, therefore, be doubly dangerous with such fuzes, because the stemming prevents the fuze from bursting laterally ; and if the obstruction in the rear connot be overcome, the flame must break through forwards, causing the charge to explode at once. Of course, a number of quite especial circumstances must coincide for such an occurence to take place, otherwise, considering the thousands of shots that are fired every day, there would be a still greater number of such accidents to record. It is, however, certain that the accumulation of the products of combustion within the fuze is favoured by firmly affixing a Roth or Norres igniter. In the trials in the expermental gallery, it was not found possible to cause explosions of fuzes by simply nipping on such igniters ; but explosions must occur whenever the back part of the fuze is sealed inside the igniter by the powder dust and the tar of the fuze covering. That such a case is not impossible is proved by a communication from the management of Consolidation Colliery Company, to the effect that, after numerous trials, they had succeeded in producing an explosion of fuze on firing it with a Norres igniter.

The effect of the igniter is also indicated by the fact that the great majority of accidents occured with the Norres igniter, and one only with a Roth igniter ; the reason being that the Norres igniter must be most carefully nipped on to the fuze to avoid a misfire, while the Roth igniter does not

really require to be nipped on in order to light the fuze with certainty. Of course, as already pointed out, it loses in the latter case its properties as a safety-igniter, owing to the flames escaping sideways from it.

Other circumstances, however, may also close completely the core-passage inside the fuze. If, for instance, a fuze is squeezed either by a large piece of stone in the stemming, or by being kinked inside the borehole, that spot might become closed completely by the residue from the powder, as would seem to be indicated by the following circumstance. A miner, who was aware of the possibility of the flame in the fuze striking through, although it had not been demonstrated at that time, attempted to secure himself by making a knot in the projecting end of the fuze, which was about 18 inches long. According to his statement, which seems quite worthy of belief, in this case the shot exploded when the fire inside the fuze must have got as far as the knot, or "at the outside" of, the stemming. Here, then, a stoppage had been produced by means of the knot.

Accordingly, the use of fuzes with resistant coverings, that are not destroyed by the burning of the core, must be looked upon as a source of danger; and, in the writer's opinion, there is such danger in the use of all fuzes in which explosive phenomena can be produced by compression, as above described. Even the employment of those fuzes in which the phenomena are only local, appears hazardous. Only those fuzes can be considered secure against sudden firing which are partly destroyed when the core is burnt, because with these a great part of the space occupied by the fuze is free for the escape of gas, so that compression can entail no risk. As a matter of fact, no accident of this kind has ever happened, as far as the writer knows, with fuzes covered with gutta-percha – in spite of these being so widely used. At the same time, there are objections to these fuzes : the quantity of gas evolved when they are burnt, as also its penetrating odour, are disagreeable accompaniments. Moreover, this class of fuzes is subject to the other danger of not being quite safe in fiery mines.

While safety-fuzes with a resistant covering may be looked upon as quite safe as regards fire- damp explosions, when the flame thrown out by them is stifled by a suitable safety-igniter, this perfect safety does not exist in the case of gutta-percha covered fuzes, as the following experiments have proved.

In a number of experiments, about 130 feet of fuze were burnt inside the explosion chamber of the experimental gallery,* which was filled with a 9 per cent. fire-damp mixture, in such a way that both ends of the fuzes were outside the gallery or that one end was lit inside it by means of a safety-igniter. Further experiments were tried with 65 feet lengths of fuzes, which were slightly kinked at intervals of about 3 feet. The explosive mixture was never fired. A fuze, 26 feet long, sharply kinked at 20 points, and thus partly damaged, caused an explosion of the fire- damp mixture after burning for seven minutes, say at about the twelfth kink. The total time of burning of 26 feet length of fuze is about eleven to twelve minutes.

In similar experiments with safety-fuzes, the gas was never fired, and whilst these fuzes appeared almost unchanged after they had burnt through, the guttapercha fuzes always broke into a number of separate pieces. It may be concluded from these experiments that there is no fear of firing a fire- damp mixture by sparks thrown out from the sides of a guttapercha fuze so long as the piece projecting from the shot-hole is uninjured. If, however, it be damaged it can fire a fire- damp mixture just as well as by the flame projected from the end, when it is lit.

The fuze is thus damaged even when a Norres or a Roth igniter is nipped on to it, and it has actually been observed that a quantity of sparks are emitted and the fuze is sometimes torn off completely below the compressed spot when the fuze is lit. Although in a number of experiments, it was not found possible thus to fire an explosive fire- damp mixture, this phenomenon indicates that the employment of igniters that require nipping on to the fuze would therefore seem not to be free from risk. Attempts have been made to meet this danger by making the tubes of the igniters so long that they project into the stemming. The sparking of the fuze is thus also prevented. This is, however, only possible when the depth of the shot-hole is such that the length of the projecting end of fuze is less than that of the igniter. Damage to the fuze may be avoided by using the Kost* or the Hohendahl† igniters, both of which cover the end of the fuze only whilst it is being lit. Then, again, there is the danger that the miner may take off the igniter before the fuze has ceased to throw out flame.

In fiery mines, the degree of safety attained in using safety-fuzes must, in the main, depend upon the skill and trustworthiness of the miner employed.

*Translated by Prof. H. Louis.

†Communications from Bergrath Kaltheuner, Of Gelsenkirchen, have been embodied in this paper.

•Trans. Fed. Inst. vol. ix., page 250.

(To be continued in the next issue of the Journal)

# TWIN PENDULUM - NEW METHOD TO SIMULATE THE GENERATION OF TOXIC FUMES

by
Gunnar Persson
SveDeFo

SUMMARY

The borehole pressure/time history of blasting practice is simulated in a twin pendulum apparatus, where the expanding shotfiring gases force two steel slab swingers apart. A pilot installation built at SveDeFo is described. The relevant factors, that govern the use of this test method as a means of classifying explosives with respect to their toxic fume potential, are described.

A twin pendulum which can simulate the actual borehole pressure/time history of explosive charges in the field with an energy content around 10 MJ should be large enough for a meaningful testing of all but a few of the cap sensitive explosives in the world market.

It is well worth further study and development as a potential international standard method for classifying explosives with respect to their toxic fume potential.

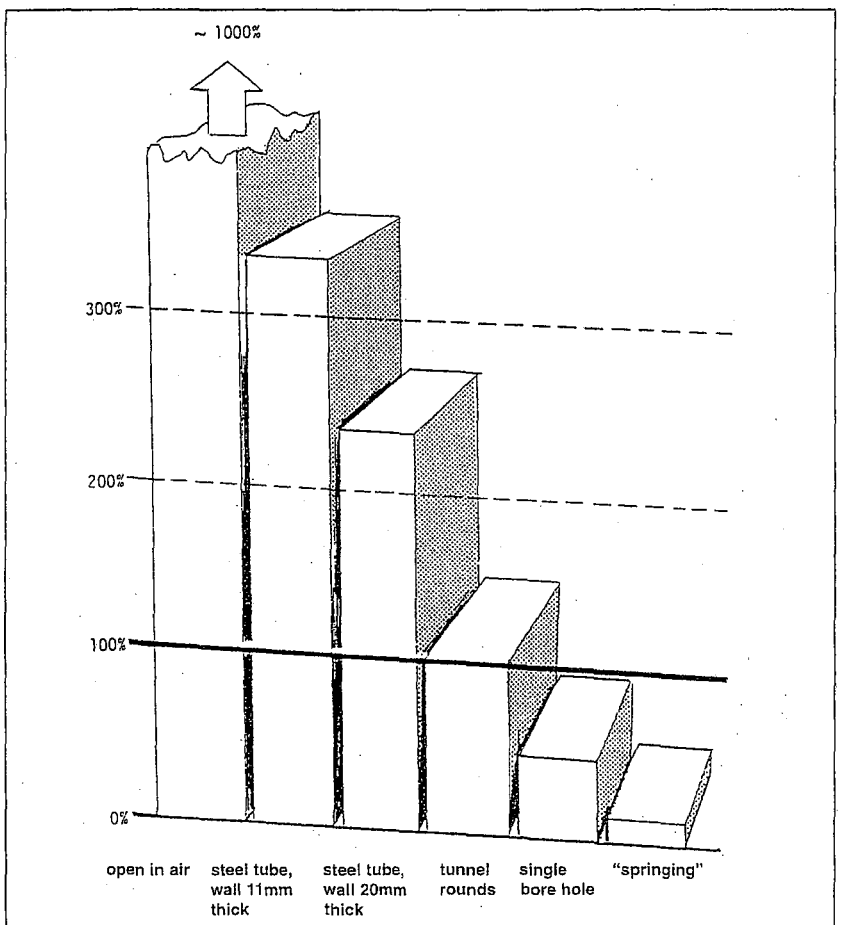



*Figure 1. The bar diagram shows the effect of the confinement (load) on the formation of $NO_x$ for a certain type of dynamite tested. 100% has been assigned as a standard value to the $NO_x$ amount that has been measured during the blasting of 10m² tunnel rounds of firing in waste rock with the specific charge of ~ 3 kg/m³.*

## BACKGROUND

The toxic components, especially carbon monoxide (CO) and nitrous oxides ($NO_x$), of the explosion gases (shotfiring fumes) are a great health risk in underground blasting. In order to determine the suitability of explosives for underground use, the generation of toxic explosion gases (fumes) must also be taken into consideration in addition to handling safety, environmental effects, detonability, and blasting efficiency.

The energy released during the detonation and the resulting detonation products can be determined by using thermochemical calculation programs. The reaction process is very complicated with many participating components. Before the chemical positions of equilibrium, the so-called freezing points, are attained during the cooling of the explosion gases, molecules, atoms, and free radicals have had many opportunities to enter into new combinations, all of which are dependent on temperature, pressure and the time conditions that prevail in the gas. It is very difficult to set up computer programs that calculate the $NO_x$ fraction with any greater relation to reality.

Several test methods have been developed in different

parts of the world in an attempt to determine in a laboratory scale the amount of toxic explosion gases generated by explosives. All of the known methods, with the exception of a West German method, lack arrangements for a true to life simulation of the load that the explosion gases are exposed to in actual boreholes.

## SIGNIFICANCE OF THE CONFINEMENT

Generally, the formation of $NO_x$ decreases with a greater confinement (load) of the detonating explosive and from that fact higher pressure. (Persson and Persson. 1) The results of comparative blastings with the same explosive but under different confinements, which give different pressure/time histories, are shown in Fig. 1. The measurements were performed in collaboration with Kurt Lindqvist of Nitro Nobel AB. (Lindqvist and Johnson 2.) The CO is only slightly affected by the confinement, and the tendency is then the same as for the $NO_x$. Under very strong confinements, non-systematic increases may occur, probably due to the burning of the wrapping under a lack of oxygen.

The atmospheric post-oxidation, when the expanding explosion gases come in contact with the air in the environment, can affect the $NO_x$ content to a max of one percent. The cloud of fumes is cooled during the expansion, and the amount of nitrogen in the air that can be oxidized is therefore small.

In practical use, one should be able to perform a meaningful determination of the generation of toxic fumes by the explosive in laboratory scale if the testing apparatus is capable of simulating the pressure/time history that prevails in the actual borehole.

The specific charge (explosive in kg per $m^3$ of blasted rock) can in underground work vary between 0.1 - 5.0 $kg/m^3$, depending on the tunnel area, nature of the rock and blasting method. The inner holes in the cuts may have a specific load over 100 $kg/m^3$. Consequently, the pressure/time history in the boreholes varies considerably. In addition, there are differences between the boreholes in a round of firings, depending on the degree of confinement (burden) and the cracks that have been produced by charges that have been detonated in nearby boreholes.

## WEST GERMAN TEST METHOD

One test method is worth mentioning among the presently known test methods for simulating actual conditions of use. It is of West German origin and has been developed by Berggewerkschaftliche Versuchsstrecke in collaboration with Versuchsgrube Tremona. (Eitz and Zimmerman 3.) The blastings are performed as rounds with 7 kg of explosives distributed in 7-10 bore holes in a rock chamber with a removable wall. As the rock blasting proceeds, the wall is moved, so that a chamber volume between 30 - 100 $m^3$ is always maintained.

## QUANTITATIVE GAS MEASUREMENTS IN ROCK BLASTING

In order to determine the amount of toxic fumes generated in liters per kg of detonated explosives during actual conditions of use, quantitative fume measurements can be made during the firing of well-defined rounds in rock. It is then suitable to blast stope holes with the same burden and spacing of holes, so that the specific charge can be determined with good accuracy. It should be noted that the same specific charge does not always mean the same load for the explosive. This is exemplified in stope blasting where the explosives in the top (roof) holes work with gravity, and the bottom (floor) holes work against it.

Previously it has not been possible to obtain in field measurements a high accuracy and low interference gas sensitivity with direct-reading, battery-operated, portable gas analyzers for CO and $NO_x$. Therefore, SveDeFo has considered it necessary, together with instrument manufacturers, to improve and develop an ND-IR analyzer for CO and a chemiluminescence instrument for NO and $N0_2$. (4.)

The in situ measurement of explosion gases may be performed according to two methods:

1. Test chamber measurements, similar to the above mentioned West German method, may be made on rounds of firings in mining areas or tunnels with a known volume. The chamber is sealed with a gate-type device, after which the explosion gas is thoroughly mixed by means of a fan, and the content of the desired toxic fumes is measured. The amount of fumes generated is calculated by multiplying the volume of the chamber by the gas content.

2. Air flow/gas content measurements, using a method tested at SveDeFo, where the fume content in the explosion gases coming from a blasting round is analysed in the passage of an accurately measured tunnel section. The air speed is measured at the same time with anemometers. When the explosion gas cloud passes through, its content of CO and $NO_x$ is registered as a function of time with an XT printer. Since the volume of the amount of air flowing by is known, the volumes of the analysed gas components can also be determined. (4)

In the above-mentioned quantitative measuring methods, it may be necessary, in certain cases, to take into consideration the explosion gas content in the rock blasted.

In order to imitate the conditions prevailing in the borehole when the explosive detonates, pressure/time measurements should also be made in situ. At present, tests are being conducted at SveDeFo with a new method which makes it possible to register the entire pres-

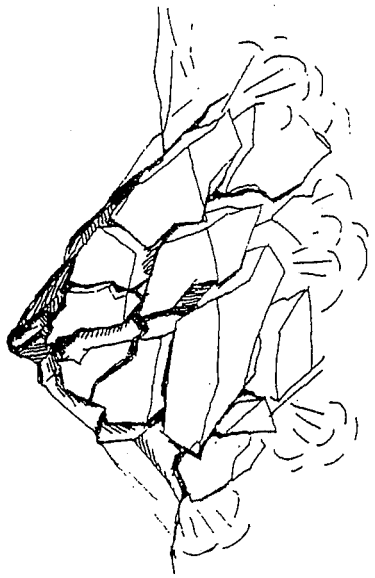


*Figure 2. Hole in wall stope with a powerful charge.*

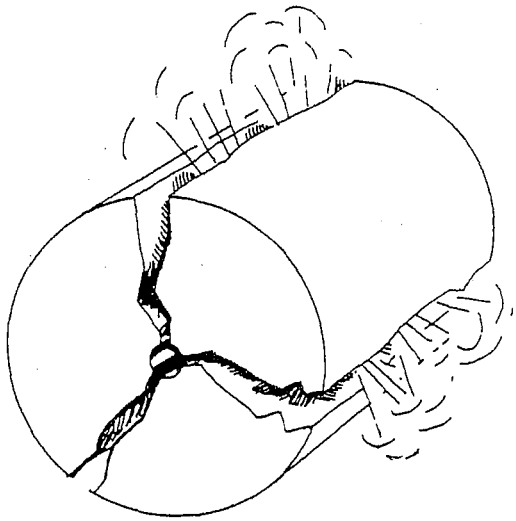


*Figure 3. Hole with rotary symmetrical tamping and critical charging.*

sure/time history when high energy explosives are detonated in boreholes.

## PRINCIPLE OF THE TWIN PENDULUM APPARATUS

The pressure/time history occurring in the above-described practical use of the explosive in boreholes (Figs. 2 and 3) can be simulated with a new test method where the explosion gases are forced to expand and work between two movably mounted steel slabs. The author has already described in EXTEST 78 the theory behind this method.

The testing apparatus consists of two or more steel slabs with planed surfaces that are pressed against each other. The explosive to be tested is placed in a groove (firing hole) milled between the steel slabs. This hole corresponds to the borehole in the rock. When the explosive detonates, the steel slabs are forced apart. The speed of this movement depends on the size of the impulse, the steel slab mass and the loss that occurs when the expanding explosion gas rushes out into the widened opening between the steel slabs. The desired pressure/time history can be simulated by changing the energy content of the explosive charge and/or the size of the mass.

The steel slabs should be fastened in a device that provides them with a returning motion after the blast. For example, this can be achieved if the two steel slabs are placed on top of each other with the lower slab as an anvil and the upper slab mounted on a movable arm as a hammer. A variant with a suspended hammer, single pendulum, is also possible. (See Figs. 4 and 5).

## PILOT TEST

Our pilot installation of the testing apparatus is designed as a twin (double) pendulum with brakes consisting of a bunch of logs for each half of the pendulum. When both of the steel slabs swing back to meet again, a rubber-covered steel plate has fallen down between them. This prevents any damage to the firing hole and to the contact surfaces.

The detonating explosive causes wear and tear on the firing hole, which, however, can be reduced considerably if a tube-shaped protective lining is used. We have developed a sand/air lining designed as self-supporting tubes. The density of the mineral is 2.65 g/CM$^3$ and the density of the lining: 1.60 g/CM$^3$.

The testing apparatus, which we call "Twin pendulum," was mounted in our 235 M$^3$ large test chamber in the Stripa Mine. After the blasting, the chamber was sealed by means of tight doors, and the explosion gases were mixed by a powerful fan. (1) When the gas mixture had become homogeneous, it was analyzed as to its content of toxic fumes with direct-reading instruments. CO was measured with an ND-IR analyzer, and $NO_x$ (NO and $NO_2$) with a chemiluminescence instrument.

When necessary, samples of other explosion gas components could be pumped into tubes for analysis by gas chromatography.

Our pilot installation of the twin pendulum had pendulum masses of approx. 700 kg with the dimensions 240x570x650 mm. The length of the pendulum arm from the supporting point to the firing hole was 2100 mm. Charges with an energy content up to 1 MJ could be placed in this twin pendulum. Then the load condition becomes such that the toxic gases generated correspond approx. to the wall stope blasting in granite with a specific charge of ~ 3 kg/m$^3$. Since our small twin pendulum only permits the firing

Examples of practical solutions for simulating actual load conditions on the explosive.

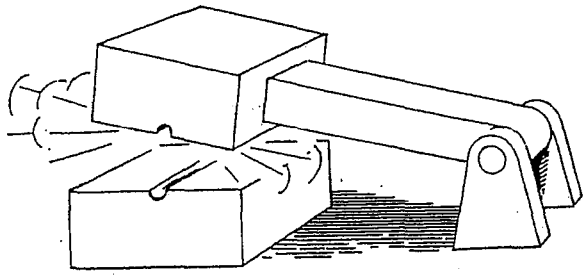


*Figure 4. Hammer with anvil.*

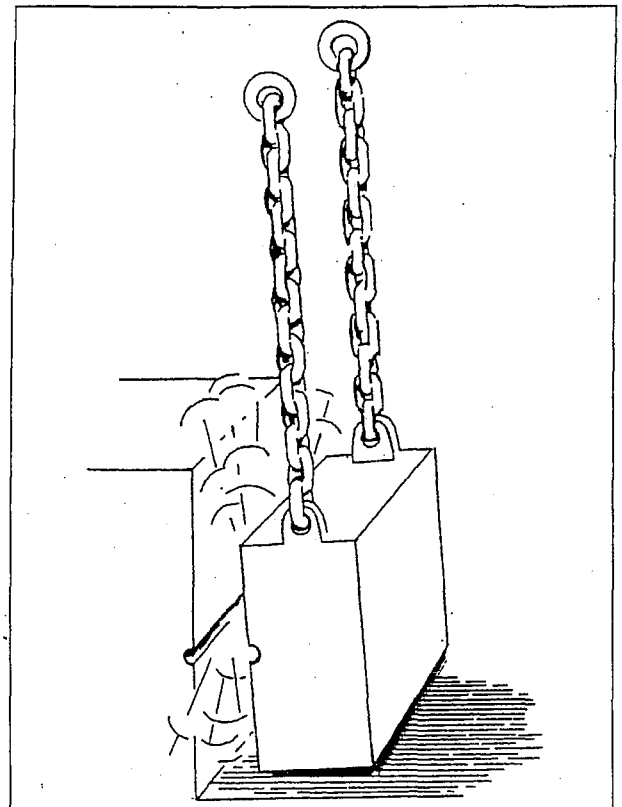


*Figure 5. Single pendulum.*

of small explosive charges, a difficulty may arise in obtaining an even velocity of detonation.

## FACTORS TO TAKE INTO CONSIDERATION WHEN USING THE TWIN PENDULUM

If an explosive is to be classified with respect to its generation of toxic explosion gases, then the testing process must be accurately thought out and the load conditions must be well known. Naturally this also applies to the twin pendulum. Some of the most important factors are discussed here, and some practical advice is offered in the following.

1. The pressure/time history in the twin pendulum must correspond to the loads under which the explosive is mainly intended to operate. This may be measured with pressure gauging according to an earlier mentioned method, or it may be tested by comparing blastings with actual rounds of firing.

2. When classifying explosives, the intended conditions of use must be taken into account. Standardized loading conditions should be possible to introduce during twin pendulum blasting. For example: A specific charge of 3 kg of explosives per $m^3$ of granite, which is a normal load in the blasting of smaller tunnel areas.

3. Load changes should first of all be made by changing the twin pendulum mass, and secondly, by varying the size of the charge.

4. The main part of the explosive tested must attain a stable rate of detonation. The charge should be so long that the acceleration distance of the detonation is a small part of the total length of the specimen.

5. The relation between the charge and firing hole diameter should be the same as in actual borehole firings that are to be simulated during the test.

6. The uncharged part of the firing hole should be so long that it prevents a load that is too low in the outer part of the explosive sample.

7. The dimensions of the firing hole are easily altered if removable steel linings are used on both sections of the pendulum.

8. The wear and tear on the firing hole is reduced considerably if energy-absorbing lining tubes of a sand/air type are used. Note that the pressure/time history can thereby be changed. By using sand of the same rock material as the explosive will be used in, the explosion gas effects, due to the mineral, can be studied during twin pendulum blasting.

9. Stemming can, of course, also be used in twin pendulum blasting, but in packing it, steps must be taken to prevent the pendulum sections from gliding apart.

10. It is necessary to effectively mix the explosion gases in the test chamber in order to make them rapidly homogeneous before the analysis is performed with high-class, direct-reading instruments.

## TWIN PENDULUM IN FULL SCALE

A twin pendulum which can simulate the actual borehole pressure/time history of explosive charges in the field with an energy content around 10 MJ should be large enough for a meaningful testing of all but a few of the blasting cap sensitive explosives in the world market. Since the pressure/time history for specific charges between 1 and 4 $kg/m^3$ is probably the most interesting to simulate, the format of the twin pendulum can be

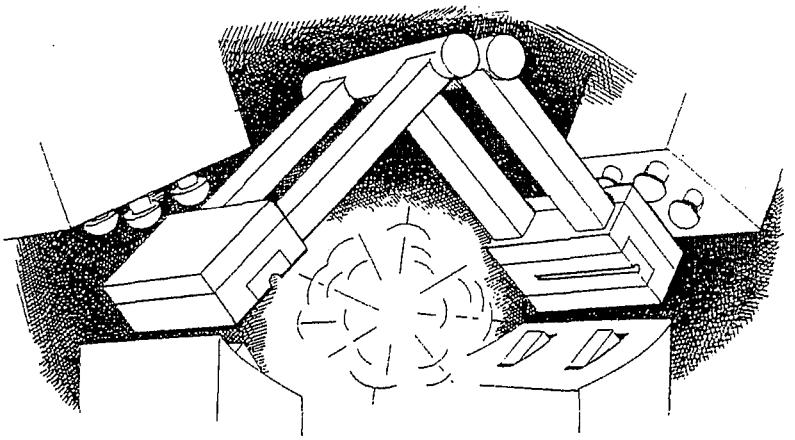


*Figure 6. Proposal for a twin pendulum for charge energies up to 10 MJ. Note the hydraulic shock absorbers, the hooking-up device, the replaceable loads and steel linings. The sketch is schematic. The contact surfaces (operating surfaces) are provided with labyrinth tracks (grooves) in order to reduce the gas loss between the surfaces during the initial phase.*

kept within manageable dimensions.

In an international standardization of methods for determining the generation of toxic explosion gases by explosives, the twin pendulum may be a proposal worth studying closer and developing further.

Rigid pendulum arms and a very strong mechanical structure consisting of supports and fastenings for the hydraulic brake cylinders which will brake the pedulum motion, are required for pendulum masses of 5 - 10 tons. The construction cost is estimated to be 4-5 million Swedish Crowns in 1995 year's value.

A common testing installation for several manufacturers of explosives or the construction of a few separate installations around the world, together with state-owned testing centers or similar organizations, should make it possible to share the cost among the persons interested in the testing method described in this report.

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*>JEE<*

# FATAL ACCIDENT REPORT

March 1, 1996
E & B COAL CO.
Mine No. 1, Floyd County

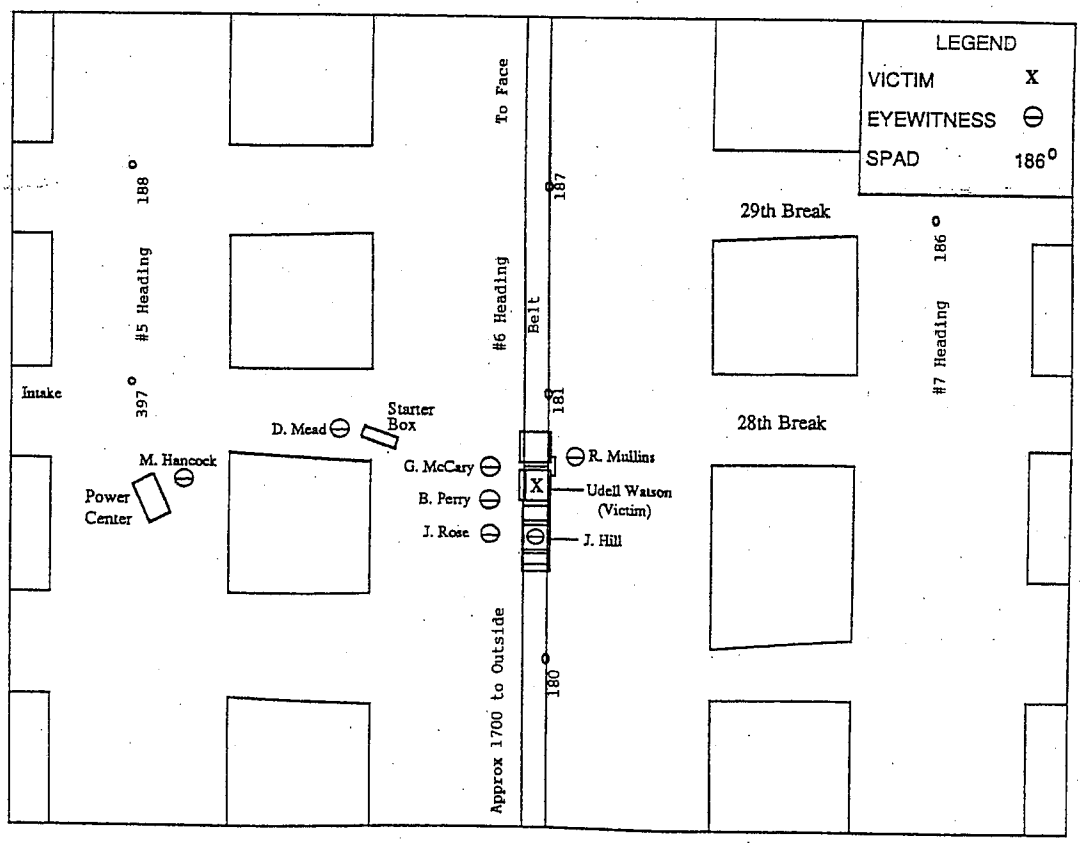
*Udell Watson,* underground miner, was fatally injured in a MACHINERY accident at approximately 1:30 p.m. *Mr Watson,* was 39 years old, and is survived by his wife and two children.

