

**EXPLOSIVE HANDLING AND  
DEMOLITION WORK PLAN  
FOR  
U.S. NAVY PRIME CONTRACT N62472-94-D-0398  
DELIVERY ORDER 0013 - B TANK FARM 4  
NAVAL EDUCATION AND TRAINING CENTER  
NEWPORT, RHODE ISLAND**

A

Prepare in quintuplicate (original and 4 copies)  
CONTROL NO 25B

CONTRACTOR DRAWINGS & INFORMATION SUBMITTAL  
NORTHNAVFACENGCOM 4335/3 (Rev 6/80)

CONTRACT NO <b>N62472-94-D-0398</b>	DELIVERY ORDER # <b>0013</b>	ACTIVITY LOCATION <b>Newport, Rhode Island</b>
PROJECT TITLE <b>Tank Farm 4 at NETC</b>		
FROM <b>Foster Wheeler Environmental Corp/ Program QCM: Akram Aziz</b>	DATE <b>May 1, 1997</b>	
TO <b>COTR: P. Briegel (3 copies)</b>	DATE <b>May 1, 1997</b>	

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ITEM NO.	SUBMITTAL DESCRIPTION	PREPARED/ SUBMITTED BY	APPROVED	DISAPPROVED	REMARKS
25B	SD-18, Records Draft Final Explosive Handling and Demolition Work Plan from North American Industries Services.	A. Aziz			

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Prepared For:

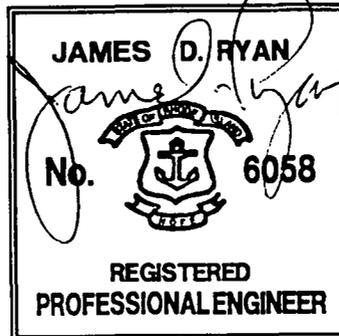
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APRIL 1997

CHA Project No: 6363.14.01

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Rhode Island Professional Engineers Seal