The accident occurred while he and several co-workers were attempting to re-thread a belt drive. The victim was pushing belt slack by hand through the top of the tandem power rollers while the belt was being "bumped" in reverse direction. Apparently the victim's hands were caught, and he was taken between the tandem power rollers, causing fatal injuries.

**PREVENTIVE MEASURES:**

1. At no time shall work be performed on equipment where there is a possibility of coming into contact with moving parts.

2. Belt guards shall remain in place where there is a possibility of persons coming in contact with conveyor head drives.




*This article is reprinted from the* Commonwealth of Kentucky Department of Mines and Minerals Bulletin, *Volume 1, 1996.*

# FATAL ACCIDENT REPORT

March 11, 1996
COSTAIN COAL COMPANY
Baker Mine, Webster County

*Wesley Littlepage*, underground utility man, was fatally injured in a SHAFT accident at approximately 2:15 p.m. He was 31 years of age and is survived by his wife and two children.

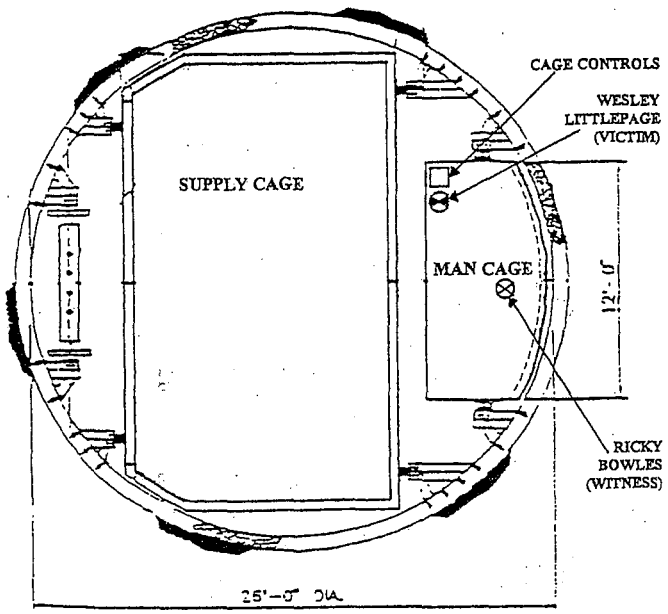
*Mr. Littlepage* and a co-worker were removing ice from the walls of an air shaft that was 1,079 feet deep and 26 feet in diameter. The shaft was equipped with both a man cage and a supply cage. The crew was working on the maintenance platform located atop the man cage. Ice had been cleared on the man cage side of the shaft to a depth of approximately 400 feet. A sheet of ice fell from an undetermined location on the supply side of the shaft, striking *Mr. Littlepage* and causing fatal head injuries.

## PREVENTATIVE MEASURES:

1. Adequate protection from falling materials shall be provided at all times when employees are allowed to ride or work outside the closed man cage or supply cage.

2. When scaling operations are necessary, the entire circumference of the shaft walls shall be scaled in a uniform manner from the collar to the bottom of the shaft.

3. Ice build-ups pose a significant threat to miners working in many areas. Special care must be taken to protect them from falling ice.




**TOP VIEW**
EAST PORTAL SHAFT CONFIGURATION

*This article is reprinted from the* Commonwealth of Kentucky Department of Mines and Minerals Bulletin, *Volume 1, 1996.*

# Group 18. Explosive Materials

## Article 113. Explosive Materials

### § 5236. Purpose.

(a) Group 18 establishes minimum standards for the manufacture, assembly, possession, storage, transportation, repacking and distribution, and use of explosive materials at places of employment.

(b) This group shall not apply to:

(1) The public display of fireworks as defined in Health and Safety Code Section 12524 and under the jurisdiction of the State Fire Marshal under Title 19.

(2) Explosive materials while in the course of transportation under the jurisdiction of the US Department of Transportation (USDOT), the permit provisions of the Health and Safety Code or the California Vehicle Code (CVC) as enforced by the California Highway Patrol.

(3) Pyrotechnic devices, fireworks and special effects which are regulated by the State Fire Marshal under provisions of Part 2, Division 11 (commencing with Section 12500) of the Health and Safety Code.

(4) The use of explosive materials in medicines and medicinal agents in the forms prescribed by the United States Pharmacopeia, or the National Formulary.

(5) Operations governed by the provisions of Group 18 under contract with federal government agencies requiring compliance with:

(A) DOD Contractors' Safety Manual(s),

(B) DOD explosive safety requirements and surveillance, and

(C) Where the Department of the Army/DOD conducts site inspections to ensure compliance.

(c) Whenever the term "explosive materials" is used in this group it shall be construed as including blasting agents unless specifically exempted in a safety order.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3 Labor Code.

HISTORY

1. Amendment of subsections (a) and (b) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendments filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of subsection (b) effective thirtieth day thereafter (Register 80, No. 38).
4. Amendment of article heading and section filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
5. Amendment of group heading, article heading and section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5237. Definitions.

"Air Loader." A device for inserting explosive materials into a bore hole or other cavity, using compressed air as the propulsive force.

"Air Supply Lines." Pipe, hose or combination of pipe and hose, that supplies compressed air to the air loader.

"ANFO." An explosive material consisting of ammonium nitrate and fuel oil.

"ATF." Bureau of Alcohol, Tobacco and Firearms, United States Department of Treasury.

"Barricade—Artificial." An artificial mound or revetted wall of earth of a minimum thickness of 3 feet at the top of the mound or acceptable equivalent.

"Barricade—Natural." Natural features of the terrain such as hills, or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine when the trees are bare of leaves.

"Barricaded." A building or structure containing explosives effectively screened from another magazine, inhabited building, railway, highway or work area either by a natural or by an artificial barricade of such height that a straight line from the top of any sidewall of the building, or structure, containing explosives to the eave line of any other magazine, inhabited building or a point 12 feet about the center of a railway, highway, or outside work area will pass through such intervening natural or artificial barricade.

"Binary Components." The combination of two non–explosive materials to form an explosive material.

"Blast Area." The area of a blast within the influence of flying fragments, gases, and concussion.

"Blast Site." The area where explosive materials are handled during loading, including the perimeter of blast holes and 50 feet in all directions from loaded holes or holes to be loaded.

"Blaster, Licensed." Any competent person designated to supervise blasting operations and in possession of a current blasters license issued by the Division.

"Blasting Accessories." Equipment used when loading and firing explosives. It does not include explosive materials.

"Blasting Agents." Any material or mixture consisting of a fuel and oxidizer, intended for blasting and not otherwise classified as an explosive, provided that the finished product, as mixed and packaged for shipment, cannot be detonated by means of a No. 8. test blasting cap when unconfined.

"Blasting Cap." See "Detonator."

"Blasting Circuit." A circuit used to initiate explosive materials.

"Blasting Machine." An electrical device designed to fire electric detonators.

"Blasting Mat." A heavy mat of woven rope, steel wire, or chain, or improvised from timber, logs, brush, or other materials placed over loaded holes to minimize the amount of rock and other debris that might be thrown into the air.

"Blasting Operation." Includes, but is not limited to use, on–site transportation and storage of commercial explosives, blasting agents, and other materials used in blasting.

"Blasting Shelter." A shelter for the protection of employees while blasting.

"Bullet Resistant." Magazine walls or doors of construction resistant to penetration of a bullet of 150–grain M2 ball ammunition having a nominal muzzle velocity of 2700 feet per second fired from a .30 caliber rifle from a distance of 100 feet perpendicular to the wall or door.

"Bus Wires." Wires in the blasting circuit to which the leg wires of electric blasting caps are attached for parallel electric blasting.

"Cap Crimper." A tool specially designed to securely crimp the metallic shell of a fuse detonator or igniter cord connector to a section of inserted safety fuse.

"Capped Fuse." A length of safety fuse to which a blasting cap has been attached.

"Car." Wheeled conveyance for use on rails, whether hand trammed or included in a train.

"Competent Person." One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

"Connecting Wires." Wires used to extend the leading (firing) line or leg wires in an electric blasting circuit.

"Coyote Hole." An underground tunnel–like chamber into which explosives are placed for primary blasting.

"Deflagration." A rapid chemical reaction in which the output of heat is sufficient to enable the reaction to proceed and be accelerated without input of heat from another source. Deflagration is a surface phenomenon with the reaction products flowing away from the unreacted material along the surface at subsonic velocity. The effect of a true deflagration under confinement is an explosion. Confinement of the reaction increases pressure, temperature, and rate of reaction, and may cause transition into a detonation.

"Detonating Cord." A flexible cord containing a center core of high explosives.

"Detonation." An explosive reaction that moves through an explosive material at a velocity greater than the speed of sound in the material.

"Detonator." Any device containing an initiating or primary explosive that is used for initiating detonation in another explosive material. Detonators were formerly called blasting caps and include:

(A) Fuse caps or ordinary blasting caps which are initiated by safety fuse.

(B) Electric blasting caps which are initiated by means of an electric current.

(C) Electric delay blasting caps are electric detonators which introduce a predetermined lapse of time between the application of electric current and the detonation of the base charge in the detonator.

(D) Shock tube, gas initiation, or miniaturized detonating cord blasting caps are detonators that are designed to be initiated by the signal, flame or detonation impulse from shock tube, gas filled tubes, or miniaturized detonating cord. Like electric blasting caps, they may incorporate a delay element to produce a predetermined lapse of time between receipt of the energy signal and the firing of the base charge in the detonator.

"DOD." U. S. Department of Defense.

"Electric Blasting Cap." See "Detonator".

"Electric Delay Blasting Caps." See "Detonator".

"Nonelectric Delay Blasting Cap." See "Detonator".

"Emulsion." An explosive material containing proportional amounts of an oxidizer dissolved in water droplets surrounded by immiscible fuel or droplets of an immiscible fuel surrounded by water containing substantial amounts of oxidizer.

"Explosive Materials." The term includes, but is not limited to, dynamite and other high explosives; slurries, emulsions, and water gels; black powder and pellet powder; initiating explosives; detonators; blasting caps; safety fuse; squibs; detonating cord; igniter; igniter cord; pyrotechnic devices; blasting agents; and propellants.

(A) "Explosives, Chlorates." Explosive materials that contain over one percent (1%) chlorate by weight, in the total mix.

(B) "Explosives, Perchlorates." Explosive materials that contain over one percent (1%) perchlorates by weight, in the total mix.

"Explosives." Any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion.

(A) "Classes."

(1) High explosives. Explosive materials which can be caused to detonate by means of an initiator test detonator when unconfined (for example, dynamite, flash powders, and bulk salutes).

(2) Low explosives. Explosive materials which can be caused to deflagrate when confined (for example, black powder, safety fuses, igniters, igniter cords, fuse lighters, and "special fireworks.")

(3) Blasting Agent. Any material or mixture, consisting of fuel and oxidizer which cannot be detonated by means of a No. 8 testing blasting cap when unconfined.

(B) Division. (For transportation purposes only.)

(1) Division 1.1 — Explosives that have a mass explosion hazard.

(2) Division 1.2 — Explosives that have a projection hazard, but not a mass explosion hazard.

(3) Division 1.3 — Explosives that have a fire hazard and (1) a minor blast hazard or (2) a minor projection hazard, or both, but not a mass explosion hazard.

(4) Division 1.4 — Explosive devices that present a minor explosion hazard.

(5) Division 1.5 — Very insensitive explosives which have a mass explosion hazard but are so insensitive that there is little probability of initiation. (Blasting Agents – ANFO, non cap–sensitive emulsions and water–gels, and packaged ANFO products.)

(6) Division 1.6 – Extremely insensitive articles which do not have a mass explosion hazard. (There currently are no commercial explosive products that fit this classification.)

"Explosives–Actuated Power Devices." Any tool or special mechanical device which is actuated by explosives, but not to include propellant actuated power devices. Examples of explosive actuated devices are jet perforators, shaped charges and similar devices.

"Face or Bank." The sides from the bottom or floor of a pit to the surface surrounding the pit. Where one or more benches or levels are used in a pit, each bench or level has a separate face.

"Face — Underground." That part of any adit, tunnel, stope, or raise where excavating is progressing, or was last done.

"Fireworks." (Also see "pyrotechnic devices.") Any device containing chemical elements and chemical compounds capable of burning independently of the oxygen of the atmosphere and producing audible, visual, mechanical, or thermal effects which are useful as pyrotechnic devices or for entertainment. The term "fireworks" includes, but is not limited to, devices designated by the manufacturer as fireworks, torpedoes, skyrockets, roman candles, rockets, Daygo bombs, sparklers, party poppers, paper caps, chasers, fountains, smoke spards, aerial bombs, and fireworks kits.

"Forbidden or not Acceptable Explosives." Explosives which are forbidden or not acceptable for transportation by common, contract or private carriers by rail freight, rail express, highway or water in accordance with the regulations of the U.S. Department of Transportation, 49 CFR Chapter I.

NOTE: Certain chemicals and certain fuel materials may have explosive characteristics but are not within the coverage of 18 U.S.C., Chapter 40 and are not specifically classified as explosives by the U.S. Department of Transportation. Authoritative information should be obtained for such materials and action commensurate with their hazards, location, isolation and safeguards, should be taken.

"Fume Classification." As defined by the Institute of Makers of Explosives, Publication No. 12, "A classification indicating the amount of carbon monoxide and hydrogen sulfide produced by an explosive or blasting agent. Explosives with positive oxygen balances are not considered as being acceptable in these classifications."

"Fuse, Safety." A flexible cord containing an internal burning composition by which fire is conveyed at a continuous uniform rate.

"Highway." Any street, alley, or road, publicly or privately maintained and open to use of the public for purposes of vehicular travel.

"Igniter Cord." A small–diameter pyrotechnic cord that burns at a uniform rate with an external flame and used to ignite a series of safety fuses.

"IME." Institute of Makers of Explosives.

"Industrial Explosive Devices." Explosive–actuated–power devices and propellant–actuated–power devices.

"Industrial Explosive Material." Shaped materials and sheet forms and various other extrusions, pellets, and packages of high explosive which include dynamites, trinitrotoluene (TNT); pentaerythritoltetranitrate (PETN); and other similar compounds used for high energy rate forming, expanding, and shaping in metal fabrication and for disassembly and quick reduction to scrap metal.

"Inhabited Building." A building regularly occupied in whole or part as a habitation for human beings, or any church, schoolhouse, railroad station, store, or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the manufacture, transportation, storage or use of explosive materials.

"Intraline Distance." The minimum distance permitted between any two buildings within one operating line. Intraline distances are also used for separating certain specified areas, buildings, and locations even though actual line operations are not involved. Intraline distance separation is expected to protect explosive materials in buildings from propagation detonation due to blast effects, but not against the possibility of propagation detonation due to fragments. Buildings separated by intraline distances will probably suffer substantial structural damage.

"Intraline Operations." Those operations accomplished within one operating line.

"Leading Wires." The wire(s) connecting the electrical power source to the blasting circuit.

"Loading Hose." The hose through which an explosive or blasting agent is blown or forced.

"Loading Line." The loading hose, loading tube and all fittings and connections from the loader to the discharge end of the loading tube.

"Loading Tube." The rigid or semi–rigid static dissipating tube in the loading line.

"Magazine." Any building or structure, other than an explosive manufacturing building, used for storage of explosive materials.

(A) Type 1 Magazines. Permanent magazines for storage of high explosive materials. Other classes of explosive materials may also be stored in Type 1 magazines.

(B) Type 2 Magazines. Mobile and portable indoor and outdoor magazines for the storage of high explosive materials. Other classes of explosive materials may also be stored in Type 2 magazines.

(C) Type 3 Magazines. Portable outdoor magazines for the temporary storage of high explosive materials while attended (for example, a "day box"). Other classes of explosive materials may also be stored in Type 3 magazines.

(D) Type 4 Magazines. Magazines for the storage of low explosive materials. Blasting agents may be stored in Type 4 magazines. Detonators that will not mass detonate may also be stored in Type 4 magazines.

(E) Type 5 Magazines. Magazines for the storage of blasting agents.

"Misfire." An explosive charge which partly or completely failed to explode as planned.

"Missed Hole." An explosive loaded hole or any portion thereof containing an explosive charge that failed to explode.

"Motor Vehicle." Any self–propelled vehicle, truck, tractor, semitrailer, or trailer used for the transportation of freight over public highways.

"Mudcapping." Blasting by placing a quantity of explosives with detonator on or against the object to be blasted. This is also known as bulldozing, adobying, or plaster shooting.

"NFPA." National Fire Protection Association.

"Operating Building." A building in which any processing of explosive materials is conducted.

"Operating Line." A group of separated operating buildings of specific arrangement, used in the assembly, modification, reconditioning, renovation, maintenance, inspection, surveillance, testing or manufacturing of explosives.

"Operating Line Separation." The required safe distance separating two or more operating lines.

"Permanent Blasting (Leading) Wires." Those wires between the firing switch and auxiliary switch, including sections between auxiliary switches, for use in blasting where the power source is an electric circuit.

"Permissible." A machine, material, apparatus, or device which has been investigated, tested, and approved by the Mine Safety and Health Administration, and is maintained in accordance with the requirements of the approving agency.

"Pneumatic Loading." Loading of explosive materials by means of compressed air.

"Prills." Spherical pellets.

"Primary Blasting." Blasting used to fragment and displace material from its original position to facilitate subsequent handling and crushing.

"Primer." A cartridge or container of explosives into which a detonator is inserted or attached to the main charge.

"Processing." A series of actions or operations involved in the manufacturing of explosive materials, including the manufacture of explosives, the assembly, loading, disassembly, modification, reconditioning, renovation, maintenance, inspection, surveillance, shipping, receiving, or testing of explosive materials and the packaging and repackaging of explosive materials for wholesale distribution.

"Propagation (Sympathetic Detonation)." The detonation of explosive charges by an impulse received from adjacent or nearby explosive charges.

"Propellant (Solid)." Explosives compositions used for propelling projectiles and rockets and to generate gases for powering auxiliary devices.

"Propellant–Actuated Power Devices." Any tool or special mechanical device or gas generator system which is actuated by a propellant, or which releases and directs work through propellant charge.

"Pyrotechnic Devices." Any combination of materials, including pyrotechnic compositions, which, by the agency of fire, produce an audible visual, mechanical or thermal effect designed and intended to be useful for industrial, agricultural, personal safety, or educational purposes. The term "pyrotechnic device" includes, but is not limited to, agricultural and wildlife fireworks, model rockets, exempt fireworks, emergency signaling devices, and special effects.

"Remote Operation." Where operating personnel are protected by substantial walls designed to safely withstand the anticipated overpressure should a incident occur.

"Safety (Blast) Shield." A barrier constructed at a particular location, or around a particular operation to protect personnel, material or equipment from the effects of a possible fire or explosion.

"Safety Fuse." See "Fuse, Safety."

"Secondary Blasting." Blasting to reduce the size of boulders resulting from a primary blast.

"Sensitizer." Any additive, active or inert, which added to a chemical compound or mixture causes that compound or mixture to become more sensitive to initiation.

"Slurry Explosives." An explosive material containing substantial portions of a liquid, oxidizers, and fuel, plus a thickener.

"Small Arms Ammunition." Ammunition of .75 caliber or less, when designated as an explosive by USDOT.

"Small Arms Ammunition Primer." Small percussion sensitive explosive charges encased in cup used for ignition of propellant powder.

"Special Effects." Articles containing any pyrotechnic composition manufactured and assembled, designed, or discharged in connection with television, theater, or motion picture productions, which may or may not be presented before live audiences and any other articles containing any pyrotechnic composition used for commercial, industrial, education, recreation, or entertainment purposes when authorized by the authority having jurisdiction.

"Springing." The creation of a pocket at the bottom of a bore hole by the use of a moderate quantity of explosives.

"Squib–Electric." A firing device that burns with a flash.

"Static Dissipating." Sufficiently conductive to dissipate charges of static electricity but possessing enough electrical resistance to be nonconductive to ordinary stray electrical currents. The electrical characteristics shall be uniform and for hose or tubes shall have a resistance of not less than 5,000 ohms per foot nor more than 30,000 ohms per foot and not more than 2 megohms over its entire length.

"Stemming Material." Inert material placed in a borehole after the explosive. Used for the purpose of confining explosive materials or to separate charges of explosive materials in the same borehole.

"Trackless Vehicle." A type of vehicle that does not run on rails.

"Train." A car or cars moved by mechanical or other power.

"Underground." Work locations in mines, tunnels or similar subterranean excavations.

"USDOT." United States Department of Transportation.

"Water Gels." An explosive material containing substantial portions of water, oxidizers, and fuel, plus a cross–linking agent.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3 Labor Code.

HISTORY

1. Amendment of subsection (a) filed 11–18–76; effective thirtieth day thereafter (Register 76, No. 44). For prior history, see Register 76, No. 29.
2. Amendment filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).
3. Editorial correction of "Blasting Shelter." (Register 95, No. 24).
4. New definition "Explosive Materials" filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
5. Amendment filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5238. Competency and Qualifications of Blasters.

(a) An employer shall not permit a blasting operation, unless a blaster having a current, valid California "Blaster's License" issued by the Divi-

sion is physically present on the site to accomplish the blasting operation and/or direct and supervise others in such operation.

(b) The employer shall ensure that the physical condition of the licensed blaster will not interfere with his or her ability to safely conduct blasting operations.

(c) A licensed blaster shall be able to understand and give written and oral orders.

NOTE: Other persons may work under the direct supervision of a licensed blaster for the purpose of obtaining the necessary experience to qualify for a California Blaster's License.

(d) The employer shall require that the licensed blaster:

(1) furnish satisfactory evidence of competency in the use and handling of explosive materials, and

(2) have the necessary qualifications to safely perform the type of blasting operations required for the specific worksite.

(e) The licensed blaster shall show proof of a valid Blaster's License when requested by a representative of the Division or other authority having jurisdiction.

(f) The applicant for a blaster's license shall meet the following minimum qualifications:

(1) Shall be at least 21 years of age;

(2) Shall have at least three years experience in the blasting category being applied for; and,

(3) Meet the requirements of subsections (b) and (c) of this Section.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Sections 142.3 and 6710, Labor Code; and Section 12006, Health and Safety Code.

HISTORY

1. Repealer and new section heading, section and NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5239. Training and Trainees.

All persons who handle or transport explosive materials shall be trained in the hazards of the job and safe performance of their duties. Trainees conducting blasting operations shall be under the direct supervision of a licensed blaster.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5240. Disposal of Explosive Materials.

(a) Deteriorated, damaged, frozen, contaminated, or scrap explosive materials which are unfit for use, shall be desensitized, destroyed or otherwise made safe in a safe place by a competent person(s).

EXPLOSIVE MATERIALS SHALL NEVER BE BURIED OR COVERED OVER BY ANY MATERIALS AS A MEANS OF DISPOSAL.

(b) Sites for destruction of explosive materials shall be located away from inhabited buildings, public highways, passenger railways, operating buildings and all other explosives. The separation shall not be less than the inhabited building distance as contained in Table Ex. 1. When possible, barricades shall be utilized between the site and inhabited buildings.

(c) A shelter or other adequate protection shall be provided near the disposal area for emergency use.

(d) A warning device shall be used when explosive materials are being destroyed.

(e) Waste static sensitive explosive materials shall be handled, transported or otherwise protected against the hazards of static electricity.

(f) Incompatible waste explosive materials shall not be transported in the same container or vehicle.

(g) Provisions shall be made so scrap explosive materials will not be placed in any burn location until at least 48 hours has past since the last fire has gone out.

(h) Bags that have contained ammonium nitrate shall not be piled, even temporarily, in or near a wooden building, as such bags are flammable. Bags shall be destroyed after emptying.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5241. Explosives for Blasting.

(a) Chlorate high explosives shall not be used for blasting operations.

(b) Low–Freezing explosives shall be of a type that will not freeze at temperatures that may reasonably be expected.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5242. Water Gels.

(a) Cap sensitive water gels and those containing an explosive shall be classified as high explosive and manufactured, transported, stored, and used as specified for explosives in this Article.

(b) Water gels containing no substance in itself classified as an explosive and which are not cap–sensitive as defined in Section 5237 under "Blasting agents" shall be classified as blasting agents and manufactured, transported, stored, and used as specified for blasting agents in this Article and Article 120.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5243. Black Powder Blasting.

(a) The use of Black Powder for blasting is not recommended. However, if it is used, the following rules shall be complied with:

(1) Inexperienced persons shall be closely supervised by a competent person.

(2) The licensed blaster and helper(s) shall not carry matches or other sources of ignition except when lighting fuse.

(3) The blasting crew shall wear shoes with no exposed metal.

(4) All persons not connected with the loading operations shall be kept at least 500 feet away and the area shall be roped off if necessary.

(5) Fires are prohibited within 500 feet of any black powder taken from the magazine for blasting purposes.

(6) Holes shall not be loaded while compressors, shovels, trucks, tractors, or sources of ignition are within 100 feet.

(7) Only bagged powder shall be used. It shall not be brought from the magazine until after the holes are sprung and have been cooled.

(8) Black powder shall not be used underground or for construction blasting.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5244. Explosives for Underground Use.

(a) Tests made to determine the fume class as shown in the following table shall be made according to the standard for "toxic gas test" procedure of the Mine Safety and Health Administration (MSHA):

| Cubic Feet of Toxic Gases Per (1–1/4" X 8") Cartridge of Explosive Material |
|---|
| Fume Class 1 — Less than 0.16 |
| Fume Class 2 — From 0.16 to 0.33 |
| Fume Class 3 — From 0.33 to 0.67 |

(b) Except as provided for in subsections (c) and (d), main explosive charge used underground shall comply with the requirements for Fume Class 1.

(c) Where the concentration of combustible dust and vapor is found to exceed 10% of the lower flammable limit, loading and blasting operations with Fume Class 1 explosive materials shall be halted.

(d) When there is reason to believe that use of Fume Class 1 explosive materials may endanger employees by igniting combustible dusts or

gases, permissible explosive materials shall be used and the ventilation increased to compensate for the resulting increase of poisonous and toxic gases.

NOTE: The composition of permissible explosives is such that they are less likely to ignite combustible dusts and gases than explosive materials which comply with Fume Class 1. On the other hand, the volume of poisonous and toxic gases produced by some permissible explosive materials is several times greater than that generated by Fume Class 1 explosive materials.

(e) Fume Class 1 explosives will not be required for the final loading of a coyote hole when the coyote hole is sufficiently back–filled to become a primary blast.

(f) Only plant mixed blasting agents where composition control is assured shall be used underground.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5245. Blasting Operations During Lightning and Dust Storms.

(a) Upon the approach of a lightning or dust storm, blasting operations shall be stopped and all persons in the blast area withdrawn to a safe location.

(b) Provisions shall be made for warning crews when an electric or dust storm approaches.

(c) In underground operations using electrical blasting systems, instrumentation to determine the presence of a lightning and dust storm within 15 miles of the portal and means to signal the heading shall be provided.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5246. Smoking and Open Flames.

Smoking and open flames are prohibited within 50 feet of explosive materials in the open, unless otherwise stated in these orders.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5247. Miscellaneous Provisions.

(a) No person shall store, handle, or transport explosive materials except under a valid permit issued by the applicable Federal, State or Local Agency.

(b) No employee shall be permitted to handle or use explosive materials while under the influence of alcohol, narcotics, or other drugs that cause drowsiness or other side effects which could cause the employee to perform duties/functions in an unsafe manner.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of section and NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5248. Blasting Accident Reports and Procedures.

(a) In the event of a blasting accident or unusual occurrence affecting the safety of employees in which explosive materials are involved, whether or not personal injury is sustained, the employer shall within 24 hours forward a report of the incident to the Division.

(b) The report shall state:

(1) The names and license numbers of all blasters involved.

(2) The names and occupations of any employees injured.

(3) The type of explosive materials, detonator, and method or methods of detonation of explosive materials.

(4) A factual account of events pertinent to the accident.

(c) In any blasting incident in which serious personal injury is sustained, there shall be no continuation of the blasting operation involved until such time as the Division has completed its investigation or authorized resumption of work.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 114. Storage of Explosive Materials

### § 5251. Storage of Explosive Materials.

(a) All explosive materials as defined in these orders, including industrial high explosives and any newly developed and unclassified explosives, shall be stored in the appropriate magazine as shown in Table EX–3. Magazines shall be constructed in conformity with the provisions of this Article.

(b) The following materials/devices shall be kept in their shipping containers until used:

(1) Explosive materials such as explosive power packs in the form of explosive cartridges or explosive–charged construction devices, explosive rivets, explosive bolts, explosive charges for driving pins or studs.

(2) Cartridges for explosives actuated power devices when in quantities of less than 50 pounds net weight of explosives.

(3) Stocks of small arms ammunition, propellant–actuated power cartridges, small arms ammunition primers in quantities of less than 750,000, and smokeless propellant in quantities of less than 750 pounds.

(4) Fuse lighters and fuse igniters.

(5) Safety fuses.

(c) Detonating cord shall not be kept or stored with blasting caps, but may be stored with other explosives.

(d) All magazines shall be located or protected as to minimize accidental impact from vehicles or falling objects.

(e) Area surrounding magazines shall be kept clear of brush, dried grass, leaves, and other combustible materials for a distance of 50 feet.

(1) Magazine contents shall be protected from flooding. The ground around magazines shall slope away from the magazine or drainage shall be provided.

(f) Electric power lines shall be kept at least 5 feet away from the exterior of any underground magazine except underground service.

(g) Magazines shall be located at least 25 feet from low–voltage electrical lines and 100 feet from high–voltage electrical lines. Care should be taken that they be placed in such a manner that should a line break, it would not fall within this distance except for underground service.

(h) Quantity and Storage Restrictions.

(1) Explosive materials in excess of 300,000 pounds or detonators in excess of 20 million shall not be stored in one magazine.

(2) Detonators shall not be kept or stored in any magazine with other explosive materials, except under any of the following conditions:

(A) In a Type 4 magazine, detonators that will not mass detonate may be stored with electric squibs, safety fuse, igniters, and igniter cord.

(B) In a Type 1 or Type 2 magazine, detonators may be stored with delay devices and any of the items listed in subsection (h)(2)(A) of this Section.

(C) When approved by the Division.

(3) No more than 50 pounds of high explosives shall be stored in an indoor magazine.

(i) Type 3 magazines "Day Box" shall not be used for storage of more than 110 pounds of explosive materials.

(j) All magazines shall be kept closed and locked, except when contents are being removed or replaced. Keys or combinations shall be kept in a safe place. Only persons authorized by the employer or licensed blaster shall be permitted to unlock or remove supplies from a magazine.

(k) Fuse caps with attached safety fuses shall not be stored in an explosives magazine, but may be stored in a magazine with other detonators.

(*l*) Vehicular storage facilities for Types 2, 4 and 5 magazines shall have wheels removed or shall be immobilized by kingpin locking devices.

(m) Explosive materials shall not be left unattended in Type 3 magazines. The explosive materials shall be removed to a Type 1 or 2 magazine for storage.

(n) A running inventory shall be maintained for the magazine to indicate the quantity of explosive materials in storage, quantity removed, date of removal and the name of the person responsible for transfer/removal of the explosive materials.

EXCEPTION: A Type 3 magazine (day box).

(o) Magazines shall not be located within 300 feet of the entrance (portal) of an active tunnel or mine.

(p) Signs shall be posted on the premises where magazines are located with the words "EXPLOSIVES — KEEP OFF" legibly printed thereon in letters not less than 3 inches high with a 1/2 inch stroke. Such signs shall be within 100 feet of the magazine and so placed that a bullet through the sign will not strike the magazine.

(q) Metal magazines shall be equipped with electrical bonding connections between all conductive portions so the entire structure is at the same electrical potential. Suitable electrical grounding methods include welding, riveting, or the use of securely tightened bolts where individual metal portions are joined. Conductive portions of non–metal magazines shall be grounded.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 12006, Health and Safety Code.

HISTORY

1. Amendment of subsections (a) and (b) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendments filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Editorial correction restoring missing text in subsection (d) (Register 91, No. 45).
4. Editorial correction reinserting article 114 heading (Register 92, No. 11).
5. Amendment of article heading, section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5252. Quantity and Distances Table for the Storage of Explosive Materials.

(a) The quantity of explosive materials that may be kept or stored in any magazine shall conform to Table EX–1, Table of Distances, which sets forth the minimum distance that a magazine may be located from the nearest inhabited building or other magazine.

(b) The quantity and distance table is not applicable to any magazine if the nearest inhabited building is effectually screened from the magazine by a natural barrier, which:

(1) Is 40 feet or more in height at any point, above a straight line drawn from the top of any sidewall of the magazine to any part of the inhabited building; and

(2) Has a natural thickness of not less than 200 feet at the point where it is intersected by the straight line.

(c) All types of blasting caps in strength through No. 8 shall be rated at 1 1/2 pounds of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.

(d) For quantity and distance purposes detonating cord up to 60 grains per foot shall be calculated as equivalent to 9 pounds of high explosives per 1,000 feet. Heavier detonating cord shall be rated proportionately.

(e) When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways; and, in addition, they shall be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosive materials contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosive materials. If any two or more magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosive materials stored in such group must be treated as if stored in a single magazine located on the side of any magazine of the group, and must comply with the minimum of distances specified from other magazines and inhabited buildings.

TABLE EX–1

AMERICAN TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES MATERIALS

As Revised and Approved by the Institute of Makers of Explosives—June 1991

| QUANTITY OF EXPLOSIVE MATERIALS | | DISTANCES IN FEET x 304.8 for mm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Inhabited Buildings | | Public Highways with Traffic Volume of less than 3,000 Vehicles per Day | | Passenger Railways—Public Highways with Traffic Volume of more than 3,000 Vehicles/Day | | Separation of Magazines | |
| Pounds Over | Pounds Not Over | Barricaded[1] | Unbarricaded | Barricaded | Unbarricaded | Barricaded | Unbarricaded | Barricaded | Unbarricaded |
| x 0.454 for kg | | | | | | | | | |
| 0 | 5 | 70 | 140 | 30 | 60 | 51 | 102 | 6 | 12 |
| 5 | 10 | 90 | 180 | 35 | 70 | 64 | 128 | 8 | 16 |
| 10 | 20 | 110 | 220 | 45 | 90 | 81 | 162 | 10 | 20 |
| 20 | 30 | 125 | 250 | 50 | 100 | 93 | 186 | 11 | 22 |
| 30 | 40 | 140 | 280 | 55 | 110 | 103 | 206 | 12 | 24 |
| 40 | 50 | 150 | 300 | 60 | 120 | 110 | 220 | 14 | 28 |
| 50 | 75 | 170 | 340 | 70 | 140 | 127 | 254 | 15 | 30 |
| 75 | 100 | 190 | 380 | 75 | 150 | 139 | 278 | 16 | 32 |
| 100 | 125 | 200 | 400 | 80 | 160 | 150 | 300 | 18 | 36 |
| 125 | 150 | 215 | 430 | 85 | 170 | 159 | 318 | 19 | 38 |
| 150 | 200 | 235 | 470 | 95 | 190 | 175 | 350 | 21 | 42 |
| 200 | 250 | 255 | 510 | 105 | 210 | 189 | 378 | 23 | 46 |
| 250 | 300 | 270 | 540 | 110 | 220 | 201 | 402 | 24 | 48 |
| 300 | 400 | 295 | 590 | 120 | 240 | 221 | 442 | 27 | 54 |
| 400 | 500 | 320 | 640 | 130 | 260 | 238 | 476 | 29 | 58 |
| 500 | 600 | 340 | 680 | 135 | 270 | 253 | 506 | 31 | 62 |
| 600 | 700 | 355 | 710 | 145 | 290 | 266 | 522 | 32 | 64 |
| 700 | 800 | 375 | 750 | 150 | 300 | 278 | 556 | 33 | 66 |
| 800 | 900 | 390 | 780 | 155 | 310 | 289 | 578 | 34 | 70 |
| 900 | 1,000 | 400 | 800 | 160 | 320 | 300 | 600 | 36 | 72 |
| 1,000 | 1,200 | 425 | 850 | 165 | 330 | 318 | 636 | 39 | 78 |
| 1,200 | 1,400 | 450 | 900 | 170 | 340 | 336 | 672 | 41 | 82 |
| 1,400 | 1,600 | 470 | 940 | 175 | 350 | 351 | 702 | 43 | 86 |
| 1,600 | 1,800 | 490 | 980 | 180 | 360 | 366 | 732 | 44 | 88 |
| 1,800 | 2,000 | 505 | 1,010 | 185 | 370 | 378 | 756 | 45 | 90 |
| 2,000 | 2,500 | 545 | 1,090 | 190 | 380 | 408 | 816 | 49 | 98 |
| 2,500 | 3,000 | 580 | 1,160 | 195 | 390 | 432 | 864 | 52 | 104 |
| 3,000 | 4,000 | 635 | 1,270 | 210 | 420 | 474 | 949 | 58 | 116 |
| 4,000 | 5,000 | 685 | 1,370 | 225 | 450 | 513 | 1,026 | 61 | 122 |
| 5,000 | 6,000 | 730 | 1,460 | 235 | 470 | 546 | 1,092 | 65 | 130 |
| 6,000 | 7,000 | 770 | 1,540 | 245 | 490 | 573 | 1,146 | 68 | 136 |
| 7,000 | 8,000 | 800 | 1,600 | 250 | 500 | 600 | 1,200 | 72 | 144 |
| 8,000 | 9,000 | 835 | 1,670 | 255 | 510 | 624 | 1,248 | 75 | 150 |
| 9,000 | 10,000 | 865 | 1,730 | 260 | 520 | 645 | 1,290 | 78 | 156 |
| 10,000 | 12,000 | 875 | 1,750 | 270 | 520 | 687 | 1,374 | 82 | 164 |
| 12,000 | 14,000 | 885 | 1,770 | 275 | 550 | 723 | 1,446 | 87 | 174 |
| 14,000 | 16,000 | 900 | 1,800 | 280 | 560 | 756 | 1,512 | 90 | 180 |
| 16,000 | 18,000 | 940 | 1,880 | 285 | 570 | 786 | 1,572 | 94 | 188 |
| 18,000 | 20,000 | 975 | 1,950 | 290 | 580 | 813 | 1,626 | 98 | 196 |
| 20,000 | 25,000 | 1,055 | 2,000 | 315 | 630 | 876 | 1,752 | 105 | 210 |
| 25,000 | 30,000 | 1,130 | 2,000 | 340 | 680 | 933 | 1,866 | 112 | 224 |
| 30,000 | 35,000 | 1,205 | 2,000 | 360 | 720 | 981 | 1,962 | 119 | 238 |
| 35,000 | 40,000 | 1,275 | 2,000 | 380 | 760 | 1,026 | 2,000 | 124 | 248 |
| 40,000 | 45,000 | 1,340 | 2,000 | 400 | 800 | 1,068 | 2,000 | 129 | 258 |
| 45,000 | 50,000 | 1,400 | 2,000 | 420 | 840 | 1,104 | 2,000 | 135 | 270 |
| 50,000 | 55,000 | 1,460 | 2,000 | 440 | 880 | 1,140 | 2,000 | 140 | 280 |
| 55,000 | 60,000 | 1,515 | 2,000 | 455 | 910 | 1,173 | 2,000 | 145 | 290 |
| 60,000 | 65,000 | 1,565 | 2,000 | 470 | 940 | 1,206 | 2,000 | 150 | 300 |
| 65,000 | 70,000 | 1,610 | 2,000 | 485 | 970 | 1,236 | 2,000 | 155 | 310 |
| 70,000 | 75,000 | 1,655 | 2,000 | 500 | 1,000 | 1,263 | 2,000 | 160 | 320 |
| 75,000 | 80,000 | 1,695 | 2,000 | 510 | 1,020 | 1,293 | 2,000 | 165 | 330 |
| 80,000 | 85,000 | 1,730 | 2,000 | 520 | 1,040 | 1,317 | 2,000 | 170 | 340 |
| 85,000 | 90,000 | 1,760 | 2,000 | 530 | 1,060 | 1,344 | 2,000 | 175 | 350 |
| 90,000 | 95,000 | 1,790 | 2,000 | 540 | 1,080 | 1,368 | 2,000 | 180 | 360 |
| 95,000 | 100,000 | 1,815 | 2,000 | 545 | 1,090 | 1,392 | 2,000 | 185 | 370 |
| 100,000 | 110,000 | 1,835 | 2,000 | 550 | 1,100 | 1,437 | 2,000 | 195 | 390 |
| 110,000 | 120,000 | 1,855 | 2,000 | 555 | 1,110 | 1,479 | 2,000 | 205 | 410 |
| 120,000 | 130,000 | 1,875 | 2,000 | 560 | 1,120 | 1,521 | 2,000 | 215 | 430 |
| 130,000 | 140,000 | 1,890 | 2,000 | 565 | 1,130 | 1,557 | 2,000 | 225 | 450 |
| 140,000 | 150,000 | 1,900 | 2,000 | 570 | 1,140 | 1,593 | 2,000 | 235 | 470 |
| 150,000 | 160,000 | 1,935 | 2,000 | 580 | 1,160 | 1,629 | 2,000 | 245 | 490 |
| 160,000 | 170,000 | 1,990 | 2,000 | 590 | 1,180 | 1,662 | 2,000 | 255 | 510 |
| 170,000 | 180,000 | 2,010 | 2,000 | 600 | 1,200 | 1,695 | 2,000 | 265 | 530 |
| 180,000 | 190,000 | 2,030 | 2,010 | 605 | 1,210 | 1,725 | 2,000 | 275 | 550 |
| 190,000 | 200,000 | 2,055 | 2,030 | 610 | 1,220 | 1,755 | 2,000 | 285 | 570 |
| 200,000 | 210,000 | 2,055 | 2,055 | 620 | 1,240 | 1,762 | 2,000 | 295 | 590 |
| 210,000 | 230,000 | 2,100 | 2,100 | 635 | 1,270 | 1,836 | 2,000 | 315 | 630 |
| 230,000 | 250,000 | 2,155 | 2,155 | 650 | 1,300 | 1,890 | 2,000 | 335 | 670 |
| 250,000 | 275,000 | 2,215 | 2,215 | 670 | 1,340 | 1,950 | 2,000 | 360 | 720 |
| 275,000 | 300,000 | 2,275 | 2,275 | 690 | 1,380 | 2,000 | 2,000 | 385 | 770 |

TABLE EX–2
Table of Separation Distances of
Ammonium Nitrate and Blasting Agents from Explosives
or Blasting Agents[1]

| *Donor Weight* | | *Minimum Separation Distance of Acceptor when Barricaded (ft.)* | | |
|---|---|---|---|---|
| *Pounds Over* | *Pounds Not Over* | *Ammonium Nitrate[2]* | *Blasting Agent* | *Minimum Thickness of Artificial Barricades (in.)* |
| | 100 | 3 | 11 | 12 |
| 100 | 300 | 4 | 14 | 12 |
| 300 | 600 | 5 | 18 | 12 |
| 600 | 1,000 | 6 | 22 | 12 |
| 1,000 | 1,600 | 7 | 25 | 12 |
| 1,600 | 2,000 | 8 | 29 | 12 |
| 2,000 | 3,000 | 9 | 32 | 15 |
| 3,000 | 4,000 | 10 | 36 | 15 |
| 4,000 | 6,000 | 11 | 40 | 15 |
| 6,000 | 8,000 | 12 | 43 | 20 |
| 8,000 | 10,000 | 13 | 47 | 20 |
| 10,000 | 12,000 | 14 | 50 | 20 |
| 12,000 | 16,000 | 15 | 54 | 25 |
| 16,000 | 20,000 | 16 | 58 | 25 |
| 20,000 | 25,000 | 18 | 65 | 25 |
| 25,000 | 30,000 | 19 | 68 | 30 |
| 30,000 | 35,000 | 20 | 72 | 30 |
| 35,000 | 40,000 | 21 | 76 | 30 |
| 40,000 | 45,000 | 22 | 79 | 35 |
| 45,000 | 50,000 | 23 | 83 | 35 |
| 50,000 | 55,000 | 24 | 86 | 35 |
| 55,000 | 60,000 | 25 | 90 | 35 |
| 60,000 | 70,000 | 26 | 94 | 40 |
| 70,000 | 80,000 | 28 | 101 | 40 |
| 80,000 | 90,000 | 30 | 108 | 40 |
| 90,000 | 100,000 | 32 | 115 | 40 |
| 100,000 | 120,000 | 34 | 122 | 50 |
| 120,000 | 140,000 | 37 | 133 | 50 |
| 140,000 | 160,000 | 40 | 144 | 50 |
| 160,000 | 180,000 | 44 | 158 | 50 |
| 180,000 | 200,000 | 48 | 173 | 50 |
| 200,000 | 220,000 | 52 | 187 | 60 |
| 220,000 | 250,000 | 56 | 202 | 60 |
| 250,000 | 275,000 | 60 | 216 | 60 |
| 275,000 | 300,000 | 64 | 230 | 60 |

NOTES:

(1) Separation distances to prevent explosion of ammonium nitrate and ammonium nitrate–based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the Table as the "donor". Ammonium nitrate, by itself, is not considered to be a donor when applying this Table. Ammonium nitrate, ammonium nitrate–fuel oil or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distances of explosives or blasting agents, one–half the mass of the ammonium nitrate should be included in the mass of the donor.

(2) The distances in the Table apply to ammonium nitrate that passes the insensitivity test prescribed in the definition of ammonium nitrate fertilizer promulgated by The Fertilizer Institute, and ammonium nitrate failing to pass said test shall be stored at separation distances determined by competent persons.

TABLE EX–3
Types of Storage Facilities

| Storage Type | Class of Explosive Materials Which May be Stored Therein | | |
|---|---|---|---|
| | For Transportation (D.O.T.) | Old Classification | New Classification |
| Type 1 (Permanent) | Division 1.1 Mass Explosion Hazard<br>Division 1.2 Projection Hazard<br>Division 1.3 Predominantly Fire Hazard<br>Division 1.4 No Significant Fire Hazard<br>Division 1.5 Blasting Agent | Class A<br>Class B<br>Class C<br>Blasting Agent | High or Low Explosive<br>High or Low Explosive<br>High or Low Explosive<br>Blasting Agent |
| Type 2 (Portable) | Same as above | Same as above | Same as above |
| Type 3 ("Day Box" for Temporary Storage) | Same as above | Same as above | Same as above |
| Type 4 | Division 1.3 Predominantly Fire Hazard<br>Division 1.4 No Significant Fire Hazard<br>Division 1.5 Blasting Agent<br>*Electric Blasting Cap | Class B<br>Class C<br>Blasting Agent<br>Electric Blasting Cap | Low Explosive<br>Low Explosive<br>Blasting Agent<br>Electric Blasting Cap |
| Type 5 | Division 1.5 Blasting Agent | Blasting Agent | Blasting Agent |

*As a result of tests with electric blasting caps, it has been determined that these blasting caps are not subject to sympathetic detonation. Therefore, a Type 4 storage facility meets the necessary requirements for storage of blasting caps that do not mass detonate.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 12006, Health and Safety Code.

HISTORY

1. Repealer and new section filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendments filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).
4. Amendment of section heading, section and NOTE, including transfer of section 1938, App B, Plate B–14, table 1 to replace former Table EX–1; transfer of section 5253 Table EX–2 to new section 5252 Table EX–2; and transfer of section 1938, App B, Plate B–14a to new Table EX–3, filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5252.1. Quantity and Distance Table for Storage of Explosives–Low Explosives Distances in Feet When Storage Is Unbarricaded.

(a) These explosives normally will be confined to pressure ruptures of containers and will not produce propagating shock waves or damaging blast over pressure beyond the magazine distance specified for this class. These distances are unbarricaded.

| *Pounds Over* | *Pounds Not Over* | *Inhabited Buildings* | *Railways and Highways* | *Above Ground Magazine Separation Intraline Separation* |
|---|---|---|---|---|
| 0 | 1,000 | 75 | 75 | 50 |
| 1,000 | 5,000 | 115 | 115 | 75 |
| 5,000 | 10,000 | 150 | 150 | 100 |
| 10,000 | 20,000 | 190 | 190 | 125 |
| 20,000 | 30,000 | 215 | 215 | 145 |
| 30,000 | 40,000 | 235 | 235 | 155 |
| 40,000 | 50,000 | 250 | 250 | 165 |
| 50,000 | 60,000 | 260 | 260 | 175 |
| 60,000 | 70,000 | 270 | 270 | 185 |
| 70,000 | 80,000 | 280 | 280 | 190 |
| 80,000 | 90,000 | 295 | 295 | 195 |
| 90,000 | 100,000 | 300 | 300 | 200 |
| 100,000 | 200,000 | 375 | 375 | 250 |
| 200,000 | 300,000 | 450 | 450 | 300 |

(b) Distances are not to be reduced by the presence of barricades or earth cover.

NOTE: Authority cited: Sections 142.3 and 7997, Labor Code. Reference: Sections 142.3 and 7997, Labor Code.

HISTORY

1. New section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5253. Quantity and Distance Table for Storage of Ammonium Nitrate and Blasting Agents.

(a) The quantity of ammonium nitrate or ammonium nitrate based blasting agents that may be stored in any magazine shall conform to Table EX–2, Table of Separation Distances, in Section 5252 which sets forth the minimum separation distances for ammonium nitrate and blasting agents from stores of high explosives or blasting agents. These distances apply to the separation of stores only. The American Table of Distances (See Table EX–1 in Section 5252) shall be used in determining separation distances from inhabited buildings.

(b) When the ammonium nitrate and/or blasting agent is not barricaded the distances shown in Table EX–2 in Section 5252 shall be multiplied by six. These distances allow for the possibility of high velocity metal fragments from mixers, hoppers, truck bodies, sheet metal structures, metal containers, and the like which may enclose the "donor." Where storage is in bullet–resistant magazines recommended for explosives or where the storage is protected by a bullet–resistant wall, distances and barricade thicknesses in excess of those prescribed in Table EX–1 in Section 5252 and are not required. (See Section 5253.1 for bullet–resistant construction.)

(c) Earth, or sand dikes, or enclosures filled with the prescribed minimum thickness of earth or sand are acceptable artificial barricades. Natural barricades, such as hills or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the "donor" when the trees are bare of leaves, are also acceptable.

(d) When the ammonium nitrate must be counted in determining the distances to be maintained from inhabited buildings, it shall be counted at 1/2 its actual weight because its blast effect is lower.

NOTE: Ammonium nitrate by itself is relatively insensitive and is widely used through the State as an agricultural fertilizer. When used for blasting purposes, it is customary to sensitize the ammonium nitrate by mixing it with carbonaceous materials such as coal dust, lamp black, carbon black, wood pulp, diesel fuel, stove oil, or other materials containing carbon. When mixed with carbonaceous materials, ammonium nitrate becomes much more sensitive to fire, friction, and shock, so it takes on characteristics resembling those of dynamite. For this reason, a mix-

ture of ammonium nitrate and carbonaceous material must be stored in compliance with regulations governing storage of explosives. Burning ammonium nitrate produces oxides of nitrogen which are very dangerous to breathe.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3 Labor Code.

HISTORY

1. Repealer and new section filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendments filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of subsections (a) and (d) filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).
4. Amendment of section, including transfer of section 5253 Table EX–2 to new section 5252 Table EX–2, filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5253.1. Construction and Use of Magazines.

(a) Type 1 Magazines.

(1) A Type 1 magazine shall be a permanent structure; a building, igloo, tunnel, or dugout. It shall be bullet, theft, fire and weather resistant, and be well ventilated.

(A) A Type 1 magazine shall be built at least equivalent to one of the following methods:

1. 8 inch masonry.

2. Metal of at least 14 gauge.

3. Wood frame with at least 26–gauge metal covering. No wood shall be exposed on the exterior.

(B) A Type 1 magazine shall meet the following additional requirements.

1. Masonry in subsection (a)(1)(A)1. shall have any openings in tile or cement blocks filled with a coarse, dry sand or a wet mixture of 1 part cement and 10 parts dry sand.

2. Metal in subsections (a)(1)(A)2. and 3. above shall be lined inside with not less than 4 inches of brick, solid cement blocks, hardwood, or equivalent.

(C) Solid wood or plywood floors are required. Floors shall be strong enough to bear the weight of the maximum quantity to be stored.

(D) Magazines shall have no openings except for ventilation and entrances. Vent openings shall be screened to prevent sparks passing through them.