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### **FIGURES:**

Figure 1 - Site Location Map

Figure 2 - Site Plan

### **DRAWINGS:**

Drawing 1 = UST Plan

Drawing 2 = Structural Column Elevation

### **APPENDIXES:**

Appendix A = NAIS Blasting Applications for Permit

Appendix B = NAIS Licence to Conduct Blasting Operations

Appendix C = Regulations

Appendix D = Calculations of Powder Factor

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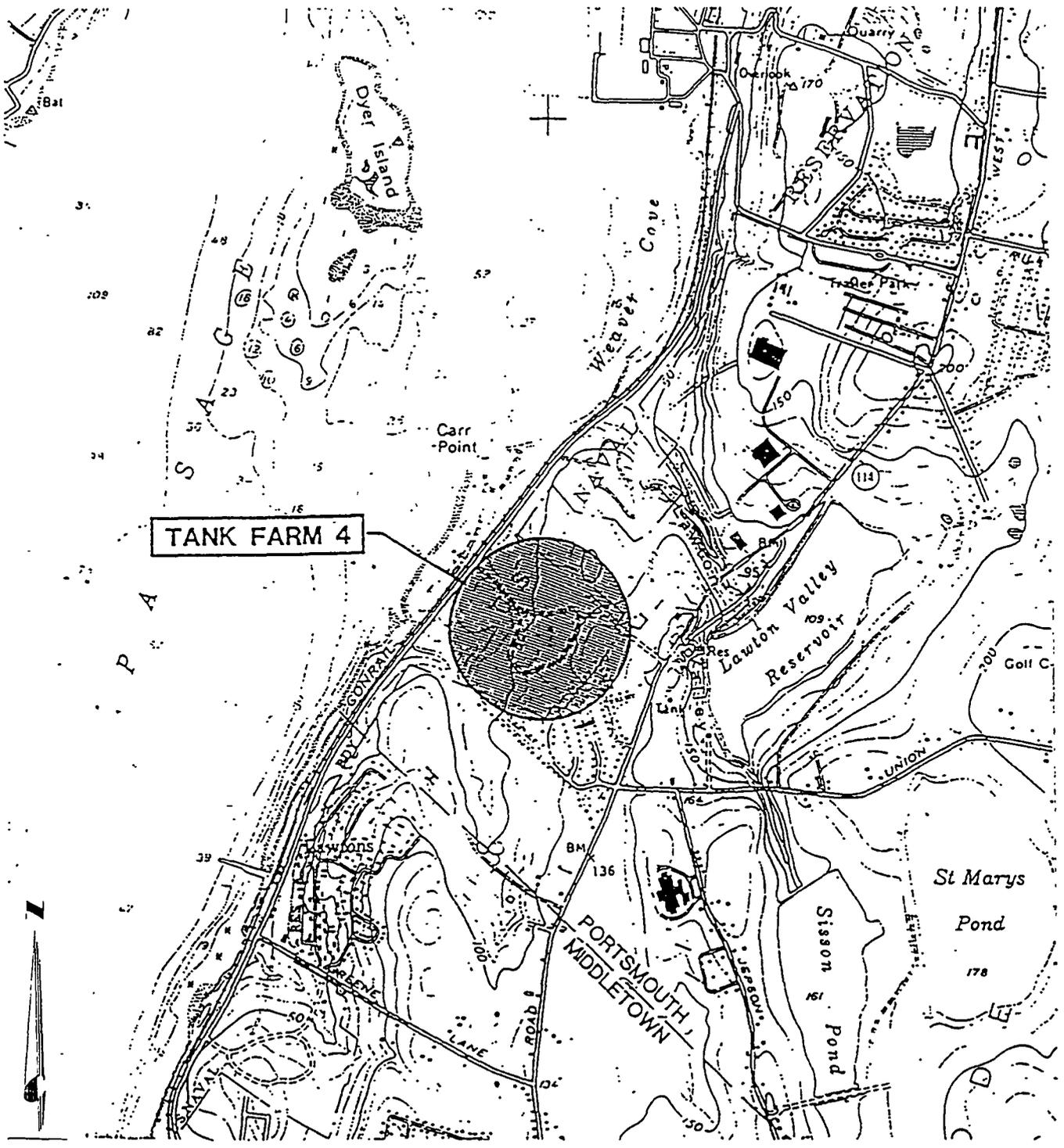
**1.0 INTRODUCTION**

Clough, Harbour and Associates LLP (CHA) was retained by North American Industrial Services, Inc. (NAIS) to author a Explosive Handling and Demolition Work Plan for the implosion of 12 underground storage tanks (USTs) at the United States Naval Education and Training Center in Newport, Rhode Island (U.S. Navy Prime Contract N62472-94-D-0398).

Pursuant to the required Tank Demolition Subcontractor Requirements, this explosive handling and demolition work plan address the requirements for site safety, precautionary measures for adjacent structures, fire protection, dust control, drilling methods, handling of explosives, placing of explosives, blasting sequence and misfires. The noted requirements conform to Federal and State regulations concerning demolition activities and explosive usage.

The 12 USTs are located at the Naval Education and Training Center in Tank Farm 4, south of Defense Highway along the coast of Narragansett Bay (Figure 1). The USTs are spaced on each side of Loop Road at the end of the cul-de-sac. On the interior of the cul-de-sac there are four USTs and along the perimeter of the cul-de-sac are eight USTs (Figure 2). Each UST is cylindrical in shape with the diameter of the tank measuring approximately 120 feet and a maximum height of approximately 34 feet. Structural supports consist of 32 circular steel reinforced concrete columns, with a diameter of approximately 1 foot - eight (8) inches. The columns are spaced a minimum of 14 feet from the interior wall and 17 feet from each column. Prior to demolition, the USTs will be filled with 15 feet of clean sand. There is approximately four (4) feet of seeded soil over the UST covers. Two openings nine (9) feet by 13 feet currently exists in the cover of each UST. The nearest structure to the USTs is approximately 350 feet away.