(E) Magazine roofs shall be constructed of at least 7/8–inch sheathing covered with not less than 26–gauge iron or aluminum. Where it is possible for a bullet to be fired directly through the roof and into the magazine at such an angle that the bullet would strike the explosives within, the magazine is to be protected by one of the following methods:

1. A sand tray lined with a layer of building paper, plastic or other nonporous material, and filled with not less than four inches of coarse, dry sand, and located at the tops of inner walls covering the entire ceiling area, except the portion necessary for ventilation, or

2. A fabricated metal roof constructed of 3/16 inch plate steel lined with four inches of hardwood. (For each additional 1/16 inch of plate steel, the hardwood lining may be decreased one inch.)

(F) Magazine doors shall be kept closed and locked, except when opened for transacting business. The magazine doors shall be constructed of at least 1/4 inch plate steel on the outside and lined with at least two inches of hardwood on the inside.

(G) Each door shall be equipped with:

1. Two mortise locks; or

2. Two padlocks fastened in separate hasps and staples; or

3. A combination of a mortise lock and padlock; or

4. A mortise lock that requires two keys to open; or

5. A three–point lock.

6. If padlocks are used, they shall have at least five tumblers and a case–hardened shackle of at least 3/8 inch diameter. Padlocks shall be protected with not less than 1/4 inch steel hoods constructed so as to prevent sawing or lever action on the locks, hasps, and staples.

EXCEPTION: The lock requirement does not apply to magazine doors that are adequately secured on the inside by means of a bolt, lock, or bar that cannot be actuated from the outside.

(b) Type 2 Magazines.

(1) A Type 2 magazine shall be a portable box, trailer, semitrailer, or other mobile facility. It shall be bullet, theft, fire, and weather resistant, and shall be well ventilated. It shall be supported to prevent direct contact with the ground and, if less than one cubic yard in size, shall be securely fastened to a fixed object.

(A) The exterior construction and doors shall be constructed of not less than 1/4 inch steel and lined with at least two inches of hardwood. Magazines with top openings shall have lids with water–resistant seals or, lids that overlap the sides by at least one inch when in the closed position.

(B) Hinges and hasps shall be attached to doors by welding, riveting, or bolting (nut on inside of door). Hinges and hasps shall be installed so that they cannot be removed when the doors are closed and locked.

(C) Doors shall be equipped with locks as required by Section 5253.1(a)(1)(G).

(D) Type 2 magazines shall be located in conformity with Table EX–1, Distances for the Storage of Explosives, but may be permitted in warehouses and in wholesale and retail establishments when located on a floor which has an exit outside at grade level and the magazine is located not more than 10 feet from such an exit. Two Type 2 magazines may be located in the same building when one is used only for blasting caps in quantities not in excess of 5,000 caps and a distance of 10 feet is maintained between magazines.

(E) Indoor magazines shall be painted "red" and shall bear lettering in "white" on sides and top at least 3 inches high with a 1/2 inch stroke which reads, EXPLOSIVES—KEEP FIRE AWAY".

EXCEPTION: When size of the indoor magazine does not permit, letterings shall be as large as possible.

(c) Type 3 Magazines.

(1) A Type 3 magazine is a "Day Box" or other portable magazine. It shall be fire, theft and weather resistant. A Type 3 magazine shall be constructed of not less than number 12 gauge steel lined with a minimum of either 1/2 inch plywood or 1/2 inch Masonite–type hardboard.

(A) The door or lid shall overlap the opening by at least one inch. Hinges and hasps shall be attached by welding, riveting or bolting (nuts on inside of door).

(B) At least one steel padlock shall be provided (which need not be protected by a steel hood) having at least five tumblers and a case–hardened shackle of at least 3/8 inch diameter.

(2) When used for temporary storage at a site for blasting operations, Type 3 magazines shall be located away from inhabited buildings, and other magazines. A distance of at least 150 feet shall be maintained between Type 3 magazines and the other work in progress.

(d) Type 4 Magazines.

(1) A Type 4 magazine shall be a building, igloo, tunnel, dugout, box, trailer, semi–trailer, or other mobile magazine. It shall be fire, theft and weather resistant.

(A) A Type 4 magazine shall be constructed of masonry, metal–covered wood, fabricated metal, or a combination of these materials. The foundation shall be constructed of brick, concrete, cement block, stone, or metal or wood posts. If piers or posts are used in lieu of a continuous foundation, the space under the building shall be enclosed with fire–resistant material. The walls and floor shall be constructed of, or covered with nonsparking material or lattice work.

(B) The doors shall be metal or solid wood covered with metal. Hinges and hasps shall be attached by welding, riveting or bolting (nuts on inside of the door). Hinges and hasps shall be installed so that they cannot be removed when the doors are closed and locked.

(C) Locks shall meet the requirements of Section 5253.1(a)(1)(G).

(e) Type 5 Magazines.

(1) A Type 5 magazine shall be a building, igloo, tunnel, dugout, box, trailer, semi–trailer, or other mobile magazine. It shall be theft and weather resistant.

(A) The doors shall be metal or solid wood covered with metal. Hinges and hasps shall be attached by welding, riveting or bolting (nuts on inside

of the door). Hinges and hasps shall be installed so that they cannot be removed when the doors are closed and locked.

(B) Locks shall meet the requirements of Section 5253.1(a)(1)(G).

(f) Magazines shall be ventilated to minimize dampness and heating of stored explosives. ventilation openings shall be screened with 14 mesh, 21–gauge wire to prevent the entrance sparks and rodents, and shall be protected in a manner that will maintain the bullet resistance of the magazine.

NOTE: The recommendation for ventilation as contained in Safety Library Publication No. 1, Institute of Makers of Explosives, 1993 Edition, is evidence of good practice.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5254. Magazine Heating.

(a) When heating systems are installed they shall be either hot water radiant heating within the magazine building; or air directed into the magazine building over either hot water or low pressure steam (15 psig) coils located outside the magazine building.

The magazine heating systems shall meet the following requirements:

(1) The radiant heating coils within the building shall be installed in such a manner that the explosive materials or their containers cannot contact the coils and air is free to circulate between the coils and the explosive materials or their containers.

(2) The heating ducts shall be installed in such a manner that the hot air discharge from the duct is not directed against the explosive materials or their containers.

(3) The heating device used in connection with the magazine shall have controls which prevent the ambient building temperature from exceeding 130°F.

(4) The electric fan or pump used in the heating system for a magazine shall be mounted outside and separate from the wall of the magazine and shall be grounded.

(5) The electric fan motor and the controls for electrical heating devices used in heating water or steam shall have overloads and disconnects which comply with the Electrical Safety Orders. All electrical switch gear shall be located a minimum distance of 25 feet from the magazine.

(6) The heating source for water or steam shall be separated from the magazine by a distance of not less than 25 feet when electrical and 50 feet when fuel fired. The area between the heating unit and the magazine shall be cleared of all combustible materials.

(7) The storage of explosive materials and their containers in the magazine shall allow uniform air circulation so temperature uniformity can be maintained throughout the explosive materials.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3 Labor Code.

HISTORY

1. Amendment of subsections (b), (d), (e) and (f), and new subsection (j) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of subsection (i) filed 9–18–80 effective thirtieth day thereafter (Register 80, No. 38).
4. Amendment of section heading, repealer of subsections (a)–(i), subsection relettering and amendment of newly designated subsections (j)(5) and (j)(7) filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5255. Second–Class Magazines.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3 Labor Code.

HISTORY

1. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of subsection (h) filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).
3. Repealer filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5256. Storage Within Magazines.

(a) Magazines shall be kept clean and free from rubbish. They shall no be used as storerooms for anything except explosive materials and trans fer conveyors or other magazine tools while explosive materials ar stored therein.

Sweepings from floors of magazines shall be properly disposed of Magazine floors stained by leakage from explosive materials shall be cleaned according to instructions by the explosives manufacturer.

(b) Smoking, matches, open flames, spark producing devices and unauthorized fire arms shall be prohibited inside of or within 50 feet of magazines. Combustible materials shall not be stored within 50 feet of magazines.

(c) Fixed electric wiring in a magazine shall be equivalent to the requirements of Class II, Division 1, Hazardous Location, Electrical Safety Orders or may be more restrictive upon classification materials. The electric switch must be located outside of the magazine.

(d) When portable lights are necessary inside the magazine, permissible flash lights or permissible lanterns shall be used.

(e) Corresponding grades and brands of explosive materials shall be stored together in such a manner that brands and grade marks show. All stocks shall be stored so as to be easily counted and checked. Packages shall be piled in a stable manner and laid flat with top side up. Black powder, when stored in magazines with other explosive materials, shall be segregated by a sandbag barricade not less than 2 bags thick.

(f) When explosive materials are removed from a magazine, the oldest explosive materials of that kind in the magazine shall be taken and used first.

(g) Containers of bulk explosives shall not be unpacked or repacked in a magazine nor within 50 feet of a magazine or in close proximity to other explosive materials, except for manufacturing processes. Opened containers of bulk explosives shall be securely closed before being returned to a magazine.

(h) When magazines need inside repairs, all explosive materials shall be removed therefrom and the floors cleaned before work is started. In making outside repairs, if there is a possibility of causing sparks or fire, the explosive materials shall first be removed from the magazine.

(i) Explosive materials removed from a magazine under repair shall either be placed in another magazine or placed a safe distance from the magazine where they shall be properly guarded and protected until repairs have been completed and the explosive materials returned to the magazine.

(j) Every magazine used for the storage of explosive materials shall be under the supervision of a competent person who shall be not less than 21 years of age.

(k) Explosive materials shall not be piled/stored against interior walls so as not to interfere with ventilation.

(*l*) If buffer material is used to isolate the explosive material from the masonry walls, brick–lined or sand filled metal walls and single–thickness walls, it shall be so placed/ positioned as to not interfere with the ventilation provisions of the side and walls.

(m) Ammonium nitrate fuel oil (ANFO) blasting agent shall be physically separated from other explosives stored in the same magazine and in such a manner that oil does not contaminate other explosives.

(n) Magazine interiors shall be of a smooth finish without cracks or crevices with all nails, screws, bolts and nuts countersunk. Exposed metal or materials capable of emitting sparks shall be covered so as not to come in contact with packages of explosive materials.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5257. Makeup or Primer House for Underground Blasting Operations.

(a) When 30 or more primers are required for a single round/shot, the primers shall be made up in advance in a makeup or primer house.

(b) When primers are made up and stored in quantities greater than for immediate need, they must be processed in a separate structure that complies with the Type 1 or Type 2 magazine requirements except as follows:

(1) Electricity for lights will be permitted if the electric wiring is at least 5 feet from explosive materials and complies with Class II, Division I, Hazardous Locations, Electrical Safety Orders.

(2) Not more than 110 pounds of explosive materials other than primers shall be stored in this makeup house.

(3) The number of made–up primers of each delay stored in this makeup house shall not exceed a normal 2–day supply.

(4) Heaters, if installed, shall comply with Section 5254(a).

(c) Makeup or primer houses shall be located no closer than 100 feet from any magazine or inhabited building.

(d) Primers not made up in a makeup or primer house shall be made up at the blasting site.

NOTE: This Section does not prohibit primers being made up in a separate building or area, provided that explosives, detonators, and primers are stored in proper magazines.

NOTE: Authority cited: Section 142. 3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5258. Storage of Explosive Materials Underground.

(a) Explosive materials stored underground shall be so located that should they detonate or burn, the escape route for the employees will not be obstructed.

(b) Magazines shall be at least 200 feet from active underground workings, 50 feet from other magazines and at least 25 feet of solid ground separation from any haulageway used for any purpose other than the transportation of explosive materials. Any timbers within 25 feet of any magazine shall be made fire resistant.

(c) Explosive materials shall not be stored in an underground work area during tunneling and construction operations.

(d) In magazines where explosive materials may become damp, electricity may be installed for drying purposes. Electrical equipment used shall comply with Class II, Division I, Hazardous Locations, Electrical Safety Orders. Electrical wiring shall be kept at least 5 feet from explosive materials. No other electrical wiring shall be permitted within 5 feet of any magazine.

(e) Underground storage magazines shall be conspicuously marked with the words, "EXPLOSIVES," in *red* letters at least 4 inches high and with 5/8–inch stroke on a *white* background.

(f) Combustible rubbish shall not be permitted within 100 feet of any underground magazine.

(g) Detonator storage magazines shall be of the same construction as explosives storage magazines and shall be separated by at least 50 feet from other magazines.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (d) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 115. Transportation of Explosive Materials

### § 5262. General.

(a) This Article shall apply to motorized vehicles, the operations of which are not under the jurisdiction of the USDOT, the California Highway Patrol, or the California Vehicle Code, or the Health and Safety Code on Public Highways.

(b) Electric detonators or similar primary explosive materials initiation devices shall not be transported on/in any vehicle equipped with a radio transmitter or other device which may cause detonation unless kept in their original shipping containers.

(c) Transportation of detonators and explosive materials together shall be in accordance with the Institute of Makers of Explosives, Safety Library Publication No. 22, Recommendations for the Safe Transportation of Detonators in a Vehicle with Certain Other Explosive Materials, May 1993, pages 1–16, which is hereby incorporated by reference.

(d) Any vehicle transporting explosive materials or oxidizing materials shall be placarded in accordance with the regulations of the USDOT. Explosive materials being transported on–site during or incidental to the manufacturing process shall be marked when deemed appropriate by the manufacturer.

(e) Original shipping containers or Type 3 magazines (day box) shall be used for taking detonators and other explosive materials from storage magazines to the blasting area.

(f)(1) Vehicles used for transporting explosive materials shall be strong enough to carry the load without difficulty and be in good mechanical condition. If vehicles do not have a closed body, the body shall be covered with a flame–proof and moisture–proof tarpaulin or other effective protection against moisture and sparks.

(2) All vehicles used for the transportation of explosive materials shall have tight floors and any exposed spark–producing metal on the inside of the body shall be covered with wood or other nonsparking materials to prevent contact with packages of explosive materials.

EXCEPTION: Exposed spark–producing metal need not be covered in vehicles transporting only blasting agents or oxidizers.

(3) Packages of explosive materials shall not be loaded above the sides of an open body vehicle.

(4) Vehicles used for transporting explosive materials shall be inspected weekly, or prior to use when used less than weekly, to determine that it is in proper condition for safe transportation. Such inspections shall include, but not be limited to, the following:

(A) Fire extinguishers that comply with subsection (g) shall be filled and in working order.

(B) All electrical wiring shall be completely protected and securely fastened to prevent short–circuiting.

1. No auxiliary lighting systems on the truck beds shall be powered by the truck's electrical system.

(C) Chassis, motor, pan, and underside of body shall be reasonably clean and free of excess oil and grease.

(D) Fuel tank and feedline shall be secure and have no leaks.

(E) Brakes, lights, horn, windshield wipers, and steering apparatus shall function properly.

(F) Tires shall be checked for proper inflation and defects which may effect the safe operation of the vehicle.

(G) The vehicle shall be in proper condition in every other respect and acceptable for handling explosive materials.

(g) Each vehicle used for transportation of explosive materials shall be equipped with at least two fully charged 4–A:20–B:C fire extinguishers in good condition securely mounted separately in conspicuous locations or in clearly marked compartments and readily accessible. The driver shall be trained in the use of the extinguisher carried on the vehicle.

(h) Vehicles transporting explosive materials for blasting operations shall not carry any other materials except blasting equipment unless the

containers of explosive materials are protected from mechanical damage or other materials are secured in place.

(1) When open body vehicles are used to transport explosive materials, the explosive materials shall be carried in a Type 3 magazine or original manufacturer's container that has been securely retained or mounted on the bed of the vehicle to prevent movement.

(2) Special service trucks such as, but not limited to, used in such operations as well services, snow avalanche control, seismic work, and explosives research and development that carry employees and materials and on which equipment is installed for use in connection with the work to be done, may carry small amounts of explosive materials necessary for their activities. When explosive materials are carried, they shall be safeguarded as provided for in subsections (e), (f), and (g).

(i) Motor vehicles or conveyances transporting explosive materials shall be driven by, and be in the charge of, a licensed driver familiar with the local, State, and Federal regulations governing the transportation of explosive materials. The driver shall have been made aware of the class of the explosive materials in the vehicle and of its inherent dangers, and shall have been instructed in the measures and procedures to be followed in order to protect employees from those dangers. The driver shall have been made familiar with the vehicle that has been assigned, and shall be trained and authorized to move the vehicle.

(j) Only the vehicle operator and powder crew shall be permitted to ride on any vehicle transporting explosive materials.

(k) Vehicles carrying explosive materials shall not be taken to a repair garage or shop for any purpose.

(1) No service or repairs involving the use of heat/flame–producing devices shall be performed on vehicles carrying explosive materials.

(*l*) Vehicles containing explosive materials when stored shall comply with the Quantity Distance Table for the appropriate class of explosive materials.

(m) Drivers of vehicles containing explosive materials shall not be permitted to leave the cab without first stopping the motor and setting the parking brake. Precautions shall be taken to prevent the movement of such vehicles.

(n) Except under emergency conditions, no vehicle transporting explosive materials shall be parked unattended before reaching its destination. No vehicle transporting explosive materials shall be parked on any public street adjacent to or in proximity to any place where people work or congregate.

NOTE: For the purpose of this subsection, a motor vehicle shall be deemed "attended" only when the driver or other attendant is physically on or in the vehicle, or has the vehicle within their field of vision and can reach it quickly and without interference. "Attended" also means that the driver or attendant is awake, alert, and not engaged in other duties or activities which may divert their attention from the vehicle. However, an explosive–laden vehicle may be left unattended if parked within a securely fenced or walled area with all gates or entrances locked where parking of such vehicle is permitted or at a magazine site established solely for the purpose of storing explosives.

(o) Incompatible materials, such as flammable liquids, flames or spark producing materials or combustibles materials, shall not be carried in the vehicle's cargo space with explosive materials.

(p) No person shall be permitted to smoke, carry matches or any other flame–producing device, or carry any unauthorized firearms or loaded cartridges while in or near a motor vehicle transporting explosive materials, or drive, load or unload such vehicle in a careless or reckless manner.

(q) Delivery of explosive materials shall be made only to authorized persons and into authorized magazines or authorized temporary storage or handling areas.

(r) The transfer of explosive materials from storage places shall be so arranged that no undue delay will occur between the time the explosive materials leave the storage place and the time they are used.

(s) Explosive materials shall not be transferred from one vehicle to another within the confines of any jurisdiction (city, county, or other area) without informing the fire and police and/or sheriff's departments thereof. In the event of breakdown or collision, the appropriate local emergency services agencies shall be promptly notified. The explosive materials shall be transferred from the disabled vehicle to another only when qualified supervision is provided.

NOTE: Federal DOT and local regulations shall also apply when applicable.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Editorial correction reinserting article 115 heading (Register 92, No. 11).
2. Amendment of article heading and section, including redesignation and amendment of former section 5263, subsections (a) – (*l*) as new section 5262, subsections (d) – (p), and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5263. Surface Transportation.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3 Labor Code.

HISTORY

1. New subsection (k) filed 3–28–75; effective thirtieth day thereafter (Register 75, No. 13).
2. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
3. Amendment filed 3–7–80; effective thirtieth day thereafter (Register 80, No. 10).
4. Redesignation of former section 5263, subsections (a)–(*l*) as new section 5262, subsections (d)–(p) filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5264. Transportation of Explosive Materials—Underground—General.

(a) Explosive materials shall not be left on the station level near the shaft collar, mine, or tunnel entrance, but shall be taken to the place of use or storage without delay.

(b) Detonators, capped fuses, and other explosive materials transported in any car, vehicle, or shaft conveyance shall be enclosed in substantially constructed containers equipped with tight–fitting covers. Such containers, including the covers, shall be made of wood, metal, fiber, or other equivalent material and shall be lined with nonconductive material.

NOTE: Except for primers, the original cases or DOT shipping containers in which the explosive materials were packaged will be accepted as being in compliance with this subsection.

(c) Except as provided in Section 5264(c)(1), detonators, primers, or capped fuses, shall not be transported in the same container or compartment with other explosive materials.

(1) When carried in the same vehicle, detonators and capped fuses shall be in a separate compartment from the other explosive materials with at least 25 inches of air space between the compartments.

(d) Except when being transported manually, primers shall be transported in a closed container constructed as described in subsection (b) of this section, and arranged so that each primer is separated from the others by a partition of nonmetallic material. No explosive materials, other than that which is contained in the primer, shall be transported in the same container with the primers.

(e) Explosive materials shall not be transported with rock, ore, or other materials or equipment other than those used in blasting.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5265. Transportation of Explosive Materials—Underground—Hoisting or Lowering.

(a) No employees except those specifically required and designated by the person in charge of the mine or tunnel, shall be permitted to ride in any shaft conveyance at the same time as explosive materials are being transported in such shaft.

(b) The hoist engineer shall be notified before explosive materials are transported in the shaft conveyance.

(c) Explosive materials shall be in a suitable conveyance while being hoisted from or lowered to any place underground.

(d) Hoisting of ore, muck or other materials in adjacent shaft compartments shall be stopped while explosive materials are being handled.

(e) Detonators and primers shall not be transported at the same time with other explosive materials in any shaft conveyance unless in a powder car.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5266. Rail Transportation of Explosive Materials—Underground.

(a) Only the train crew and powder crew shall be permitted to ride on a train transporting explosive materials.

(b) Explosive materials in quantities of 110 pounds or more when transported on a train, shall be in special powder cars. Such cars shall be constructed of metal and have closed compartments for the explosive materials. The compartments shall be lined with nonconductive material.

(c) Explosive materials shall not be transported on or in any locomotive. When transporting explosive materials by train, at least one empty car shall be kept between the locomotive and the car which contains explosive materials.

(d) Each side of the special powder car shall bear a sign with the word "EXPLOSIVES" in letters not less than 4 inches high with a 5/8–inch stroke on a background of sharply contrasting color.

(e) Powder cars that are carrying explosive materials shall be pulled, not pushed, except when switching or traveling at the dead end of a line.

(f) The primers shall be placed in a primer compartment of the powder car in a suitable box with divisions for each separate delay. If capped fuses are used, they must be in a suitable container in the primer compartment. The primer and powder compartments shall be separated by at least 25 inches of air space.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5267. Transportation of Explosive Materials—Underground— Special Trackless Vehicles.

(a) Trackless vehicles used for the transportation of explosive materials shall be especially equipped for that purpose and shall be carefully maintained in compliance with the provisions of section 5262.

(b) Truck–type vehicles used for the transportation of explosive materials shall be especially equipped with closed compartments for the explosive materials. The compartments shall be lined with nonconductive materials.

(c) Each side, front, and rear of every truck–type vehicle, when transporting explosive materials, shall bear a sign with the word "EXPLOSIVES" in letters not less than 4 inches high with a 5/8–inch stroke on a background of sharply contrasting color.

(d) Truck–type vehicles when transporting explosive materials underground, shall be equipped with a flashing red light visible from the front and rear.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5268. Transportation of Explosive Materials—Manual.

(a) Explosive materials that are transported manually from one area to another shall be placed in suitable bags or other containers for such transportation.

(b) Detonators and primers shall be transported separately from other explosive materials.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5269. Transportation of Explosive Materials—Air and Water.

Aircraft and water transportation of explosive materials shall comply with standards of Federal Government or equivalent to such standards.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5270. Explosive Materials at Railway and Truck Terminals.

(a) Every railway car and truck containing explosive materials which has reached its destination, or is stopped in transit so as no longer to be in interstate commerce, shall remain placarded in accordance with the regulations of the U.S. Department of Transportation.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of section heading, section NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 116. Handling and Use of Explosive Materials in Blasting Operations

### § 5276. General.

(a) There shall be no smoking, open flames or other sources of ignition within 50 feet of any area where explosive materials are being handled, except devices necessary to ignite the fuses of set charges.

NOTE: Internal combustion engines equipped with spark arresters which are functioning as designed are not considered sources of ignition.

(b) Tools used for opening containers of explosive materials shall be constructed of non–sparking material, except that metal slitters may be used for opening fiberboard containers provided that the metal slitter does not come into contact with any metallic fasteners which may be in or part of the case. Only a wooden wedge and a fiber, rubber or wooden mallet shall be used for opening or closing wood containers of explosive materials.

(c) Empty boxes, paper and fiber packing materials which have previously contained high explosives shall not be used again for any other purpose. They shall be destroyed by burning at an isolated location out of doors, and no person shall be nearer than 100 feet after the burning has started.

EXCEPTION: Containers designed and maintained for reuse.

(d) Explosive materials shall not be placed within 25 feet of an electrical circuit except during transportation.

(e) Explosive materials left over after loading operations are completed, shall be promptly returned to their proper magazines.

(f) When blasting in a location where flying rock or material may damage other property or endanger employees, all loaded holes shall be covered with a blasting mat that has been anchored.

(g) No person under the age of 21 years shall be permitted in any explosive magazine or be permitted to use, handle, or transport explosives.

EXCEPTION: Persons 18 years or older and under the direct personal supervision of a licensed blaster.

(h) Spilled explosive materials shall be cleaned up promptly.

(i) Explosive materials shall not be subjected to excessive heat, friction or force.

(j) Explosive materials shall be used only at temperatures recommended by the manufacturer.

(k) Defective blasting equipment shall not be used.

(*l*) No fire shall be fought where the explosive materials are in imminent danger of contact with the fire. All employees shall be removed to a safe area and the fire area guarded against intruders.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (d), repealer of subsection (e), and new subsections (e) and (i) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of article heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5277. Tamping Poles or Devices.

(a) Tamping poles or devices shall be made of wood or plastic materials manufactured for tamping explosives.

NOTE: There are many kinds of "plastics," most of which cannot be used safely for tamping explosives. Some plastics are too soft to withstand physical abuse, some are too hard, others are flammable or will absorb nitroglycerin or generate hazardous accumulations of static electricity.

(b) The end of the tamping pole shall be kept squared and shall be of such size that the pole will not bypass the cartridges in the hole.

(c) Wooden tamping poles shall have no metal parts, other than non–ferrous metal ferrules, for extending the length of the pole.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5278. Loading of Explosive Materials—General.

(a) Loading shall not commence until all drilling is completed and drill holes are cleaned or blown out, unless this procedure is impracticable under conditions encountered. When conditions justify simultaneous loading and drilling in the same area, such operations shall be separated as widely as practicable and in no case shall a drilling operation be closer than 50 feet to a hole being loaded. All drill holes shall be sufficiently large to freely admit the insertion of the explosive materials.

(b) At least 5 foot candles illumination shall be provided to safely perform loading operations. Only approved lights shall be used within 50 feet of the loading area.

(c) No vehicle traffic shall be permitted over loaded holes.

(d) Loading operations shall be carried on with the smallest practical number of persons and explosive materials loading equipment present and no one but the loading crew, inspection personnel, and authorized supervisory personnel shall be allowed within 50 feet of the loading area.

(1) At locations where 50 foot minimum distance cannot be maintained, an alternative plan shall be submitted to the Division for approval 30 days prior to anticipated start of work. The Division shall give written notice of receipt to the applicant within 7 days. Notice of approval/disapproval, shall be given within 15 days of receipt of the application. The Division may shorten the 30–day notification requirement where construction has commenced and unexpected site and/or emergency conditions requiring blasting occur.

(2) The Division shall approve the alternative plan if the following elements are satisfied:

(A) All blasting operations will be conducted using low sensitivity explosive materials.

(B) All blasting operations will be conducted using initiation systems which cannot be affected by stray current or radio frequency energy.

(C) A lightning and electric storm–detection system and written plan of action is provided to the Division. The plan shall include provisions for a detection system capable of warning the loading crew when a storm is 100 miles away. When a storm is detected 50 miles from the loading operation, the storm's movement is to be monitored. When a storm is detected at 25 miles from the loading operation, loading operations will be discontinued and all persons in the blast area withdrawn to a safe location.

(D) K–rails, barriers, traffic control systems or natural terrain shall be used to prevent entry by vehicular traffic into the loading site.

(e) The amount of explosive materials delivered into a loading area shall not exceed the amount estimated by the licensed blaster as necessary for the blasting. No holes shall be loaded except those to be fired in the next round of blasting.

(f) Detonators shall not be less strength than No. 8.

(g) The detonator, if used, shall be properly encased in explosives when inserted into the drill hole.

(h) Tamping shall be by pressured or light blows only, and never by excessive ramming. The primer shall not be tamped.

(i) All blast holes in open work shall be stemmed to a point that will sufficiently confine the charge.

(j) Stacks of explosive materials shall be spaced and distributed in the loading area to prevent propagation of an explosion between any two piles or loaded holes in the event of a premature explosion in any portion of the blast area.

(k) Springing holes:

(1) Boreholes shall not be sprung within 100 feet of any hole containing explosive materials for primary blasting.

(2) A hole that has been sprung shall not be loaded until sufficient time has elapsed for the hole to cool. Artificial means may be used to cool the hole.

(l) Except for avalanche blasting, drop fuses or any other method that calls for ignition of the fuse prior to placement of the charge in its final position shall not be used.

(m) Drill holes or any part of such holes which have been charged with explosive materials shall not be deepened.

(n) Drilling shall not be started until all remaining butts of old holes are examined for unexploded charges and if any are found, they shall be detonated or properly disposed of before other work proceeds. (See Section 5293).

(o) Except as provided in Section 5278(w), holes to be blasted shall be charged as near to blasting time as practical and such holes shall be blasted as soon as possible after charging has been completed.

(1) No explosive materials shall be left unattended at the blast site.

(2) Loaded holes shall not be left unattended except as permitted in Section 5278(w).

(p) Explosive materials shall be kept separated from detonators until charging is started.

(q) Capped primers shall be made up at the time of charging and as close to the blasting site as conditions allow.

(r) Only wooden or other nonsparking implements shall be used to punch holes in an explosive cartridge.

(s) Areas in which charged holes are awaiting firing shall be guarded or barricaded and posted or flagged against unauthorized entry.

(t) The double–trunkline or loop system shall be used in detonating–cord blasting.

(u) Trunklines, in multiple–row blasts, shall make 1 or more complete loops, with crossties between loops at intervals of not over 200 feet.

(v) All detonating cord knots shall be tight and all connections shall be kept at right angles to the trunklines.

(w) Loaded holes intended for geophysical operations:

(1) Shall be attended; or

(2) May be left attended, but only where the loaded explosives, if detonated, it will not cause injuries and where the loaded explosives are:

(A) Anchored, tamped or stemmed so that the charge cannot be removed; or

(B) Left so that the detonator leads are inaccessible to or concealed from unauthorized persons.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsections (a) and (c) filed 3–28–75; effective thirtieth day thereafter (Register 75, No. 13). 2. Amendment of subsection (d) and new subsection (l) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of section heading and section filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
3. Amendment filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5279. Loading and Blasting Near or Under Power Lines.

(a) When electric initiated blasting under, or near overhead power lines, the leading wires shall be placed at right angles to such lines and shall be securely anchored to prevent the blasting circuit conductors from being thrown into the overhead lines.

(b) When blasting under, or near overhead power lines, all loaded holes shall be covered with a nonconductive blasting mat anchored to prevent the mat or other material from being blown into the overhead lines.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5280. Pneumatic Loading of Explosive Materials for Blasting.

(a) Construction of Air Loaders.

(1) Blasting agents shall not be loaded into any air loader constructed of copper, copper alloys, or zinc (including galvanized metals) unless the loader is constructed so that such incompatible materials do not come in contact with blasting agents.

(2) An explosive shall not be loaded into any air loader constructed wholly or in part of ferrous metals except that stainless steel may be used.

(3) The vessel that is pressurized on an air loader shall be designed, constructed, inspected, and stamped in compliance with the Unfired Pressure Vessel Safety Orders.

(b) Air Loader Equipment.

(1) A 20–mesh screen, an air trap or a filter shall be installed in the air supply line adjacent to the loader when a pressure vessel is being used.

(2) An air pressure reducing regulator of standard manufacture shall be installed in the air supply line and be a part of the loader assembly for a pressure–type loader.

(3) An air pressure relieving safety valve of adequate capacity shall be installed in the air supply line between the air pressure reducing regulator and the pressure vessel of the air loader. There shall be no valve between the pressure vessel and the pressure relieving device.

(4) An adequate pressure gauge shall be installed in the air supply line between the air pressure reducing regulator and the air loader pressure vessel.

(c) Air Temperature and Pressure.

(1) The temperature of the air supplied to the air loader shall not exceed 150 degrees Fahrenheit.

(2) The air pressure shall not exceed 50 pounds per square inch when explosive materials are being loaded.

(3) The air pressure relieving safety valve shall be set to open at a pressure not to exceed 55 pounds per square inch, when an explosive is being loaded.

(4) When a blasting agent is being loaded, the safety valve shall be set at not more than 110% of the safe loading pressure, but in no case to exceed 110 psi.

(d) Control of Static Electricity and Stray Currents.

(1) There shall be continuous electrical path from the discharge end of the loading tube, through the loading tube, the loading line, the air loader, and to ground. The loading tube shall be static dissipating and shall be at least 2 feet longer than the deepest hole loaded.

(2) Where metal air loaders are on non–conductive rock or earth, an auxiliary ground shall be provided by metal straps or cables of at least #8 American Wire Gauge connected to ground rods. If it is necessary, the ground rods shall be driven into water–filled holes. The total resistance from the discharge end of the loading tube to ground shall not exceed two megohms.

(3) Pneumatic loading equipment shall not be grounded to water lines, airlines, rails, or other permanent electrical grounding systems.

(4) The loading tube and loading hose, if one piece, shall be either of a distinctive design or else identified at least every 18 inches that it is static dissipating.

(e) Operations and Procedures.

(1) The air supply line shall be thoroughly blown out before it is attached to the air loader.

(2) All material poured into a pressure type air loader shall be passed through a screen having openings not larger than half an inch.

(3) Air loaders when used to blow or force stemming into loaded holes shall be thoroughly cleaned before and after such use.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5291. Firing of Explosive Materials (Blasting Operations).

(a) The licensed blaster–in–charge shall fix the time of blasting.

(b) Blasts are not to be fired without a warning signal/procedure and until definite assurance that all surplus explosive materials are in a safe place, and all persons are at a safe distance or under sufficient cover.

(c) Precautions, such as the following, shall be taken to prevent unauthorized entry into the blast area: warning signs, barricades, or flaggers when necessary.

(d) Warning signals shall be given by the use of a compressed air whistle, a horn, lights or equivalent means, such as flaggers or voice warning and shall be clearly audible at the most distant point in the blast area. Where other than flagger or other visible method or voice warning is used, the following signals are recommended:

| | |
|---|---|
| WARNING SIGNAL | |
| 5 minutes prior to the blast | A 1–minute series of long audible signals |
| BLASTING SIGNAL | |
| 1 minute prior to the blast | A series of short audible signals |
| ALL–CLEAR SIGNAL | |
| Following inspection of the blast area | A prolonged audible signal |

(e) The type of warning signal or method shall be posted at one or more conspicuous locations and all employees shall be made familiar with the signals and instructed accordingly.

(f) The "ALL CLEAR" signal shall not be given until the licensed blaster has made a thorough, visual inspection of the blast area for misfires. In the event of a misfire, the requirements of Section 5293 shall be complied with before the "ALL CLEAR" signal is given.

(g) Warning signs, indicating a blast area, shall be maintained at all approaches to the blast area. The warning sign lettering shall not be less than 4 inches in height on a contrasting background.

(h) Whenever blasting is being conducted in the area immediately adjacent to gas pipelines, flammable liquid gas pipelines, electric, water, fire alarm, telephone, telegraph, and steam utilities, the licensed blaster shall notify the appropriate representatives of such pipelines or utilities at least 24 hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notice shall be confirmed with written notice before the blast. In an emergency this time limit may be waived.

(i) Employees shall be prohibited from entering the blast area after blasting until any toxic vapor/fumes, dust and gases have been reduced to safe limits.

(j) After blasting, the blasting crew shall wait at least 5 minutes before returning to the point of blasting.

(k) For underground blasting, no one shall enter the place where primary blasting has been done for at least 15 minutes.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (a) and new subsection (e) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of section heading, section and NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5292. Secondary Blasting.

(a) There shall be no activity of any kind that would create a hazard to explosive materials that have been placed or are being placed for secondary blasting.

(b) Where shots are to be fired in such close proximity that one shot may displace another, the firing shall be done by use of detonating cord or instantaneous electric blasting caps.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5293. Misfires.

(a) After each shot the blast area shall be examined for misfires. If any are found, or suspected to exist, they shall be reported to the person in charge. Steps shall be taken to eliminate all undetonated explosive materials.

(b) In case of a detonator misfire, the shot area shall be made safe under competent supervision by one of the following means after a 30–minute wait following electric or non–electric shock tube blasting, or a 60–minute wait following fuse cap blasting:

(1) Where practical a new primer shall be inserted into the hole and the hole reblasted, or

(2) Where the hole cannot be reblasted, the stemming and explosive shall be washed out with water, or

(3) Where blasting agents are used, try to remove the detonator and cap sensitive explosive materials.

(4)(A) Where reblasting, washing, or removing explosive materials is unsafe or impracticable in a geophysical operation, the Division and surface owners shall be notified within 24 hours. The notice shall include the location, depth and the amount of the undetonated explosive material; and

(B) Following concurrence by the Division that retrieval of the explosive material in a misfired geophysical operation is impractical or unsafe, a substantial concrete cap capable of containing the explosion shall be placed above the explosive material at least 3 feet below the ground surface, or other permanent protection shall be installed.

(c) If explosive materials are suspected of burning in a hole, all persons in the endangered area shall move to a safe location and no one shall return to the hole until the danger has passed, but in no case within 1 hour.

(d) Holes shall not be drilled where there is danger of intersecting a charged hole of misfired explosives.

(e) No other work shall be performed in the danger area except that necessary to remove the hazard of the misfire. No other employees except the licensed blaster and the necessary crew shall be in the danger area when a misfire hazard is being removed.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New subsection (e) filed 3–28–75; effective thirtieth day thereafter (Register 75, No. 13).
2. Amendment of section and new NOTE filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
3. Amendment of subsection (b), new subsection (c) and subsection relettering filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5294. Coyote Hole Blasting.

(a) Electric lighting circuits shall not be permitted in a coyote hole while it is being loaded with explosives. Electric flashlights or cap lamps shall be used for illumination.

(b) In electrical blasting, the ends of leading wires shall be kept shorted until ready to blast. Circuits should be tested at least every 10 feet if stemming is placed in the cross–cuts, or before each explosives charge is placed.

(c) When detonating cord is used, a double line of cord with frequent cross ties shall be used throughout so that the detonating wave can reach each explosive charge from 2 independent sources.

(d) Coyote holes shall be backfilled tightly and for a sufficient length to prevent a blown–out shot.

(e) The area being loaded for blasting shall be plainly marked both in front and on top of the bank to be blasted with appropriate warning signs.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5295. Use of Safety Fuse—General.

(a) No fuse except safety fuse shall be used for fuse cap blasting.

(b) The average burning rate per foot of safety fuse used shall be determined by burning not less than three, 3–foot lengths of such fuse in open air at or near the blast area. Safety fuse which varies more than 10 percent from the manufacturer's stated burning range shall not be used.

(c) Notice shall be displayed conspicuously at the work location, stating the burning rate of safety fuse used.

(d) Damaged safety fuse shall not be used.

(e) If the roll of safety fuse has not been fully used and is stored for future use after blasting has been completed, the average burning rate shall be re–determined prior to use as required by subsection (b).

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5296. Safety Fuse Storage.

(a) In cold weather the safety fuse shall be warmed slightly before being uncoiled in order to avoid breaking or cracking.

(b) Safety fuse and igniter cord shall be stored in a place which is dry, cool, oil/grease free, and the relative humidity of the air is less than 80 percent.

(c) Safety fuse shall not be hung on nails or other projections that could cause a sharp bend to be formed in the fuse.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5297. Making Capped Fuses and Primers.

(a) In capping safety fuse, at least one inch shall be cut from the end of each coil of the fuse to be used to prevent damp fuse ends from getting into the cap.

(b) Blasting caps shall be kept in original or equivalent containers except as they are used for capping safety fuses.

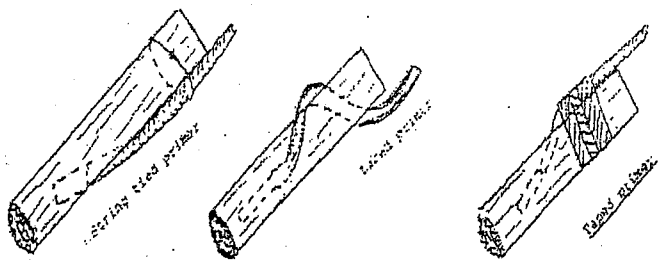
(c) Only a ring–type cap crimper of standard design shall be used for attaching blasting caps to safety fuse.

(d) In capping fuse, the fuse ends shall be cut squarely with a sharp cutting blade. The capping operation shall be performed in a safe, dry location. The area shall be conspicuously posted with no smoking signs.

(e) A waterproof ring–type crimp or a compound especially prepared for waterproofing shall be used when necessary.

(f) A capped fuse shall not be attached to the primer cartridge by half–hitch.

(g) The safety fuse shall not be kinked when using the lacing method. The safety fuse shall lie in smooth curves as shown on the illustration. The cap shall be properly embedded along the axis of the cartridge.



Recommended Methods of Attaching Capped Fuse to Primer Cartridge

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5298. Non–Electric Blasting Systems.

(a) Safety Fuse Initiation System.

(1) Safety fuses shall not be ignited before explosive charges are in place.

EXCEPTION: Avalanche blasting.

(2) When blasting with safety fuse, consideration shall be given to the following: (A) the length and burning rate of the fuse; (B) the condition of the escape route; and, (C) the distance to a place of safety.

(3) Safety fuses shall not be used in any location, such as a shaft, raise or winz, where the lack of adequate nearby shelter and the distance of travel to a place of safety is such that there is a hazard to employees from flying rock and concussion.

(4) All safety fuses shall be cut sufficiently long to extend beyond the collar of the hole and in no case shall they be less than 3 feet in length.

NOTE: At the usual rate of burning, a 3–foot length of safety fuse will fire a shot in about 2 minutes.

(5) Only single shots shall be fired when using 3–foot safety fuses. If more than one fuse is to be lighted at one time, such fuses shall comply with subsection (6) of this section.

(6) When lighting safety fuse, the fuses shall be so timed that no charge will detonate until at least 2 minutes after the last fuse in the blast area has been ignited.

(7) No one employee shall be permitted to ignite more than 12 safety fuses in succession. When 2 or more safety fuses in a group are lighted as one, by means of igniter cord or other fuse–lighting device, they may be considered as one fuse for the purpose of the subsection.

(8) If more than 3 safety fuses are lighted at one time, no person shall be permitted to enter the blast area until after a period of time equal to 2 minutes for each foot in the length of the longest fuse in the round or 15 minutes, whichever is the longest time.

(9) At least two employees shall be present when lighting fuses.

EXCEPTION: Avalanche blasting.

(10) Fuses shall be lit with devices approved for such purposes.

(b) Shock Tube Initiation System.

(1) Connections with other initiation devices shall be secured in a manner which provides for uninterrupted propagation;

(2) Factory–made units shall be used as assembled and shall not be cut except that a single splice is permitted on the lead–in trunkline during dry conditions; and

(3) Connections between blast holes shall not be made until immediately prior to clearing the blast site when surface delay detonators are used.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
2. Repealer and new section heading and amendment of section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5298.1. Use of Detonating Cord.

(a) Detonating cord shall be selected consistent with the type and physical condition of the bore hole and stemming and the type of explosives used.

(b) Detonating cord shall be handled and used as an explosive.

(c) The line of detonating cord extending out of a bore hole or from a charge shall be cut from the supply spool before loading the remainder of the bore hole or placing additional charges.

(d) Detonating cord shall be handled and used with care to avoid damaging or severing the cord during and after loading, stemming and hooking up.

(e) Detonating cord connections shall be made in accordance with the manufacturer's recommendations. Knot–type or other cord–to–cord connections shall be made only with detonating cord in which the explosive core is dry.

(f) All detonating cord trunklines and branchlines shall be free of loops, sharp kinks, or angles that direct the cord back toward the oncoming line of detonation.

(g) All detonating cord connections shall be inspected before firing the blast.

(h) When detonating cord millisecond–delay connectors or short–interval–delay electric blasting caps are used with detonating cord, the practice shall conform strictly to the manufacturer's recommendations.

(i) When connecting a blasting cap or an electric blasting cap to detonating cord, the cap shall be taped or otherwise attached securely along the side or the end of the detonating cord, with the end of the cap containing the explosive charge pointed in the direction in which the detonation is to proceed.

(j) Detonators for firing the trunkline shall not be brought to the loading area nor attached to the detonating cord until everything else is in readiness for the blast.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5299. Firing with Electricity—General.

(a) Before adopting any system of electrical firing, the licensed blaster shall conduct a thorough survey for extraneous currents, and all dangerous currents shall be eliminated before any holes are loaded. No electric blasting or preparation for electric blasting shall be done when stray electrical currents exceed 0.05 amperes.

EXCEPTION: Specialty electric blasting caps used as recommended by the manufacturer.

(b) Electric firing shall be done only with devices designed for initiating electric detonators.

(c) Electric detonators to be fired with blasting machines shall be connected in accordance with the number and circuitry limitations recommended by the machine or detonator manufacturer.

(d) Devices used for igniting electric detonators shall not cause arcing in the detonators. A circuit interrupter shall be used when arcing is a problem.

(e) All blasting wires shall be kept clear of electric lines, pipes, rails, and other conductive materials.

(f) That part of the blasting circuit leading from the firing switch to the blast area shall not be grounded.

(g) All low–voltage electric power lines within 50 feet of the holes to be loaded shall be removed or de–energized before an electric detonator or starter is brought into the blast area. Where this is not practical, a check for stray current shall be made with a proper instrument.

(h) The blasting circuit shall be tested with a blasting galvanometer or other device designed to test blasting circuits before firing the round.

(i) The blasting circuit shall remain shorted until the round is ready to test and fire.

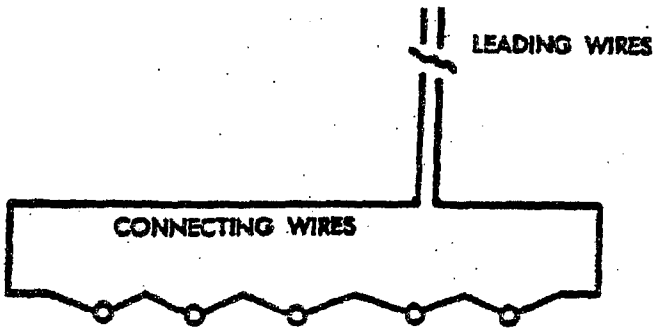
(j) Electric detonators of different brands shall not be used in the same round.

(k) Where light and power circuits are used for blasting, keys to the shot–firing and safety switches shall be kept by the licensed blaster. When necessary to make repairs, extensions, or tests on the blasting or shot–firing lines, the licensed blaster or blaster in training shall unlock and remain at the switch until he or she relocks the switches or designates that responsibility to someone who reports back to the licensed blaster with the keys when work is completed. No preparations for loading or blasting shall be done until all switches are relocked and the keys back in the possession of the licensed blaster. At the end of the shift, the licensed blaster shall give the keys to the licensed blaster of the following shift. A duplicate set of keys should be kept by the superintendent under lock and key in the office. There shall be no other set of keys fitting these locks on the job site.

(*l*) Mobile radio transmitters shall be de-energized and effectively locked when less than 100 feet from electrical blasting caps that are not in their original container.

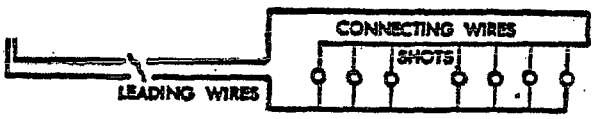
EXAMPLES OF BLASTING CIRCUITS

Electric Detonators




ELECTRIC DETONATORS

Diagram for Series Blasting




ELECTRIC DETONATORS

Diagram for Parallel Blasting

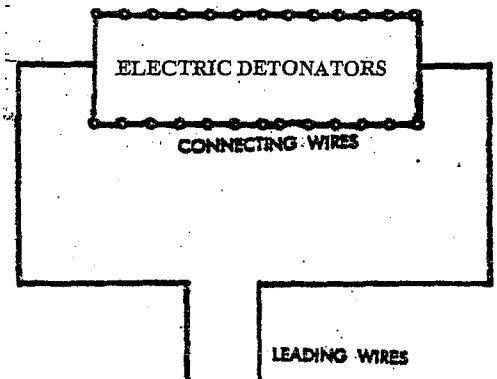



Diagram for Parrallel—Series Blasting

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (c) filed 3–28–75; effective thirtieth day thereafter (Register 75, No. 13).
2. Amendment of subsection (a) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
3. Repealer of subsection (a) and relettering of existing subsections filed 3–7–80; effective thirtieth day thereafter (Register 80, No. 10).
4. Amendment filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5300. Firing Switches.

(a) The firing switch shall conform to the following minimum standards:

(1) It shall be an externally operable switch, enclosed in a tight case provided with a lock.

(2) It shall be a double pole, double throw switch with the handle arranged to be locked in the "off" position only.

(3) It shall be provided with a bar for short–circuiting, but not grounding the leading wires when the switch is in the "off" position.

(4) Switches shall have adequate rating for the maximum voltage and current to be used.

(5) The service entrance switch fuse or circuit breaker rating shall be fused not exceeding 33 percent of the maximum calculated current requirement and will blow at 15 times the rated capacity in 1/20 of a second.

(6) The switch shall be mounted so that the handle is down when the switch is in the "off" position. The leading wires shall be attached to the blade terminals and the power line wires to the up–throw terminals.

(b) When firing by means of a light or power circuit, the circuit shall be open at all times in at least one place by an air gap of at least 5 feet underground and 15 feet on the surface, between the firing and the auxiliary switches at all times, except during the actual firing operation. The air gap shall be established by means of a cable and 2–pole plug and receptacle of adequate capacity. The plug shall be provided with a device, preferably of automatic type, to short–circuit the wires when the plug is removed from the receptacle.

(c) The shot firing switch shall be no less than 1,000 feet from the face of a tunnel if the tunnel length exceeds 1,000 feet.

(d) For tunnels less than 1,000 feet in length, the shot switch shall be outside the portal.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New subsections (c)–(d) and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5301. Auxiliary Switches.

(a) One or more auxiliary switches shall be installed at the beginning of each branch circuit of the permanent leading wires.

(b) Such switches shall be as described in Section 5300 except that they need not be fused.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

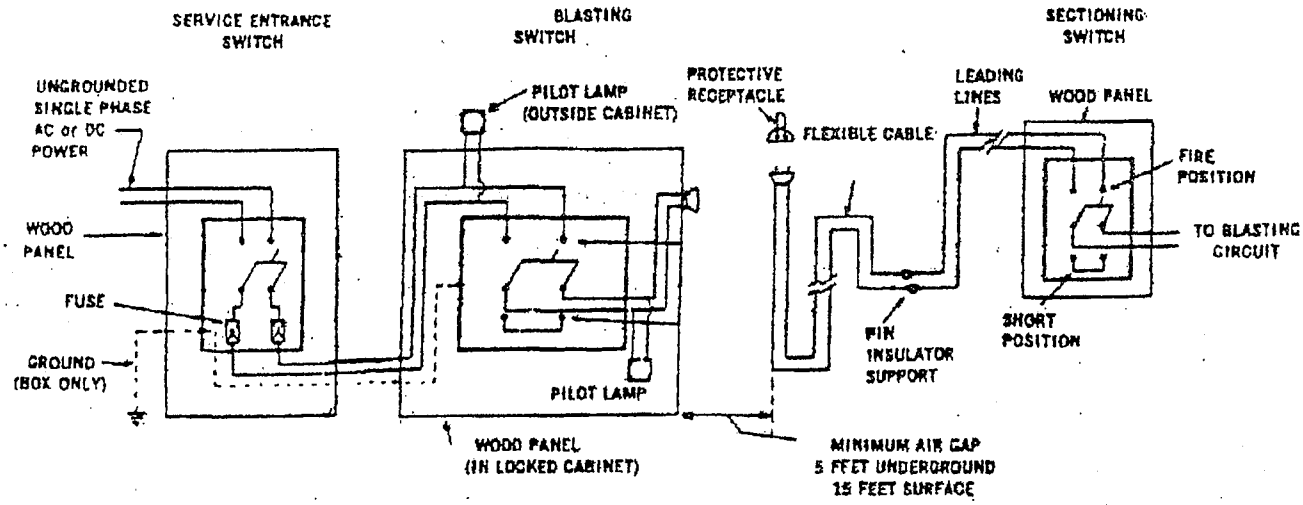
## § 5302. Permanent and Temporary Leading Wires.

(a) All leading wires shall be type "S" cable or equivalent, or shall consist of 2 suitable insulated solid aluminum or solid copper wires.