The blasting agents for this project will consist of a maximum of 400 pounds of Class A explosives (Power Ditch 1000), and charges using detonating cord and electric blasting caps, for each of the USTs. The United States Occupational Safety and Health Administration (OSHA) defines an explosive as any chemical compound, mixture, or device, the primary or common purpose, of which is to function by explosion, (i.e., with substantially instantaneous release of gas and heat). The term "explosives" shall include all material which is classified as Class A, Class B, and Class C explosives by the OSHA, and includes, but is not limited to dynamite, black powder, pellet powders, initiating explosives, blasting caps, electric blasting caps, safety fuse lighters, fuse igniters, squibs, cordeau detonant fuse, instantaneous fuse, igniter cord, igniters, small arms

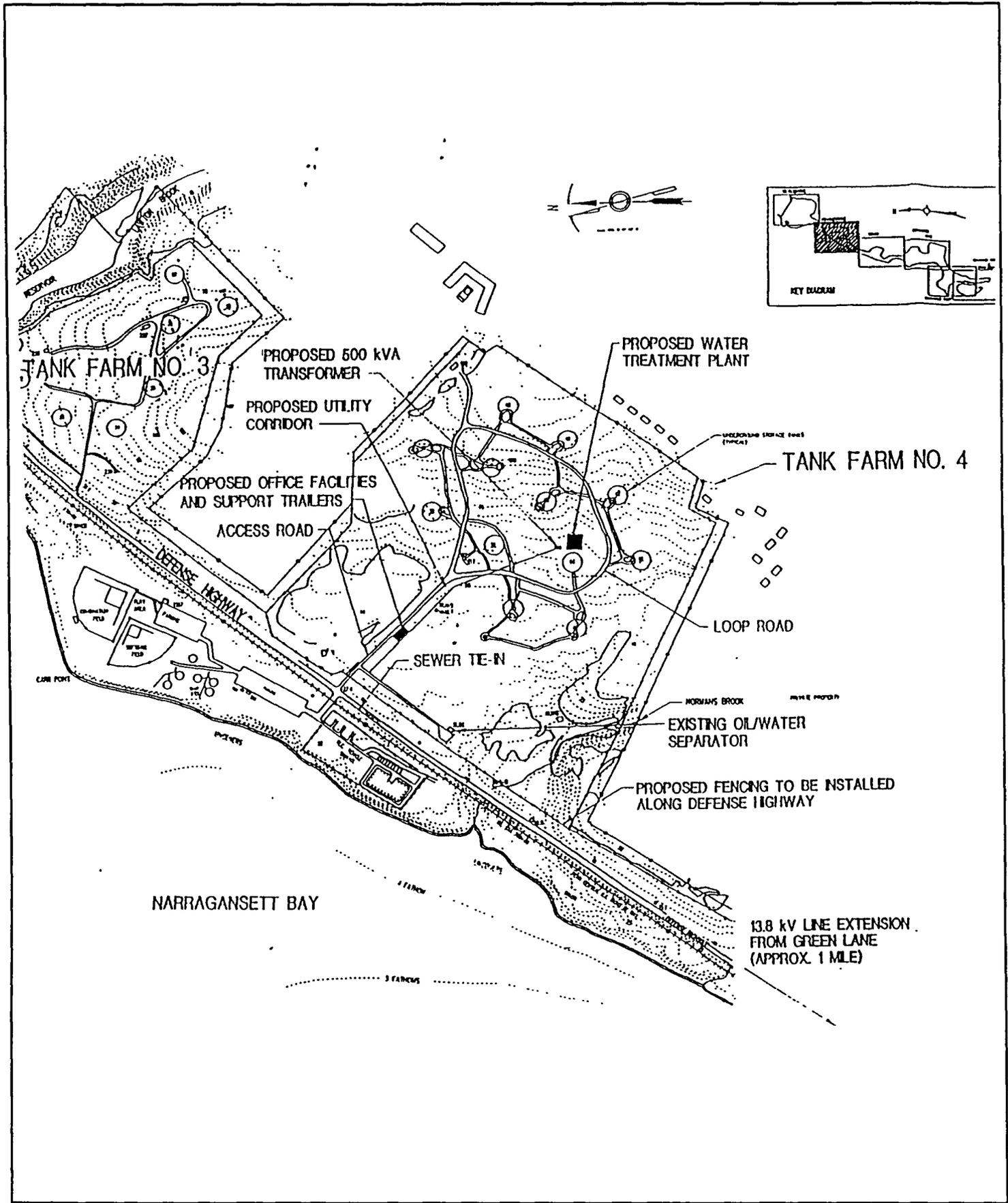


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FIGURE 1  
**SITE LOCATION MAP**

EXPLOSIVE HANDLING & DEMOLITION WORK PLAN  
 NAVAL EDUCATION & TRAINING CENTER  
 NEWPORT, RHODE ISLAND



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**FIGURE 2  
 SITE PLAN**

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ammunition, small arms ammunition primers, smokeless propellant, cartridges for propellant-actuated power devices, and cartridges for industrial guns. Commercial explosives are those explosives which are intended to be used in commercial or industrial operations.

Class A explosives are those possessing, detonating, or otherwise maximum hazard; such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.

Class B explosives are those possessing flammable hazard, such as propellant explosives (including some smokeless propellants), photographic flash powders, and some special fireworks.

Class C explosives include certain types of manufactured articles which contain Class A or Class B explosives, or both, as components but in restricted quantities.

## **1.1 RELATED REGULATIONS**

The requirements of the various codes referred to within this work plan are to be complied with. The referenced codes and regulations shall be of the date of the latest version in effect at the time of the work activity. Regulations applicable to the UST implosion work include worker protection through the Rhode Island and OSHA.

- Rhode Island Rules and Regulations of the State Fire Marshal, Section 10.
- 29 CFR 1926.900-914; Subpart U. "Blasting and the Use of Explosives" - OSHA.
- 29 CFR 1926.850; Subpart T. "Demolition" - OSHA.
- 29 CFR 1910.109. "Explosives and Blasting Agents" - OSHA.