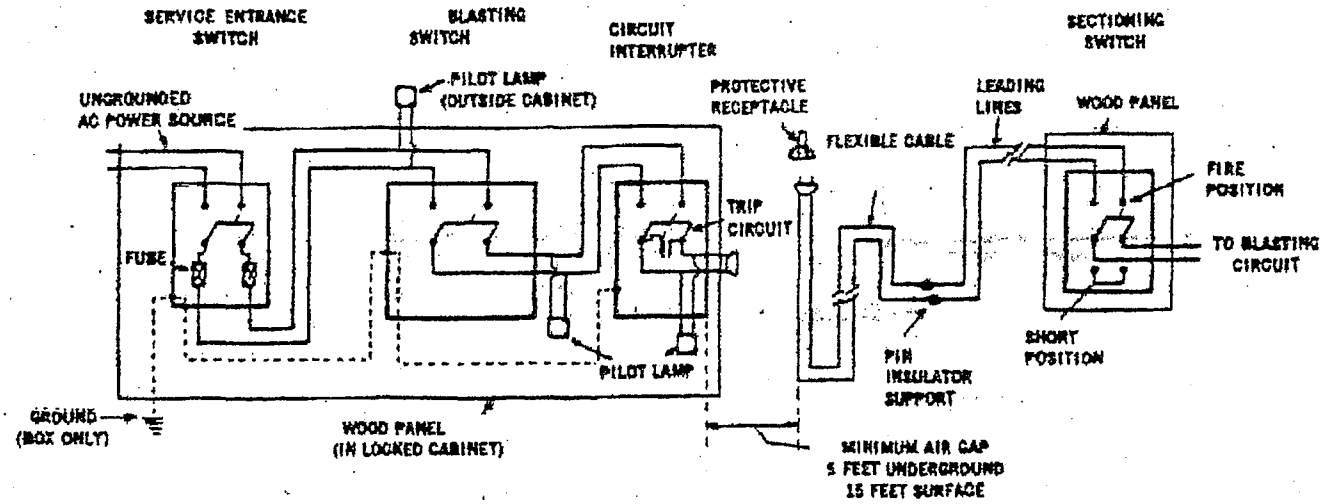
(b) Permanent leading wires shall be installed in conduit or shall be strung on insulators and kept at least 5 inches apart.

(c) The conductor used to close the air gap shall be type "S" cable or equivalent.

(d) All leading wires shall have the capacity to carry the required firing current to the detonators. In no case shall a capacity of less than copper wire No. 14 American Wire Gauge or aluminum wire No. 12 American Wire Gauge be used, except No. 18 American Wire Gauge may be used for one electric blasting cap.




Recommended power firing systems for series and parallel series firing with no circuit interrupter.




Recommended power firing systems for series and parallel series firing using a circuit interrupter.

(e) All splices shall be well made and shall be so joined as to be electrical and mechanically secure. Splices shall be taped or otherwise effectively insulated.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (d) and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5304. Blasting Procedure with Power and Light Circuits.

(a) Before connecting the leading wires to the leg wires, the licensed blaster shall make sure that the auxiliary switch or switches are locked in the "off" position, the air gap is open, the short–circuiting device is in place, and the firing switch is locked in the "off" position.

(b) If an electric circuit from a light or power source is used for firing shots, the electrical connections shall be made within an approved weatherproof enclosure.

(c) Leading or connecting wires shall be tested for the presence of stray electric current before they are attached to the leg wires. The test shall be made with an instrument designed and approved for this purpose. If stray current is detected it shall be eliminated before the connection is made.

(d) Before the leg wires are connected to the temporary leading wires, the blaster shall cause all persons to leave the blast area and proceed to a safe location.

(e) When the blast area is clear of all persons, the person responsible for firing shall proceed to the auxiliary switch, unlock it, and move the switch handle to the "on" position.

(f) After blasting, no one shall approach the blasted area until:

(1) The blasting switch has been locked in the "off" or "open" position, and,

(2) The blasting switch attachment plug has been disconnected from the electrical source, and,

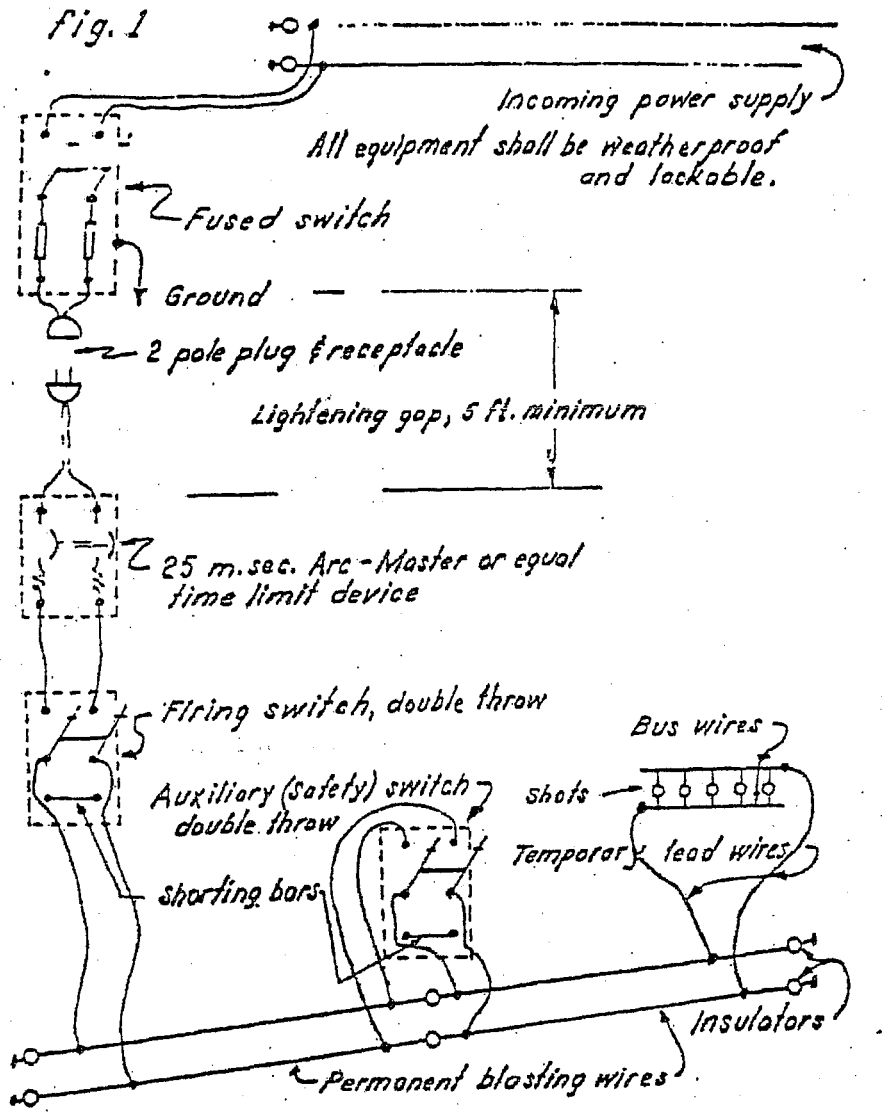
(3) The blasting wires have been shorted together.

(g) In case the shot fails to fire (misfire) or the licensed blaster is not sure that the charges have fired, the licensed blaster shall lock the firing switch in the "off" position and open the air gap. The licensed blaster shall wait at least 30 minutes before proceeding to the auxiliary switch which shall be locked in the "off" position before entering the blast area.

(h) Only the crew actually necessary for the loading and connecting-up operation shall be at the face during operations.

(i) No unnecessary work shall be done at the face during or after loading before the shots are fired.

BLASTING CIRCUIT DIAGRAM




NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section, including transfer of Plate C-27 from section 1938, Appendix C, and new NOTE, filed 7-11-2003; operative 8-10-2003 (Register 2003, No. 28).

## § 5305. Electric Blasting Devices and Electric Blasting Machines.

(a) All blasting devices and blasting machines shall be in the charge of the licensed blaster-in-charge and no other person shall connect the leading wires to the blasting machine or other blasting devices.

(b) Leading wires shall not be connected to blasting devices or blasting machine until all steps preparatory to firing have been completed and all persons proceed from the blast area to a safe location.

(c) After firing the round, the licensed blaster-in-charge shall immediately disconnect all wires from blasting devices or blasting machines and short-circuit the leading wires.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7-11-2003; operative 8-10-2003 (Register 2003, No. 28).

## § 5306. Electric Blasting in Proximity with Radio Transmitters.

(a) A sign shall be posted reading, "BLASTING AREA TURN OFF 2-WAY RADIOS AND CELLULAR TELEPHONES," "BLASTING ZONE 1000 FT" and "END BLASTING ZONE." Lettering of the sign shall be at least 4 inches in height and 5/8-inch stroke on a sharply contrasting color background. The sign shall be displayed prior to installa-

tion of electric–sensitive devices, during loading and during blasting operations.

NOTE: Where applicable, see State of California, Department of Transportation, Traffic Manual, Chapter 5, Traffic Controls for Construction and Maintenance Work Zones for specific sign requirements.

(b) Signs shall be posted approximately 1,000 feet from the blasting area on all public access.

(c) Electric blasting operations shall not be conducted closer to any operating mobile or fixed radio, television, or radar transmitter than the distances shown in the following tables:

Table 1
Recommended Table of Distances for
Commercial AM Broadcast Transmitters
(0.535 to 1.605 $MH_z$)

| *Transmitter Power*[1] *(Watts)* | *Minimum Distance (Feet)* |
|---|---|
| Up to 4,000 | 720 |
| 5,000 | 800 |
| 10,000 | 1,130 |
| 25,000 | 1,790 |
| 50,000 [2] | 2,500 |
| 100,000 | 3,600 |
| 500,000 | 8,000 |

[1] Power delivered to the antenna.

[2] 50,000 watts is the present maximum power of U.S. broadcast transmitters in this frequency range.

Table 2
Recommended Distances for Transmitters Up to 50 MHz
(Excluding AM Broadcast) Calculated for a Specific Loop Pickup Configuration[1][2]

| *Transmitter Power*[3] *(Watts)* | *Minimum Distance (Feet)* |
|---|---|
| 100 | 790 |
| 200 | 1,120 |
| 500 | 1,770 |
| 1,000 | 2,500 |
| 1,500 | 3,070 |
| 5,000 | 5,590 |
| 50,000 | 17,700 |
| 500,000[4] | 55,900 |

[1] Based on the configuration with the blasting machine being the component of the blasting circuit closed to the transmitter, using 20.8 MHz, which is the most sensitive frequency.

[2] This table should be applied to International Broadcast Transmitters in the 10–25 MHz range.

[3] Power delivered to the antenna.

[4] Present maximum for International Broadcast.

Table 3
Recommended Distances of Mobile Transmitters and Cellular Telephones Including Amateur and Citizens' Band

| | MINIMUM DISTANCE (Feet) | | | | | |
|---|---|---|---|---|---|---|
| *Transmitter*[1] *Power (Watts)* | *MF 1.7 to 3.4 MHz Industrial* | *HF 28 to 29.7 MHz Amateur* | *VHF 35 to 36 MHz Public Use 42 to 44 MHz Public Use 50 to 54 MHz Amateur* | *VHF 144 to 148 MHz Amateur 150.8 to 161.6 MHz Public Use* | *UHF 450 to 470 MHz Public Use Cellular Telephones Above 800 MHz* |
| 1 | 15 | 47 | 37 | 12 | 8 |
| 5 | 33 | 105 | 82 | 27 | 18 |
| 10 | 46 | 148 | 116 | 38 | 25 |
| 50 | 102 | 331 | 259 | 85 | 55 |
| 100 | 144 | 468 | 366 | 120 | 78 |
| 180[2] | 193 | 627 | 491 | 161 | 104 |
| 200 | 204 | 661 | 518 | 170 | 110 |
| 250 | 228 | 739 | 579 | 190 | 123 |
| 500[3] | 322 | 1,045 | 818 | 268 | 174 |
| 600[4] | 353 | 1,145 | 897 | 294 | 190 |
| 1,000 | 455 | 1,478 | 1,157 | 379 | 245 |
| 1,500[5] | 557 | 1,810 | 1,417 | 464 | 300 |
| 10,000[6] | 1,438 | 4,673 | 3,659 | 1,198 | 775 |

Citizens Band, Class D Transmitters, 26,965 $MH_z$
(Channel 1)–27,405 $MH_z$ (Channel 40)

| *Type* | *Recommended Minimum Distance* | |
|---|---|---|
| | *Hand–Held* | *Vehicle–Mounted* |
| Double Sideband – 4 watts maximum transmitter power | 5 ft. | 65 ft. |
| Single Sideband – 12 watts peak envelope power | 20 ft. | 110 ft. |

(1) Power delivered to antenna.

(2) Maximum power for two–way mobile units in VHF (150.8 or 161.6 $MH_z$ range) and for two–way mobile and fixed station units in UHF (450 to 460 $MH_z$ range).

(3) Maximum power for major VHF two–way mobile and fixed station units in 35 to 44 $MH_z$ range.

(4) Maximum power for two–way fixed station units in VHF (150.8 to 161.5 $MH_z$ range).

(5) Maximum power for amateur radio mobile units.

(6) Maximum power for some base stations in 42 to 44 $MH_z$ band and 1.6 to 1.8 $MH_z$ band.

Table 4
Recommended Table of Distances for VHF TV and FM Broadcasting Transmitters

| *Effective Radiated Power (Watts)* | *Minimum Distance (Feet)* *Channels 2 to 6* | *FM Radio* | *Channels 7 to 13* |
|---|---|---|---|
| Up to 1,000 | 820 | 667 | 502 |
| 10,000 | 1,450 | 1,190 | 892 |
| 100,000[1] | 2,580 | 2,115 | 1,585 |
| 316,000[2] | 3,450 | 2,820 | 2,130 |
| 1,000,000 | 4,600 | 3,770 | 2,820 |
| 10,000,000 | 8,190 | 6,690 | 5,020 |

[1] Present maximum effective radiated power channels 2 to 6 and FM—100,000 watts.

[2] Present maximum effective radiated power channels 7 to 13—316,000 watts.

Table 5
Recommended Table of Distances from UHF TV Transmitters

| *Effective Radiative Power (Watts)* | *Minimum Distance (Feet)* |
|---|---|
| Up to 10,000 | 600 |
| 1,000,000 | 2,000 |
| 5,000,000[1] | 3,000 |
| 100,000,000 | 6,000 |

[1] Present maximum power channels 14 to 69—5,000,000 watts.

NOTE: RECOMMENDED TABLES OF DISTANCES

These tables of distances are designed for the convenience of the licensed blaster. The selected groupings include all the obvious types of RF transmitters that will be encountered around blasting sites.

These tables were derived from analytical worse case calculations. They are based on an assumed 40–milliwatt no–fire level of commercial blasting caps. Actual field tests have shown that these tables are conservative as would be expected. Because of the uncertainties involved in field tests as to the efficiency of RF energy pickup and its delivery to the blasting cap, we strongly recommend that these tables be followed. If these tables present distances which are operationally inconvenient to use, we suggest field tests be made by expert consultants and the procedures detailed for providing minimum RF pickup be adhered to.

The data upon which these tables are based were derived by the Franklin Institute Research Laboratories for the Institute of Makers of Explosives.

(d) The specified distances in the tables may be reduced provided special precautions, acceptable to the Division are taken.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (a) filed 7–8–81; effective thirtieth day thereafter (Register 81, No. 28).
2. Amendment of section and NOTE, including transfer of section 1938, App. B, Plate B–15 to section 5306, tables 1–5, filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5307. Blasting in Excavation Work Under Compressed Air.

(a) Detonators and explosives shall not be stored or kept in caissons. Detonators and explosives for each round shall be taken directly from the magazines to the blasting zone and immediately loaded. Detonators and explosives left over after loading a round shall be removed from the working chamber before the connecting wires are connected up.

(b) When detonators or explosives are brought into an air lock, no employee except the licensed blaster, lock tender and the employees necessary for carrying, shall be permitted to enter the air lock. No other material, supplies, or equipment shall be locked through with the explosives.

(c) Detonators and explosives shall be taken separately into pressure working chambers.

(d) The licensed blaster shall be responsible for the receipt, unloading, storage, and on–site transportation of explosives and detonators.

(e) The explosives suitable for use in wet holes shall be water–resistant and shall be Fume Class I.

(f) All metal pipes, rails, air locks and steel tunnel lining shall be electrically bonded together and grounded at or near the portal or shaft, and such pipes and rails shall be cross–bonded together at not less than 1,000–foot intervals throughout the length of the tunnel. In addition, each low–air supply pipe shall be grounded at its delivery end.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5308. Underwater Blasting.

(a) Loading tubes and casings of dissimilar metals shall not be used because of possible electric transient currents from galvanic action of the metals and water.

(b) Only water–resistant blasting caps and detonating cords shall be used for all marine blasting. Loading shall be done through a non–sparking metal loading tube when tube is necessary.

(c) No blast shall be fired while any vessel under way is closer than 1,500 feet to the blasting area. Those on board vessels or craft moored or anchored within 1,500 feet shall be notified before a blast is fired.

(d) No blast shall be fired while any swimming or diving operations are in progress in the vicinity of the blasting area. If such operations are in progress, signals and arrangements shall be agreed upon to assure that no blast shall be fired while any person is in the water.

(e) Blasting flags shall be displayed.

(f) The storage and handling of explosives aboard vessels used in underwater blasting operations shall be according to provisions outlined herein on handling and storing explosives.

(g) When more than one charge is placed underwater, a float device shall be attached to an element of each charge in such a manner that it will be released by the firing.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 118. Explosives for Well Service Industry

### § 5311. Scope.

This article shall cover loading, assembly, transporting and storage, and well site use of special industrial explosive material, perforating tools, including projectile firing devices and similar explosive–actuated devices.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5312. Loading or Assembling of Industrial Explosives and Devices and/or Propellent Devices.

(a) Loading operation of projectile firing devices which would fire in other than a vertical plane shall be isolated from other operations by a partition constructed of materials capable of withstanding the explosion of the device or shall be carried on in a separate area at least 25 feet from other work areas.

(b) Loading operations of projectile firing devices which fire only in a vertical direction shall have the work areas clearly delineated to separate them from other work areas.

(c) Loading operations of other types of explosive and/or propellant–actuated power devices shall be conducted in clearly defined areas separated from other work areas.

(d) Electrical apparatus in the loading area shall conform with the wiring requirements for Class II, Division 2, Hazardous Areas, Electrical Safety Orders, except that no electrical outlets or electrical tools are permitted on the loading bench. Metal parts of loading benches and racks shall be electrically bonded and grounded.

(e) Work benches used for loading shall be smooth finished to facilitate cleaning.

(f) Materials not necessary for the operation shall not be stored in the loading area.

(g) Only personnel necessary to the loading operation shall be in the loading area.

(h) The amount of explosive materials in the loading area shall be limited to that amount required for the day's loading operations.

(i) Waste, scrap and unused explosive materials shall be kept in labeled, covered containers and be returned to the magazine immediately upon completion of the days loading activities. More than one day's accumulation of waste or scrap explosives shall be stored in at least a Type 2 magazine, located outside the loading area, or destroyed or desensitized in a safe manner.

(j) Spilled explosives shall be cleaned up promptly.

(k) Explosives shall not be subjected to excessive heat, friction, or force during loading operations.

(l) Detonators shall not be installed in explosive devices in the loading area unless assembly of the detonator is necessary at the time of loading.

(m) Explosive loading areas shall be posted with a sign reading, "EXPLOSIVES," with letters 4 inches high and a 5/8–inch stroke on a background of sharply contrasting color.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (c) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5313. Storage and Transportation of Industrial Explosive Materials.

(a) Industrial explosive charges shall be transported as explosive materials.

(b) Explosive devices shall not be transported with detonators installed unless installation of the detonator is necessary at the time of loading.

(c) Explosive charges shall be protected from mechanical damage, heat, and electric current during storage and transportation.

(d) Loaded explosive power actuated devices shall be stored in a manner which will result in the least possible hazard to employees in case of fire or premature explosion as follows:

(1) Jet charges assembled in appropriate carriers shall be stored on storage racks in designated areas or as appropriate.

(2) Projectile–type devices to be maintained in the horizontal position shall be stored in pits below ground level in an isolated part of a building at least 25 feet from work areas, in an open area at least 25 feet from any building, or surrounded by a barrier capable of withstanding the blast of the device and/or containing the projectile(s).

(3) "Armed" explosive devices (detonator installed) shall be stored in pits below ground level or compartmented steel containers.

(e) Quantities of explosive–actuated power device charges less than 50 pounds net weight of explosives, not assembled as in subsection (b)(1) or less than 500 detonators may be stored in a Type 2 magazine located in a building provided that:

(1) The storage area within the building is enclosed by walls of one–hour fire resistant construction or the enclosure is protected by an acceptable automatic sprinkler system or the magazine is located within 10 feet of an exit.

(2) The magazine is on a floor having a ground level exit.

(3) A distance of 10 feet is maintained between detonator and explosive magazines.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5314. Firing with Electricity—Well Site.

(a) Before implementing any system of electrical firing, the licensed blaster shall conduct a thorough survey for extraneous currents, and all dangerous currents shall be eliminated before any loading is accomplished.

(b) The firing circuit shall be effectively shorted following testing and remain shorted until the explosive device is lowered below the surface of the well.

(c) Well casing, service unit and rig, shall be connected and effectively bonded to minimize stray currents.

(d) Warning signs shall be posted at all entrances to the well site with lettering "RADIO TRANSMITTING PROHIBITED IN THIS AREA" or equivalent. Lettering of the sign shall be at least 4 inches high in red letters with a 5/8–inch stroke on a white background.

(e) Perforating shall not be knowingly conducted closer to any operating mobile or fixed radio, television, or radar transmitter than shown in tables in Section 5306, unless special precautions are taken that are acceptable to the Division.

(f) Employees shall be prohibited from entering the cellar after blasting until any toxic vapor/fumes, dust and gasses have been reduced to safe limits.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 119. Manufacturing and Processing of Explosive Materials

### § 5319. Scope.

The orders in this Article shall apply to the manufacturing, processing and handling of explosives, blasting agents, ammunition and pyrotechnic devices upon the manufacturing site including:

(a) The assembly of raw materials.

(b) Handling activities of raw materials, such as: mixing, grinding, blending, forming, loading encasement, packaging and similar activities in the manufacturing process.

(c) On–site testing and storage of explosive materials and the packaged product through removal from storage for transportation off the manufacturing site.

(d) Packing and repacking of explosive materials for wholesale distribution.

(e) The disposal of all waste explosive materials resulting from the manufacturing process.

EXCEPTION: For the purpose of this Article, the manufacturer of explosive materials does not include any person who assembles or fabricates any sets or mechanical pieces for public display, and/or persons operating within the scope of a public display license, or a pyrotechnic operator license.

NOTE: Authority cited: 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New section filed 11–1–76 as an emergency; effective upon filing (Register 76, No. 45).
2. Certificate of Compliance filed 1–11–77 (Register 77, No. 3).
3. Amendment of subsection (d) filed 8–18–77, effective thirtieth day thereafter (Register 77, No. 34).
4. Amendment of subsection (d) filed 9–19–80; effective thirtieth day thereafter (Register 80, No. 38).
5. Amendment of article heading and section filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
6. Amendment of article heading and first paragraph, new subsection (d) and subsection relettering filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5320. Reporting Requirements.

(a) Employers manufacturing explosive materials shall make available upon request by the Division the following information:

(1) The exact location of the place of manufacture.

(2) The kind or kinds of explosives, ammunition, blasting agents, or pyrotechnic devices to be manufactured or processed, and the property of hazardous materials to be used.

(3) The names and addresses of individual owners, partners, or officers of a corporation.

(4) A map of the operating premises with the operating buildings indicated in which greater than one pound of explosives is manufactured, handled, used, or stored. The maximum amount of explosives greater than one pound to be used in each building, number of persons in each operating building, barricade locations and dimensions, and the location and capacity of storage magazines.

EXCEPTION: This article shall not be construed as applying to, or prohibiting the mixing of, binary components or blasting agents such as ANFO in the loading area provided all necessary safety precautions are taken.

(5) A copy of the general safety rules which the manufacturer will enforce including plans for emergency procedures in the event of fire or explosion.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 11–1–76 as an emergency; effective upon filing (Register 76, No. 45).
2. Certificate of Compliance filed 1–11–77 (Register 77, No. 3).
3. Amendment filed 8–18–77; effective thirtieth day thereafter (Register 77, No. 34).
4. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5321. Plans of Plant.

A copy of the plans of the plant shall be kept in the office on the premises of each explosives, ammunition, blasting agents, pyrotechnic devices processing facilities, or manufacturing plants, and shall be made available to the Division upon request.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5322. Training and Instruction.

Employees who handle explosive material shall be instructed in the hazards of the materials and processes in which they are to be engaged and with the safety rules governing such materials and processes.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5323. Emergency Procedure.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Repealer of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5324. Change Rooms and Washing Facilities.

Whenever employees are required to change from street clothes into protective clothing, change rooms shall be provided equipped with locker space suitable for employees street clothing and personal effects at each explosives, ammunition, blasting agents or fireworks manufacturing plant. Shower baths and washbasins with hot and cold running water shall be required where necessary.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5325. Food.

Employees shall not be permitted to eat at places where explosive materials or pyrotechnic devices are present.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5326. Intraline Distance.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Repealer of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5327. Intraline Separation of Operating Buildings.

(a) All mass detonating explosives and pyrotechnic devices manufacturing buildings, including those where explosive charges are assembled, prepared, or loaded shall be separated from all other buildings, including magazines, within the confines of the manufacturing plant at a distance not less than those shown in the following table when buildings are BARRICADED.

NOTE: Explosives not subject to mass detonation may be processed in buildings located in accordance with other intraline distance tables of recognized authority such as DOD or ATF Tables 55.219 and 55.222 through 55.224, with footnotes.

(b) When a building or magazine containing explosives is not barricaded the intraline distances shown in the following Table shall be doubled.

*Intra Plant Distance Table*

*For Use Only Within Confines of Explosives Manufacturing Plants*

| *Pounds Over* | *Pounds Not Over* | *Distance in Feet When Building is Barricaded** | *Pounds Over* | *Pounds Not Over* | *Distance in Feet When Building is Barricaded** |
|---|---|---|---|---|---|
| 2 | 5 | 16 | 12,000 | 14,000 | 220 |
| 5 | 10 | 20 | 14,000 | 16,000 | 230 |
| 10 | 20 | 25 | 16,000 | 18,000 | 238 |
| 20 | 30 | 28 | 18,000 | 20,000 | 245 |
| 30 | 40 | 31 | 20,000 | 25,000 | 265 |
| 40 | 50 | 34 | 25,000 | 30,000 | 280 |
| 50 | 75 | 38 | 30,000 | 35,000 | 295 |
| 75 | 100 | 42 | 35,000 | 40,000 | 310 |
| 100 | 125 | 45 | 40,000 | 45,000 | 320 |
| 125 | 150 | 48 | 45,000 | 50,000 | 330 |
| 150 | 200 | 53 | 50,000 | 55,000 | 340 |
| 200 | 250 | 57 | 55,000 | 60,000 | 350 |
| 250 | 300 | 60 | 60,000 | 65,000 | 360 |
| 300 | 400 | 66 | 65,000 | 70,000 | 370 |
| 400 | 500 | 71 | 70,000 | 75,000 | 380 |
| 500 | 600 | 76 | 75,000 | 80,000 | 390 |
| 600 | 700 | 80 | 80,000 | 85,000 | 395 |
| 700 | 800 | 84 | 85,000 | 90,000 | 400 |
| 800 | 900 | 87 | 90,000 | 95,000 | 410 |
| 900 | 1,000 | 90 | 95,000 | 100,000 | 420 |
| 1,000 | 1,200 | 96 | 100,000 | 110,000 | 430 |
| 1,200 | 1,400 | 101 | 110,000 | 120,000 | 445 |
| 1,400 | 1,600 | 106 | 120,000 | 130,000 | 455 |
| 1,600 | 1,800 | 110 | 130,000 | 140,000 | 465 |
| 1,800 | 2,000 | 113 | 140,000 | 150,000 | 475 |
| 2,000 | 2,500 | 122 | 150,000 | 160,000 | 485 |
| 2,500 | 3,000 | 130 | 160,000 | 170,000 | 495 |
| 3,000 | 4,000 | 143 | 170,000 | 180,000 | 505 |
| 4,000 | 5,000 | 154 | 180,000 | 190,000 | 515 |
| 5,000 | 6,000 | 164 | 190,000 | 200,000 | 525 |
| 6,000 | 7,000 | 172 | 200,000 | 210,000 | 535 |
| 7,000 | 8,000 | 180 | 210,000 | 230,000 | 555 |
| 8,000 | 9,000 | 190 | 230,000 | 250,000 | 575 |
| 9,000 | 10,000 | 200 | 250,000 | 275,000 | 600 |
| 10,000 | 12,000 | 210 | 275,000 | 300,000 | 635 |

*When a building or magazine containing explosives is not barricaded, the distances shown in this Table should be doubled.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5328. Operating Buildings and Equipment.

(a) Operating buildings or rooms in which more than 50 pounds of explosive materials which mass detonate are present at any time shall be constructed with at least one wall and roof of explosion–relief type. The direction of the relief wall shall be so placed as to be of least hazard to employees in adjacent buildings.

(b) When explosion pressure relief venting is required, the venting area shall be calculated on one square foot for each 35 cubic feet of building or room area.

(c) Floors and work surfaces shall be constructed to facilitate cleaning and to preclude, to the extent possible, cracks and crevices in which explosive materials can lodge/accumulate.

(d) When it is desirable to heat or cool buildings in which explosives are manufactured or charges are prepared, this shall be by steam, water, or other indirect sources. No floor registers will be permitted.

(e) All electrical wiring and equipment shall be in accordance with the Electrical Safety Orders.

(f) Bonding and grounding means shall be provided to prevent accumulation of static charges.

(g) Hydraulic or pneumatic presses and hand jacks shall be provided with pressure–relief valves so arranged and set that the material being processed will not be subjected to pressure likely to cause it to explode. Dies and plugged press equipment shall not be cleared by striking blows that may detonate or start the material burning.

EXCEPTION: Where provisions have been made to contain or preclude a fire/detonation.

(h) Explosives dust shall not be exhausted to the atmosphere. Where vacuum dust collection systems are used, they shall be designed by a qualified person, installed and maintained commensurate with the hazards involved, incorporating the following requirements:

(1) Adequate filters shall be installed between the source vacuum and the point of pick–up to prevent explosive materials from entering the vacuum pump or exhauster.

(2) The explosive material dust collection system shall be designed to prevent pinch points threaded fittings exposed to the hazardous dust and sharp turns, dead ends, pockets, etc., in which explosive materials may lodge and accumulate outside the collecting chamber.

(3) The entire vacuum collection system shall be made electrically continuous and be grounded to a maximum resistance of 5 ohms.

(4) Chambers in which the dust is collected shall not be located in the operating area unless protective shields adequate for the maximum quantity of material in the collector are furnished for personnel protection.

(5) No more than two rooms shall be serviced by a common connection to a vacuum collection chamber. Where interconnections are used, means shall be employed to prevent propagation of an incident via the collection piping.

(6) When collecting sensitive explosive materials such as black powder, lead azide, etc., a "wet" collector which moistens the dust close to the point of intake and maintains the dust wet until removed for disposal shall be used. Wetting agents shall be compatible with the explosive materials.

(7) Explosive material dust shall be removed from the collection chamber as often as necessary to prevent overloading, but under no circumstances shall the material be left in the chamber overnight. The entire system shall be cleaned at a frequency that will eliminate hazardous concentrations of explosive material dust in pipes, tubing, and/or ducts.

(i) Squirrel cage blowers shall not be used for exhausting hazardous fumes, vapors, or gases. Only non–sparking fan blades shall be used for fans located within the ductwork and through which hazardous materials are exhausted. Motors shall be located outside the duct.

(j) Work stations for explosive materials shall be separated by distance, barrier, or other means, so fire/initiation in one station will not initiate explosive materials in the next work station. When necessary, each operator shall be protected by a protective shield located between the operator and the explosive device or explosive materials being processed. This shield shall be designed to safely withstand a blast from the maximum amount of explosive materials allowed behind it.

(k) A prototype of the shield to be used shall be tested and proven sufficient for the anticipated conditions prior to an operational model being placed in service.

(l) If the personnel protection wall for the required operation becomes so large that it is impractical, the operator shall perform the operations by remote control or be protected by a suitably constructed shelter designed with a safety factor of not less than 4 to withstand the overpressure from the maximum amount of explosive materials in process.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (f) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5329. Explosives Operations.

(a) Process hazard analysis shall be performed in accordance with Section 5189 of these Orders on all operations involving explosive materials including such factors as: (1) initiation sensitivity; (2) quantity of explosive materials; (3) blast output; (4) thermal output; (5) rate of burning; (6) potential ignition and initiation sources; (7) separation barricades; (8) personal protective equipment; and, (9) personnel exposure with special consideration given to the respiratory and circulatory damage to be expected by inhalation of hot vapors and the toxicological effects due to inhalation of combustion products.

(b) Workers shall be provided protection from potential blast overpressures, hazardous fragments and thermal effects when hazard assessments indicate the probability of an accidental explosion.

(c) A fire detection and extinguishing system that is quick–acting and of adequate capacity to extinguish potential flash fires in their incipient state shall be installed. Such system shall maximize speed of detection and application of the extinguishing agent.

(d) The working area where the screening, grinding, blending, and other processing of static–sensitive explosive materials is done shall be maintained above 20 percent relative humidity. Except for controlled environments where it is necessary to maintain the humidity below 20%, when the relative humidity drops below 20 percent, the above operations shall be stopped and secured (personnel removed) until the relative humidity can be raised above 20 percent.

(e) Means shall be provided and used to discharge static electricity from hand trucks, buggies, and similar equipment before they enter buildings containing static–sensitive explosive materials.

(f) Bulk explosive materials shall be kept in covered containers when not being used or processed. In no case shall explosive materials be stored or transported in open containers.

(g) The quantity of explosive materials at any particular work station shall be limited in accordance with the quantity distance table in 5327, and not to exceed 4 hours supply of material or 4 hours supply of product, except that when this quantity would introduce a serious hazard, such quantities shall be limited to a lesser amount.

EXCEPTIONS: Quantities required for a unit of production for the following:

(1) Propellant processing;

(2) Explosive casting operations; or

(3) Batch processing of explosive materials.

(h) Appropriate receptacles with covers shall be provided for each station for disposing of waste material and debris. These waste receptacles shall be emptied and cleaned as often as necessary, but not less than once each day or at the end of each shift.

(i) General safety rules and operating instructions governing the particular operation or process carried on at that location, shall be available at each work station. The rules shall include requirements for bonding

and grounding, compatible cleaning agents to use and other precautions deemed necessary for safe operation.

(j) Personnel and explosive load limits shall be conspicuously posted.

(k) Major repairs or changes to the building or equipment shall not be undertaken in an explosives location during regular operations without removing the explosive materials. This does not prohibit minor adjustments or emergency repairs to secure immediate safety. Before beginning repairs, the consent of the competent person in immediate charge of the building or location shall be obtained. Any other personnel in the location shall be notified of the work to be performed; the area shall be inspected for the presence of residue explosive materials and dusts; and all such material shall be removed from equipment, crevices beneath floors, from walls and pipes, and under fittings where explosive materials may accumulate. The area shall be washed down thoroughly and maintained wet during repairs.

(l) Tools and equipment used near explosive materials shall be compatible with the explosive materials.

(m) Spilled explosive materials shall be cleaned up immediately.

(n) Shipping containers, cleaning rags, and other materials contaminated with explosive materials shall be removed daily and disposed of in a safe manner.

(o) Explosive materials shall not be placed near any source of ignition.

(p) A warning system shall be provided to alert persons approaching a hazardous operation or area. The warning system shall be activated when operations are being conducted.

(q) Employees working in processing facilities shall wear flame retardant, non–static generating, pocketless coveralls or coats. Footwear having waffle or similar soles which can capture and retain explosive materials shall not be worn.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5330. Testing of Explosive Materials.

(a) Detonation or ignition of explosive charges or pyrotechnic devices for testing shall be done only in a location isolated by distances or barriers/shelters shall be provided so all personnel will be protected.

(b) When tests are being conducted or explosive materials are being detonated, only authorized persons shall be present. Areas where explosive materials are regularly or frequently detonated or burned shall be fenced or provided with controlled access and posted with warning signs. Warning devices shall be used before burning or detonating explosive materials to warn persons who might approach from any direction that they are approaching a danger zone.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5331. Disposal of Waste Explosives and Fireworks.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Repealer of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 120. Blasting Agents

### § 5340. General.

(a) Unless otherwise set forth in these Orders, blasting agents shall be transported, stored, and used in the same manner as explosive materials.

(b) Unless otherwise set forth in these Orders, water gels, slurries, and emulsions shall be transported, stored, and used in the same manner as explosives or blasting agents in accordance with the classification of the product.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of article heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5341. Mixing of Blasting Agents—Location.

(a) Buildings or other facilities used for mixing blasting agents, including mobile equipment, shall be located in accordance with the Quantity and Distance Table, Section 5252, unless the mobile equipment is in the process of loading blast holes.

(1) Smoking, matches, open flames, spark–producing devices, and firearms shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents. The land surrounding the mixing plant shall be kept clear of brush, dried grass, leaves, and other combustible materials for a distance of at least 50 feet.

(b) If ammonium nitrate is stored at a closer distance to blasting agents than recommended by Section 5253, then 1/2 the ammonium nitrate weight shall be added to the quantity of blasting agents to calculate the total quantity involved for the application of the aforementioned table.

(c) Liquid oxidizers shall be stored in a manner to prevent them from contaminating blasting agents or fuels.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsections (b) and (c) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of subsection (c) filed 11–18–76; effective thirtieth day thereafter (Register 76, No. 47).
4. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5342. Mixing Buildings.

(a) Buildings used for the mixing of blasting agents shall conform to the requirements of this section. Buildings constructed after May 21, 1971, shall be noncombustible construction or of sheet metal on wood studs.

(b) The layout of the mixing building shall provide physical separation between the finished product storage and the mixing and packaging operation in accordance with applicable intraline distances contained in Section 5327.

(c) Floors in the processing plant shall be of concrete or of nonabsorbent material and free of cracks and crevices.

(d) Floors shall be constructed to eliminate open floor drains and piping into which molten materials could flow and be confined in case of fire.

(e) Liquid fuel shall be stored outside the mix building and away from the oxidizer area. The storage area shall be designed and located in such a manner that in case of tank rupture, the oil fuel shall be retained or be drained away from the mixing plant building. The shut–off valves shall be at the tank. Suitable means shall be provided to prevent the flow of oil fuel to the mixer in case of fire. In gravity flow systems, an automatic spring–loaded shut–off valve with fusible link shall be installed.

(f) The building shall be well ventilated.

NOTE: The recommendation for ventilation as contained in SLP No. 1, Institute of Makers of Explosives, 1993 Edition, is evidence of good practice.

(g) Heat shall be provided exclusively from a unit outside of the building or electric heat at a safe distance from combustible material.

(h) Personnel limits shall be established, posted, and enforced while operations involving blasting agents are underway at the mix house.

(i) Blasting agents and fuels shall be removed from the mix house and the equipment or area completely washed down before major work, other than routine maintenance, or open flame repairs are made.

(j) Before welding or repairs to hollow shafts, all oxidizer material shall be removed from the outside and inside of the shaft and the shaft vented.

(k) All internal combustion engines used for electric power generation shall be located outside the mixing plant building at least 50 feet from any

opening in the building or shall be properly ventilated and isolated by a fire wall having a minimum one hour fire–resistance rating. The exhaust system on all such engines shall be equipped with a spark arrestor and shall be located so any spark emission cannot be a hazard to any material in or adjacent to the plant.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5344. Mix Room Equipment.

(a) Mixing facilities shall comply with the fire prevention requirements of this Section. The mixing equipment shall be designed to minimize the possibility of friction, heating, compaction, overloading, confinement, and the accumulation of static electricity.

(b) Bearings and gears shall be of the outboard type and protected from accumulation of explosive materials.

(c) All surfaces shall be accessible for cleaning. Mixers, pumps, valves and related equipment shall be designed to permit regular and periodic flushing, cleaning, dismantling and inspection.

(d) Mixing and packaging equipment shall be constructed of materials that are compatible with blasting agents.

(e) All electrical equipment in the mixing room shall conform to the requirements of the Electrical Safety Orders. The frame of the mixer and all other equipment used shall be effectively bonded.

(f) An automatic water–deluge system with adequate capacity shall be provided to protect mixers and the finished blasting agents storage area in the plant. The floors and equipment of the mixing and packaging room shall be washed down frequently to prevent accumulation of oxidizers, fuels, or sensitizers. The entire mixing and packaging plant shall be washed down periodically to prevent excessive accumulation of dust.

(g) Empty oxidizer bags shall be disposed of daily in a safe manner.

(h) Not more than 4 hours production of blasting agents or the limit determined by the Quantity and Distance Table, TABLE EX–1, Section 5252, whichever is less, shall be permitted in or near the mixing and packaging area. The total amount of oxidizer and blasting agents in the mix house shall be considered blasting agents in process.

(i) Equipment and handling procedures shall be designed to prevent the introduction of foreign objects or materials into the mix.

(j) Each day prior to starting operations, a visual inspection shall be made of the mixing, conveying, and electrical equipment to establish that such equipment is in good operating condition. A program of systematic maintenance sufficient to maintain the equipment in proper working order shall be conducted.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5345. Composition.

(a) The sensitivity of the blasting agent shall be determined by means of a No. 8 test blasting cap or equivalent at regular intervals and after every change in formulation.

NOTE: Oxidizers of small particle size, such as crushed ammonium nitrate prills or fines, may be more sensitive than coarser products and therefore, should be handled with greater care.

(b) No hydrocarbon liquid fuel with flash point lower than that of No. 2 diesel fuel oil (125° F minimum or legal) shall be used.

(c) Waste oil, including crankcase oil shall not be used.

EXCEPTION: The requirements of subsections (b) and (c) do not apply to compositions made under the supervision of qualified personnel capable of determining the overall hazards of the resulting product in its manufacture, storage, transportation and use.

(d) Metal powders such as aluminum shall be kept dry and shall be stored in containers or bins which are moisture–resistant or weather–tight. Fuels shall be used in such manner as to minimize dust explosion hazards.

(e) Peroxides and chlorates shall not be used.

(f) Ingredients shall be measured or proportioned to ensure control of sensitivity and oxygen balance.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Repealer and new section filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5346. Blasting Agent Storage.

(a) Blasting agents or ammonium nitrate, when stored in conjunction with explosive materials, shall be stored in the manner set forth in Article 114 for explosives. The mass of blasting agents and one–half the mass of ammonium nitrate shall be included when computing the total quantity of explosive materials for determining distance requirements.

(b) The front, both sides, and rear of the trailer or truck shall be posted with a warning sign reading: "EXPLOSIVES" in red letters, at least 4 inches high with a 5/8–inch stroke, on a white background.

(c) Blasting agents and blasting agent slurries may be stored in a noncombustible bin or tank, provided they comply with storage requirements of Article 114. All openings shall be designed to provide a tight closure and shall be locked except during use. Storage containers shall be constructed of materials compatible with the blasting agents being stored, shall be waterproof, and adequately supported and braced to withstand the combination of all loads, including impact forces arising from product movement within the bin and accidental vehicle contact. Bins containing blasting agents shall be located, with respect to inhabited buildings in accordance with Table EX–1, and with respect to other blasting agent storage and explosive storage, in conformity with Table EX–2.

(d) Good housekeeping practices shall be maintained around any bin containing ammonium nitrate or blasting agent. This includes keeping weeds and other combustible materials cleared within 50 feet of such bin. Accumulation of spilled product on the ground shall be prevented.

(e) Any electrically driven conveyors for loading or unloading bins shall conform to the requirements of the Electrical Safety Orders. They shall be designed to minimize damage from corrosion.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Repealer and new section filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of subsections (e) and (j) filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).
4. Amendment filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## § 5347. Transportation of Blasting Agents.

(a) Blasting agents shall be transported in compliance with Article 115.

(b) Bulk blasting agents and water gels may be transported in tank or hopper trucks provided that the pump or conveyor equipment, including electrical equipment, is equivalent to on–site mix trucks.

(c) The front, both sides, and rear of the truck or trailer shall be posted with warning signs reading: "EXPLOSIVES" in red letters at least 4 inches high, with a 5/8–inch stroke on a white background.

(d) Matches, fire arms, acids or other corrosive liquids, oils, greases or other similar hydrocarbons shall not be carried in the cargo carrying space of any vehicle containing blasting agents, unless the blasting agents are in an unopened shipping container.

(e) A bulk vehicle body for delivering and mixing blasting agents shall comply with the following:

(1) The body shall be constructed of noncombustible materials.

(2) Vehicles used to transport bulk premixed blasting agents shall have closed bodies.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (c) and new subsections (d) and (e) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of subsection (c) and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5348. On–Site Mixed Water Gels, Slurries, Emulsions, and Blasting Agents.

(a) The composition of field mixed blasting agents and water gels shall comply with Section 5340.

(b) Liquid fuels shall be stored in separate tanks with shut–off valves. Solid fuels shall be stored in separate containers until mixed.

(c) Ingredients in themselves classified as explosive materials, shall be stored in compliance with Article 114.

(d) Liquid ammonium nitrate spills or leaks shall be cleaned up immediately.

(e) Mixing equipment shall comply with the following requirements:

(1) If electric power is used, it may be furnished by cable from an outside source or by a self–contained motor generator. In case of a self–contained power source, it shall be located at the end of the storage container opposite that which the blasting agent is discharged. It shall have adequate capacity for the loads to be expected and be equipped with suitable overload protection devices.

(2) Electric wiring and motors shall conform to the requirements of the Electrical Safety Orders.

(3) All exposed metal parts, electric equipment and personnel shall be placed at the same potential by electrical bonding.

(4) All moving parts of the mixing system shall be designed to prevent a heat build up. Shafts or axles which contact the product shall have outboard bearings with one–inch minimum clearance between the bearings and the outside of the product container. Particular attention shall be given to the clearances on all moving parts.

(5) Mixing equipment and other transfer equipment shall be compatible with blasting agents.

(f) Sensitized blasting agents shall not be pulverized or crushed.

(g) Each mixer unit shall be equipped with an operable, UL approved fire extinguisher, 4–A:20–B:C or equivalent.

(h) All unused explosives shall be returned to their proper magazines or designated storage area, upon completion of loading operations.

(i) A warning sign shall be posted on the front, sides, and rear of the mixing unit reading: "EXPLOSIVES" in red letters at least 4 inches high, with a 5/8–inch stroke, on a white background.

(j) Repairs to bulk delivery and/or mixing vehicles shall conform with the following requirements:

(1) No welding or open flames shall be used on or around any part of the delivery equipment unless it has been completely washed down and all oxidizer material removed.

(2) Before welding or repairs to hollow loading shafts, the shaft shall be thoroughly cleaned inside and out and vented.

(k) The entire loading and mixing equipment shall be cleaned to prevent hazardous accumulations of ingredients and before open flame work is performed on the unit.

(*l*) Intransit mixing of blasting agents shall not be performed.

(m) The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment and shall be familiar with the commodities being delivered and the general procedure for handling emergency situations.

(n) Caution shall be exercised in the movement of the vehicle in the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, detonator wires, or explosive materials. The driver in moving the vehicle shall obtain the assistance of a second person to guide the movements.

(o) The location chosen for water gel or ingredient transfer from a support vehicle into the borehole loading vehicle shall be away from the blast hole site when the bore holes are loaded or in the process of being loaded.

(p) No person shall smoke, carry matches or any flame–producing device, or carry any fire arms while in or about bulk vehicles effecting the mixing transfer or down–the–hole loading of blasting agents at or near the blasting site.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment of subsection (d) filed 11–18–76; effective thirtieth day thereafter (Register 76, No. 47).
3. Amendment of section heading and section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 121. Snow Avalanche Blasting

### § 5355. Scope.

The provisions found in Article 121, Snow Avalanche Blasting, take precedence when in conflict with other applicable safety orders.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section heading and section and new NOTE filed 9–24–97; operative 10–24–97 (Register 97, No. 39).

### § 5356. Safety Fuse.

(a) Water resistant safety fuse shall be used in snow avalanche blasting.

(b) Safety fuse used in snow avalanche blasting shall be of sufficient length to provide a minimum burning time of 90 seconds from ignition to detonation.

(c) An approved fuse lighter shall be used for lighting safety fuse. The lighter shall not be attached to the safety fuse until just prior to time of ignition.

(d) Cut ends of fuses shall be protected from damage.

(e) Fuse igniters shall not be installed on a damaged fuse.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsection (c), new subsection (d) and new NOTE filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
2. Amendment of subsection (b) and new subsection (e) filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5357. Placing Explosives Charges.

(a) Charges shall be placed, thrown or propelled to the desired location from a safe position or by one of the following methods:

(1) Lowered by rope, cord or a long pole to the designated location if there is danger that the charge may slide down hill.

(2) Hand placed on or in the snow. When performing this operation, the crewmen will be belayed from behind.

(b) Licensed avalanche blasters shall be instructed to seek a position of safety behind a terrain barrier or a position not less than 100 feet from the ignited charge.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of section and new NOTE filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
2. Amendment of subsection (a) and new subsections (a)(1)–(2) filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5358. Misfires—Snow Avalanche Blasting.

(a) Where a suspected misfire occurs, the slope shall be closed and the licensed blaster shall wait at least one hour before approaching the blast site. After the one hour has elapsed, one of the following shall be accomplished to abate the condition:

(1) Relight the original charge.
(2) Place another charge alongside and detonate.
(3) Retrieve and disarm the misfire.

(b) If subsections (a)(1), (a)(2), or (a)(3) above are not immediately possible due to terrain or storm conditions, the location of the misfire must be carefully noted and marked so a search for the misfire can be undertaken as soon as conditions permit.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of first paragraph and subsection (d) and new NOTE filed 9–24–97; operative 10–24–97 (Register 97, No. 39).
2. Amendment filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 122. Ammonium Nitrate Storage

### § 5359. Scope.

(a) This Article applies to storing, having or keeping ammonium nitrate in quantities of 1,000 pounds or more.

(b) Except as provided in subsection (c), this Section applies to the storage of ammonium nitrate in the form of crystals, flakes, grains or prills including fertilizer grade, dynamite grade, nitrous oxide grade, technical grade and other mixtures containing 60 percent or more ammonium nitrate by weight but does not apply to blasting agents.

(c) The storage of ammonium nitrate and ammonium nitrate mixtures which are more sensitive than allowed by the Fertilizer Institute's publication, "Definition and Test Procedures for Ammonium Nitrate Fertilizer", dated August 1984, pages 1 – 12, which is hereby incorporated by reference, shall be stored in accordance with TABLE EX–1 in Section 5252.

NOTE: For further guidance see:
"Definition and Test Procedures for Ammonium Nitrate Fertilizer" available from The Fertilizer Institute, 501 2nd Street, N.E., Washington, D.C. 20002. This definition limits the contents of organic materials, metals, sulfur, etc., in a product that may be classified ammonium nitrate fertilizer.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. New Article 122 (§§ 5359–5363) filed 10–17–75; effective thirtieth day thereafter (Register 75, No 42).
2. Amendment of subsection (b) filed 12–19–75 as procedural and organizational; effective upon filing (Register 75, No. 51).
3. Amendments filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
4. Amendment of subsection (c) filed 7–13–78; effective thirtieth day thereafter (Register 78, No. 28).
5. Amendment of section and NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5360. Storage.

(a) Ammonium nitrate shall be in a separate building or shall be separated by fire walls constructed to be of not less than one hour fire–resistance rating from storage of organic chemicals, acids or other corrosive materials, materials that may require blasting during processing or handling, compressed flammable gases, flammable and combustible materials or other contaminating substances. Walls referred to in this Section need extend only to the underside of the roof. In lieu of separation walls, ammonium nitrate may be separated from these materials by a space of at least 30 feet and if necessary, sills or curbs shall be provided to prevent mixing.

(b) Flammable and combustible liquids such as gasoline, kerosene, solvents and light fuel oils shall not be stored on the premises except when such storage conforms to Articles 135 and 141 of these orders and when walls and sills or curbs are provided in accordance with subsection (a) of this Section.

(c) Sulfur and finely divided metals shall not be stored in the same building with ammonium nitrate except when such storage conforms to the requirements of subsection (a) of this Section.

(d) Explosive materials shall not be stored in the same building with ammonium nitrate except on the premises of makers, distributors and user–compounders of explosive materials.

(e) Quantities of 2,500 tons or more of bagged ammonium nitrate shall not be stored in buildings or structures unless equipped with automatic sprinkler systems. Sprinkler protection shall be required for the storage of less than 2,500 tons of ammonium nitrate where location of the building or the presence of other stored materials presents a fire or detonation hazard. Sprinkler systems shall be of approved type and installed in accordance with Article 159.

(f) Suitable fire control devices complying with Articles 157 and/or 158 shall be provided throughout the warehouse and in the loading dock areas.

(g) Where required by local fire authorities or the State Fire Marshal, lightning strike protection shall be provided.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of subsection (b) filed 11–18–76; effective thirtieth day thereafter (Register 76, No. 47).
3. New subsection (f)(1) filed 9–8–81; effective thirtieth day thereafter (Register 81, No. 37).
4. Editorial correction of subsections (f)(1) and (g) filed 11–9–81; effective thirtieth day thereafter (Register 81, No. 45).
5. Amendment of section and NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5361. Structures.

(a) Ammonium nitrate storage buildings shall be only one–story buildings without basements.

(b) Storage buildings shall have adequate ventilation or be capable of adequate ventilation in the event of fire.

(c) The wall on the exposed side of a storage building within 50 feet of a combustible building, forest, piles of combustible materials and similar exposure hazards shall be of fire–resistive construction. In lieu of the fire–resistive wall, other suitable means of exposure protection such as a free standing wall may be used.

(d) All flooring in storage and handling areas shall be of noncombustible material or protected against impregnation by ammonium nitrate and shall be without open drains, traps, tunnels, pits or pockets into which any molten ammonium nitrate could flow and be confined in the event of fire.

(e) Buildings and structures shall be dry and free from water seepage through the roof, walls and floors.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of subsections (a), (b) and (e) and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5362. Container Storage.

(a) Bags and containers used for ammonium nitrate shall comply with specifications and standards required for use in interstate commerce.

(b) Containers of ammonium nitrate shall not be accepted for storage when the temperature of the ammonium nitrate exceeds 130° F.