## **2.0 SITE SAFETY REQUIREMENTS**

The site safety requirements are detailed within the NAIS Site Safety Plan (SSP) for the project and are bound under a separate cover. Included within the NAIS SSP, but not limited to the SSP, are the following detailed items as outlined in the Rhode Island Rules and Regulations of the State Fire Marshal and OSHA regulations as outlined in Title 29 of the Code of Federal Regulations, Part 1926.900 (29 CFR 1926.900) - General Provisions.

### **2.1 OPERATIONS**

- A permit to blast shall be obtained from the State Fire Marshal at least three (3) working days prior to requested blast time. Copies of NAIS' blasting applications for permits are pending approval and are included in the Appendix.
- Blasting operations shall be conducted between sunrise and sunset; exceptions may be authorized by the State Fire Marshall.

Smoking, firearms, matches, open flame lamps, and other fires, flame or heat producing devices and sparks shall be prohibited in or near explosive magazines or while explosives are being handled, transported or used.

- All explosives shall be accounted for at all times. Explosives not being used shall be unavailable to persons not authorized to handle them. NAIS shall maintain an inventory and use record of all explosives. Appropriate authorities shall be notified of any loss or theft of explosives. No explosives or blasting agents shall be abandoned. Empty boxes and paper and fiber packing materials, which have previously contained high explosives, shall not be used again for any purpose, but shall be destroyed by burning at an approved location.
- Explosives, blasting agents, and blasting supplies that are obviously deteriorated or damaged shall not be used.
- No fire shall be fought where the fire is in imminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area guarded against intruders.
- Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity. These precautions shall include: 1) Detonators shall be short-circuited in holes which have been primed and shunted until wired into the blasting circuit. 2) The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm. 3) The prominent display of adequate signs, warning against the use of mobile radio transmitters, on all roads within 1,000 feet of blasting operations. 4) Compliance with the recommendations of The Institute of the Makers of Explosives with regard to blasting in the vicinity of radio transmitters as stipulated in Radio Frequency Energy -- A Potential Hazard in the Use of Electric Blasting Caps, IME Publication No. 20, March 1971.
- Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the operators and/or owners have been notified and measures for safe control have been taken.