EXCEPTION: Containers used on the premises in the manufacturing or processing need not comply with the provisions of subsections (a) or (b).

(c) Bags of ammonium nitrate shall not be stored within 30 inches of the storage building walls and partitions.

(d) The height of stacked bags shall not exceed 20 feet. The width of the stacked bags shall not exceed 20 feet and the length 50 feet except that where the building is of noncombustible construction or is protected by automatic sprinklers the length of piles shall not be limited. In no case shall the ammonium nitrate be stacked closer than 36 inches below the roof or supporting and spreader beams overhead.

(e) Aisles shall be provided to separate piles by a clear space of not less than 3 feet in width. At least one service or main aisle in the storage area shall be not less than 4 feet in width.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment of subsections (a), (b) and (d) and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5363. Bulk Storage.

(a) Bulk storage may be in piles or bins in warehouses, or in separate, bin–type structures.

(b) Unless constructed of noncombustible material or unless adequate facilities for fighting a roof fire are available, bulk storage structures shall not exceed a height of 40 feet.

(c) Bins shall be free of materials which may contaminate ammonium nitrate.

(d) Due to the corrosive and reactive properties of ammonium nitrate, and to avoid contamination, galvanized iron, copper, lead and zinc shall not be used in bin construction unless suitably protected. Aluminum bins, and wooden bins protected against impregnation by ammonium nitrate, are permissible.

NOTE: Steel or wood can be protected by special coatings such as sodium silicate (water glass), or epoxy coatings, or polyvinyl chloride coatings.

(e) The warehouse may be subdivided into any desired number of ammonium nitrate storage compartments or bins. The partitions dividing the ammonium nitrate storage from the storage of other products which would contaminate the ammonium nitrate shall be of tight construction to eliminate cracks or crevices.

(f) The ammonium nitrate storage bins or piles shall be clearly identified by signs reading: "AMMONIUM NITRATE" with letters at least 2 inches high.

(g) Piles or bins shall be so sized and arranged that all material in the pile is moved out periodically in order to minimize possible caking of the stored ammonium nitrate.

(h) Height or depth of piles shall be limited by the pressure–setting (caking) tendency of the product. However, in no case shall the ammonium nitrate be piled higher at any point than 36 inches below the roof or supporting and spreader beams overhead.

NOTE: Pressure–setting (caking) is a factor affected by humidity and temperature in the storage space and by pellet quality. Temperature cycles through 90° F. and high atmospheric humidity are undesirable for storage in depth.

(i) Ammonium nitrate shall not be accepted for storage when the temperature of the product exceeds 130° F.

EXCEPTION: Manufacturing or processing.

(j) Explosive materials shall not be used to break up or loosen the caked, bagged, or bulk ammonium nitrate.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Article 123. Small Arms Ammunition, Small Arms Ammunition Primers, Smokeless Propellants, and Black Powder Propellants

### § 5370. Scope.

The provisions of this Article apply to the channels of distribution of and to the users of small arms ammunition, small arms ammunition primers, smokeless propellants, and black powder propellants. They do not apply to in–process storage and intra–plant transportation during manufacture.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Repealer of Article 123 ( § 5370) and new Article 123 ( §§ 5370–5374) filed 10–17–75; effective thirtieth day thereafter (Register 75, No. 42).
2. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
3. Amendment of article heading, section and NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5371. Small Arms Ammunition.

(a) Small arms ammunition shall be separated from flammable liquids, flammable solids and oxidizing materials by a fire–resistant wall of one–hour rating or by a distance of 25 feet.

(b) Small arms ammunition shall not be stored together with high explosive materials unless the storage facility is adequate.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).
2. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5372. Smokeless Propellants.

(a) All smokeless propellants shall be stored in shipping containers except as noted in subsection (b).

(b) Commercial stocks of smokeless propellants shall be stored as follows:

(1) In quantities over 20 pounds and not more than 110 pounds, they shall be stored in portable wooden boxes having walls of at least 1–inch thickness.

(2) In quantities over 100 pounds and not more than 750 pounds, they shall be stored in nonportable storage cabinets having wooden walls of at least 1–inch thickness or other non–sparking material of equivalent strength. Not more than 400 pounds shall be permitted in any one cabinet.

(c) Commercial stocks in excess of 750 pounds and not more than 5,000 pounds may be stored in a building if all of the following requirements are met:

(1) The warehouse or storage room is not accessible to unauthorized personnel.

(2) The smokeless propellant stocks are stored in nonportable storage cabinets having wooden walls at least 1–inch thick and having shelves with not more than a 3–foot separation between shelves.

(3) Not more than 400 pounds is permitted in any one cabinet.

(4) Cabinets are located only against walls of the storage room or warehouse with a minimum distance between cabinets of 40 feet.

(5) Separation distance between cabinets may be reduced to 20 feet if barricades:

(A) are attached to the wall and are at least twice the height of the cabinet;

(B) are centered between cabinets and extend at least 10 feet beyond the wall toward the center of the room;

(C) are constructed of at least 2–inch thick lumber, brick, or concrete block or steel plate at least 1/4–inch thick, or of equivalent materials; and

(D) are firmly attached to the building structure at both ends.

(6) Smokeless propellant is separated by a fire–resistive wall of 1–hour rating or by a distance of 25 feet from materials classified by the U.S. Department of Transportation as flammable liquids, flammable solids and oxidizing materials.

(7) The building is equipped with an automatic sprinkler system installed in compliance with Article 159.

(d) Commercial stocks of smokeless propellant not stored in accordance with subsections (b), and (c) of this Section, whichever applies, shall be stored in a magazine constructed and located as specified in Article 114.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).

2. Repealer of subsection (b) and consecutive relettering of subsections (c)–(e) filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).

3. Amendment of section and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5373. Black Powder Propellants.

(a) All black powder propellants shall be stored in shipping containers approved by the U.S. Department of Transportation.

(b) Quantities of black powder propellant in excess of 50 pounds shall be stored in an outdoor magazine.

(c) If smokeless propellants are stored in the same magazine with black powder propellants, the total quantity shall not exceed that permitted for black powder propellants.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Repealer of subsections (b) and (c), subsection relettering and new NOTE filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

### § 5374. Small Arms Ammunition Primers.

(a) Small arms ammunition primers shall not be transported or stored except in the original shipping containers.

(b) Small arms ammunition primers shall be separated from flammable liquids, flammable solids and oxidizing materials by a fire–resistive wall of one–hour rating or by a distance of 25 feet.

(c) Quantities up to 750,000 small arms ammunition primers may be stored in a building if not more than 100,000 are stored in any one pile and piles are at least 15 feet apart.

(d) Quantities in excess of 750,000 small arms ammunition primers may be stored in a building if all of the following conditions are met:

(1) The warehouse or storage room is not accessible to unauthorized personnel.

(2) The primers shall be stored in cabinets.

(3) Shelves of storage cabinets shall not have more than a 2–foot vertical separation.

(4) Not more than 200,000 primers shall be stored in one cabinet.

(5) Cabinets shall be located only against walls of the warehouse or storage room with a minimum distance between cabinets of 40 feet.

(6) Separation distance between cabinets may be reduced to 20 feet if barricades are attached to the wall and are at least twice the height of cabinets. Barricades shall be centered between cabinets and shall extend at least 10 feet beyond the wall toward the center of the room. They are to be constructed of at least 2–inch thick lumber, brick, concrete block, or of steel plate at least 1/4–inch thick, or of equivalent materials. Barricades shall be firmly attached to the building structure at both ends.

(7) Small arms ammunition primers shall be separated by a fire–resistive wall of 1–hour rating or by a distance of 25 feet from flammable liquids, flammable solids, and oxidizing materials.

(8) The building is equipped with an automatic sprinkler system installed in compliance with Article 159.

(e) Commercial stocks of small arms ammunition primers not in the original shipping containers shall be stored in a magazine constructed as specified in Article 114.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

HISTORY

1. Amendment filed 7–16–76; effective thirtieth day thereafter (Register 76, No. 29).

2. Amendment filed 9–18–80; effective thirtieth day thereafter (Register 80, No. 38).

3. Amendment of subsections (d), (d)(6) and (e) filed 7–11–2003; operative 8–10–2003 (Register 2003, No. 28).

## Group 20. Flammable Liquids, Gases and Vapors

## Article 134. Definitions

### § 5415. Definitions.

Adequate Ventilation. Ventilation which, under normal operating conditions, is sufficient to keep the concentration of a hazardous gas, vapor, mist, fume or dust below 25 percent of the lower explosive limit and sufficient to ensure that no employee is harmfully exposed.

Aerated Solid Powders. Any powdered material used as a coating material which shall be fluidized within a container by passing air uniformly from below. It is common practice to fluidize such materials to form a fluidized powder bed and then dip the part to be coated into the bed in a manner similar to that used in liquid dipping. Such beds are also used as sources for powder spray operations. The combustibility of such materials may be determined by reference to the "Standard for the Prevention of Dust Explosions in the Plastics Industry," NFPA No. 6541982.

Aerosol. A material which is dispensed from its container as a mist, spray or foam by a propellant under pressure.

Atmospheric Tank. A storage tank which has been designed to operate at pressures from atmospheric through 0.5 psig.

Barrel. A volume of 42 U. S. gallons.

Boiling Point. The boiling point of a liquid at a pressure of 14.7 psia (760 mm). Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for purposes of this code the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D–86–78, may be used as the boiling point of the liquid.

Boil–Over. The expulsion of crude oil (or certain other liquids) from a burning tank. The light fractions of the crude oil burn off producing a heat wave in the residue, which on reaching a water strata may result in the expulsion of a portion of the contents of the tank in the form of froth.

Bulk Oxygen System. A bulk oxygen system is an assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping, which has a storage capacity of more than 20,000 cubic feet of oxygen (NTP) including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid.

Bulk Plant. That portion of a property where flammable or combustible liquids are received by tank vessel, pipe lines, tank car, or tank vehicle, and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipe line, tank car, tank vehicle, or container.

Chemical Plant. A large integrated plant or that portion of such a plant other than a refinery or distillery where flammable or combustible liquids are produced by chemical reactions or used in chemical reactions.

Closed Container. A container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

Combustible Liquids. See Liquids.

Container. Any vessel of 60 U.S. gallons or less capacity used for transporting or storing flammable or combustible liquids.

Crude Petroleum. Hydrocarbon mixtures that have a flash point below 150 F. and which have not been processed in a refinery.

Dip Tank. A tank, vat or container of flammable or combustible liquid in which articles or materials are immersed for the purpose of coating, finishing, treating or similar processes.

# Safe Packaging for Explosives

**by**
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*Jerry Greenway has worked in some form of packaging throughout his entire career. He enjoys working on new designs of shipping containers and has saved several millions of dollars doing just that. He earned his doctorate in packaging in the Food Science Department at Rutgers University and teaches packaging to engineers at the University of Missouri-Rolla.*

## Introduction

To many young Explosive Engineers fiberboard boxes represent the only container in which you have experience in receiving conventional commercial explosives. However, those powdermen with more than twenty-five years of explosive experience can easily recall the ornate wooden boxes used with the day to day operations prior to the dominance of the fiberboard (or more commonly cardboard) explosive container. Unfortunately, the era of wooden explosive boxes is gone and only occasional discoveries at flea markets or in long forgotten storage sheds does one see what has become a collection treasure for old powdermen. It is unlikely that the industry will ever see the wooden box containers for commercial products in the future.

It may be a little surprising to the younger Engineers that the fiberboard powder box has been approved for use in our industry for over 60 years! Table I presents a time line history for commercial explosive boxes. First accepted by the Department of Transportation (DOT) in 1931 the use of fiberboard boxes for commercial explosives was slow to be accepted by the industry. The acceptance of polyethylene case liners in 1953 significantly improved the leakproofness quality of the fiberboard powder boxes. Eventually, with the advent of more competitive blasting alternatives to nitroglycerine based explosives and the increased safety parameters surrounding water based composite explosive compositions the fiberboard shipping container came to dominance by 1970. Although not as quickly in time frame the wooden boxes generally associated with nitroglycerine based products eventually converted to fiberboard containers as technology improved to minimize nitroglycerine leakage from the paper shells used to contain the explosive.

The use of fiberboard shipping containers for commercial explosives has been governed by the DOT based on standards determined decades ago. The industry has seen remarkable advancements in explosive technology since the 1960's, however, fiberboard box design was slower to progress due to

the rather simplified and somewhat ungoverned standards for fiberboard explosive containers in the past. Between the period from 1982 to 1991 significant effort between the DOT and explosive manufacturers was spent to attempt to define fiberboard performance standards for containers used to ship commercial explosives. The outcome of ten years of effort and compromise exists today as a set of standards based on United Nations (UN) recommendations for packaging standards throughout the world. HM 181 has arrived and without question the explosive industry is significantly effected by the final regulations of this law.

CFR 49 (171-178)-HM 181

Too few individuals in our industry are familiar with HM 181 which clearly defines the regulations for Hazardous Materials Transportation. The old title of "shipping clerk" for explosives has become a job definition of the past. Today it is essential that the manufacturers, distributors, and users of explosives are sure that all involved with handling and shipping explosives are educated and aware of the responsibilities defined by HM 181.

Table II is a brief Guide for Shippers of Hazardous Materials as presented by the US Department of Transportation. Specific details are included in the Code of Federal Regulations (CFR), Title 49, Transportation, Parts 100-1. Primary manufacturers of explosives are most concerned with the 12 Steps to Compliance, however, any entity receiving and reshipping commercial explosives need to be aware of their responsibilities involving the transportation of Hazardous Materials.

Commercial explosives in particular are defined as a CLASS 1 dangerous good. Table III defines the most common products shipped in conventional fiberboard boxes. Detonators, boosters, detonating cord, ANFO, and other key items of our industry are contained in the five divisions of Class 1 Dangerous Goods. Upon receipt of explosive products the receiver should inspect and confirm the case markings before redistributing any explosive products. Included in these five divisions are proper UN shipping numbers for the explosive being transported. These divisions and UN numbers went into law in October 1993.

All containers for commercial explosives now carry a uniform identification system for defining the contents of the shipping box. Proper shipping labels are generally included on the box by the box supplier. All manufacturers are required to include an EX number on each case or with the shipping papers which can be used by DOT to confirm the transportation authorization for any given product.

In addition to these regulations which cover the proper labeling of shipping containers are specific requirements covering loading, blocking, and bracing explosive shipments and proper use of transport placards. In that all explosives are classified as Hazardous Materials there are specific training requirements for individuals who handle explosives that cannot be addressed in this paper. Included on the DOT Guide for Shippers is the clear warning: "It is the duty of each person who offers hazardous materials for transportation to instruct each of his officers, agents, and employees having any responsibility for preparing hazardous materials for shipment as to the applicable regulations..." (Section 173.1 b)).

## Performance-Oriented Packaging Standards

Since the advent of fiberboard explosive boxes to replace conventional wooden boxes there has been a significant degree of improvement in the quality of box designs. Over the past twenty years the industry has seen some box designs that barely met requirement standards while some companies went so far as to promote the quality of a specific box design to further promote their explosive products. In general it was perceived by many that the quality of the shipping container was falling prey to the highly competitive explosive industry. Acceptance of UN recommendations for performance packaging standards has redefined the requirement for fiberboard containers which in general supplies the explosive industry with a suitable shipping container that can be generally improved upon, but not compromised.

To meet performance standards for fiberboard containers as outlined in the Hazardous Materials Guide, Subpart L, Section 178.500, explosive manufacturers and fiberboard box companies benefited by working together to resolve the new UN requirements. Additionally, the academic community and Corporate R & D groups joined together to insure each other that the box standards set by UN guidelines were met. Effective October 1994 shipping containers manufactured for commercial explosives will bear an official UN seal indicating that performance

standards are confirmed. Additionally, recertification of performance standards will be required every 12-24 months depending upon specific box application. These new regulations will provide the industry with a set of standards to better insure that the Transportation of Hazardous Goods will be safely performed in a consistent manner by all countries of the United Nations.

Table IV presents standards for fiberboard boxes as defined in the Hazardous Materials Guide, Section 178.516. Table V defines testing requirements for fiberboard boxes to meet UN performance standards as stated in Subpart M Section 178.600. As previously mentioned, both box supplier and manufacturer have worked together to meet the testing requirements for certification. It should be noted that various testing laboratories are currently used as third party certification agencies of the United Nations to issue the actual permit required for fiberboard boxes proposed for use with commercial explosives. The identification seal of those agencies is required as part of the UN certification process and will be displayed on each box approved as a shipping container.

For the most part the requirements for performance standardization are not difficult to achieve since explosive manufacturers have been aware of the important function of the powder box. The most stringent requirement of the new performance standards has come in the stacking quality of the shipping container. Over the years of conversion from wood boxes to fiberboard boxes magazine keepers are most aware of the loss of stacking strength in fiberboard boxes compared to the old durable wooden boxes. Effects of transportation, handling, and climatic conditions can topple the cases of the best magazine keepers in the business. Studies have shown that with breakthrough technologies of the corrugation industry the stacking strength of the fiberboard box will be achieving new standards of excellence in the upcoming years.

## TABLE I: Evolution of Boxes for Explosives (*)

| | |
|---|---|
| 1907 | Box made of 1/2 inch thick lumber, with "nailed and lock-cornered construction", is approved standard. |
| 1914 | IME studies standardization of lining paper. |
| 1926 | IME Tests various boxes utilizing pine, plywood, and cleating. |
| 1927 | Cleated boxes first used in industry. |
| 1928 | ICC authorized a lock cornered box. |
| 1931 | Fiberboard boxes for dynamite approved by ICC. |
| 1953 | Polyethylene or other efficient materials allowed as a replacement for paper case liners. |

(*) As researched by Mr. Robert Hopler for the 75th Anniversary tribute to the Institute of Makers of Explosives (IME).

## Table II: Hazardous Materials Transportation Guide for Shippers (*)

| | |
|---|---|
| STEP 1: | Determine The Proper Shipping Name |
| STEP 2: | Determine The Hazard Class or Classes |
| STEP 3: | Determine The Mode(s) Of Transport To Ultimate Destination |
| STEP 5: | Select The Proper Label(s) And Apply As Required |
| STEP 6: | Determine And Select The Proper Packages |
| STEP 7: | Mark The Packaging (Including Overpacks) |
| STEP 8: | Prepare Shipping Papers |
| STEP 9: | Certification |
| STEP 10: | Loading, Blocking, and Bracing |
| STEP 11: | Determine The Proper Placecard(s) |
| STEP 12: | Hazardous Waste/Hazardous Substance |

(*) as contained in U.S. Department of Transportation handout from Research and Special Programs Administration titled HAZARDOUS MATERIALS TRANSPORTATION GUIDE FOR SHIPPERS (7.3)

## Table III: Explosive Categories

| DOT Designation | Common Name |
|---|---|
| Explosive, blasting, type A 1.1D UN 0081 II | Dynamite |
| Explosive, blasting, type B 1.1D un 0082 II | Low Water Explosive |
| Explosive, blasting, type E 1.1D un 0241 II | Emulsion, Gel High Explosive |
| Explosive, blasting, type E 1.5D un 0332 II | Emulsion,Gel Blasting Agent Ammonium Nitrate-Fuel Oil |
| *Mixture* 1.5D UN 0331 II | *ANFO* |
| Detonators, electric 1.1B un0030 II | Class A Electric Cap |
| Detonators, electric 1.4B un0255II | Class C Electric Cap |
| Detonators, non-electric 1.1B un0029 II | Class A Non-Electric Cap |
| Detonators, non-electric 1.4B un0267 II | Class A Non-Electric Cap |
| Booster 1.1D un0042 II | Cast Primer or Equivalent |
| Cord, detonating 1.1D un0065 II | Class A |
| Cord, detonating 1.4D un0289 II | Class C |
| Ammonium Nitrate 5.1 un1942 II | Fertilizer |

# QUESTIONS ANSWERS

by Stan Lippincott

*We continue to receive questions about proper priming and initiation techniques, accounting for the questions selected for this issue.*

**Q. "Back in the November/December 1992 EEJ issue you answered a question about adequate priming. Would you comment more on this subject?"**

A. This is a very timely question, since I was recently collecting information on the minimum priming requirements for the various water gel, emulsion and blend products available on the market today. I asked our good friend Jim Heinlen for his input and received these comments:

"The question of minimum priming can become rather complex when the different types of priming material are considered. If there is any question about the proper priming material are considered. If there is any question about the proper priming technique for any of these products, it is recommended that the user contact their supplier for assistance."

He further suggests consideration of the following:

- Some manufacturers recommend a standard cap as a minimum to initiate certain products.
- In today's industry it is unclear what is considered a "standard cap". In some cases it is considered to be a No. 8 strength cap as described by the USBM tests.
- Some foreign caps are being classed as No. 8 and they all do not fit the USBM test description.
- Some caps are classed as No. 12 caps. The industry does not have a description for a No. 12 cap.
- Some caps are considered to be "No. 12" caps if they have a base load of 12 grains of PETN. The initiating capability of a cap is greatly affected by the amount of compaction of the base charge.
- Some caps that were classed as "No. 12" caps have had their base charges reduced to pass the DOT 1.4B tests. This reduced the initiating capabilities of these caps.
- The caps that have higher output than No. 8 caps are usually called "high strength" caps. The output of these caps vary. There is no industry standard for "high strength" caps.
- The initiating capability of cast boosters varies considerably with composition.
- The minimum priming requirements for ANFO products varies from a high strength cap for industrial grade prills blown into a small diameter hole to a 5lb. cast booster in extra large holes.
- ANFO is made from ammonium nitrate prills that come in many different grades. There are many different priming requirements and hole diameter restrictions for the products made with these different grades of prills.
- Emulsions come in different levels of sensitivity, sometimes with the same product name.
- Emulsion blends made with prills that have an excess of fines often require more priming than blends made with prills with a standard amount of fines.
- An emulsion blend in a 150 ft. deep hole might require more priming than the same blend in a 20 ft. deep hole.
- A 1 lb. cast booster might be adequate priming for an emulsion blend in a 6" diameter hole and be very inadequate for priming an 18" hole of the same blend.
- Many priming recommendations are determined by shooting products with one primer at a time in laboratory conditions. The advent of the VODR has

shown that many products are adversely affected by transient pressure created by holes that have previously fired.

- When the main priority of the person loading the shot is cost, the tendency is to under prime.
- When the main priority of the person loading the shot is fragmentation, the tendency is to over prime.

Any additional thoughts you may have on this very important subject will be welcomed.

**Q. "Can emulsions and emulsion blends be used safely with electric blasting caps?" (This question came from one of our overseas ISEE members, where emulsions and blends are just beginning to be introduced).**

A. Yes, electric blasting caps can be and are being used safely with emulsions and emulsion blends. The only concern I would have, other than the usual concerns of static, stray and induced currents, would be if the cap leg wires became abraded and current bleed-off occurred. We experienced this situation with bulk water gels in Florida some years ago. Random misfires were occurring and the reason was not readily apparent. On investigation, we found some cap leg wires had exposed wire, which allowed the current from the blasting machine to bleed off into the conductive water gel. This resulted in insufficient current for the initiation system. Correcting the abrasion problem corrected the misfire problem.

# Safety MUSINGS OF A Philosopher

## Relating to Blasting Safety

*By Ralph Dawson*

***ALWAYS AND NEVERS continuing the "walk-thru"***

***REMINDER TO BLASTERS: Use the "Always and Nevers" regularly to orient new members of your crew.***

### Using Explosive Materials: Loading and Tamping

#### Loading

**ALWAYS** check each borehole to assure it is safe for loading.

One of the common observations over the years, someone in the loading crew checks a few holes at random locations and presumes that all holes are OK. The only positive way to assure that there will be no surprises once loading begins is to check every hole. On short holes, the loading pole is ideal-not only for clearance but for expected or needed depth. For deeper holes, on a sunny day, the mirror is an excellent way to check for obstructions, otherwise the tape measure to check for clearance and depth.

**ALWAYS** take precautions during pneumatic loading to prevent the accumulation of static charges.

The use of semi-conductive loading hose typically controls the static to safe levels. However, the hose must be inspected regularly and replaced when necessary. Each company will have specific rules governing pneumatic loading.

**NEVER** place any unnecessary part of the body in front of the borehole when loading, tamping, or stemming.

This refers to horizontal holes, typically underground. The corollary for vertical holes, is to stand beside, never directly over the hole.

**NEVER** force explosive materials into a borehole.

Many tragedies have occurred from this unsafe practice. Repeating an often stated reminder-every blast crew must have the tools needed to control the loading process, such as the stinger, the lowering hook, the retrieving hook, etc.

**NEVER** load a borehole containing hot or burning material. Temperatures above 150°F could be dangerous.

Since the practice of "springing" holes to enlarge the bottom area using explosives has, we understand, almost been eliminated, hot holes are much less common. There used to be one coal area in Pennsylvania that typically had very high ground temperatures to require special loading materials and techniques. The 150°F temperature limit is the temperature that every detonator manufacturer designs their product to withstand. Obviously, any temperature exceeding 150°F could detonate the detonators.

**NEVER** spring a borehole near other holes loaded with explosive materials.

The danger here is the potential for propagation. Do not get lulled into the false security that the danger is reduced because you may be using less sensitive materials such as ANFO or emulsions. The rule is **NEVER**- regardless of the type explosive materials.

**NEVER** stack more explosive materials than needed near working areas during loading.

The object here is to avoid a common practice of off-loading the remainder of the materials brought from the magazine and not used in the normal distribution at each hole **near the blast loading area.** Move the leftovers away some distance so that an accidental detonation will not propagate to these materials.

**NEVER** drop another cartridge directly on the primer.

The primer typically is the most potentially sensitive unit in the borehole–so every loading technique is intended to protect the primer. One very common practice of experienced blasters is to set the next cartridge on top of the primer and lower both together.

### *Tamping*

**NEVER** tamp a primer or explosive material removed from its cartridge.

It is not often that a primer is removed from the package it came in, but the safe rule recognizes that without a package, the detonator is not as secure, and thus more susceptible to move around.

**NEVER** tamp explosive materials with metallic devices, except jointed non-sparking poles with nonferrous metal connectors.

The knife used to cut and slit cartridges is typically the only non-sparking metal that the blast crew should have. Attempts to use non-sparking knives has not been too successful because those metals will not stay sharp.

**NEVER** tamp violently.

Violently is an interesting word choice in the art of tamping. Experienced blasters learn quickly that if a few light taps do not get the job done, then all the more vigorous action leading up to "violent," will not compress the charges anymore. There should **NEVER** be a necessity to tamp violently. **NEVER.** When anyone in the crew approaches the violent stage of tamping, the blaster in charge had better review the loading practices.

**NEVER** kink or damage safety fuse, detonating cord, shock tube, plastic tubing or wires of detonators when tamping.

The outer covering for all the named items have been made tougher to damage in recent years, but the very small diameters carry a critical material inside whose integrity must be kept intact. The continuous flow of whatever energy is inside is crucial to detonating each hole in sequence per the blast design. The first requirement to reduce the possibility for damage is to pull the cord, tube, etc. taut (straight) so there are no loops in them.