## 2.2 PERSONNEL

- The handling and firing of explosives shall be performed by a person possessing a license to conduct blasting operations and a user's permit. Copies of NAIS' license to conduct blasting operations and the applicable user permits are included in Appendix B.
- Delivery and issue of explosives shall only be made by and to authorized persons and approved temporary storage or handling areas. All loading and firing shall be directed and supervised by competent persons thoroughly experienced in this field.
- No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs.

## 3.0 PRECAUTIONARY MEASURES FOR ADJACENT STRUCTURES

A pre-blast survey will be conducted to include video of any basements and foundations of adjacent structures. The distance from the UST implosion area and the closest structure will not be less than the scaled distance factor according to Rhode Island Fire Marshall and/or IME standards. A pre-blast inspection will be conducted to confirm scaled distance. To determine the maximum weight per timed explosive delay, the closest structure is estimated to be 350 feet from the blast area. Therefore, using the distance from the blast are to the closest item of concern divided by the scaled distance of 70, and squaring the quotient, the maximum weight per delay is determined to be:

$$\left(\frac{350 \text{ ft}}{70 \text{ ft/lb}^2}\right)^2 = 25 \text{ Pounds of explosives per delay}$$

## 3.1 GROUND VIBRATION AND AIRBLAST

In all commercial blasting operations a portion of the energy released upon detonation of the explosives is manifested as ground vibration and airblast. Except in geophysical prospecting, ground vibration is an undesirable by-product of blasting. Although ground vibration cannot be totally eliminated from blasting operations, it can be controlled or minimized by employing good blast design.

When an explosive material detonates in a borehole, the near-instantaneous generation of a shock wave and high pressure produces an intense stress wave in the surrounding rock. Practically all the energy in the explosion is expended in shattering and displacing the rock around it. The energy left over will be dissipated through the ground in the form of elastic waves that radiate away from the blast site. The explosion will have a three zone effect in the vicinity of the borehole. Immediately adjacent to the borehole, the explosive action pulverizes the material. As the stress

wave propagates outward from the hole, it rapidly decreases in intensity and the crushing action is reduced to a fragmenting stage. Finally, the strength of the stress wave is so attenuated that no breakage occurs, and the remaining vibratory energy is propagated outward as a seismic wave. This wave has no permanent displacement effect and all vibrating rock particles eventually return to their original position.

This latter zone, known as the “elastic zone”, might contain homes and other structures where occupants, fearful of personal injury and/or structural damage, may complain about the vibrations.

Blasting vibrations can be reduced by good blast design that provides an optimum powder factor and maximum practical relief. In addition, shorter holes in lower benches, deck loading and the use of delay initiators with sequential blasting machines or nonelectric delays and surface delay connectors to reduce the charge-weight-per-delay will help to decrease undesirable vibration.

Blasting vibrations can be detected and recorded by seismographs, and are usually measured in one of three modes: particle displacement, particle velocity or particle acceleration. These are measured as a function of time and are recorded in mutually perpendicular directions. Particle velocity measurement is most widely used when monitoring commercial blasting operations.

Based on a study of blasting vibration published by the United States Bureau of Mines (USBM) in Bulletin 656 the following equation was developed to determine maximum peak particle velocity:

$$V_{max} = k \left( \frac{D}{W^{1/2}} \right)^{-m}$$

Where

- V = maximum peak particle velocity, in/sec
- D = distance between the explosion and receiving sites (ft)
- W = weight of explosives detonated per delay interval of 8 milliseconds or more (lbs)
- K and -m = site factors based on the geology and ground transmission characteristics of the rock at the blast site as determined by seismographic measurements.

Based on a large number of field measurements made at actual blasting operations, it has been determined that the following propagation equation can be used to conservatively estimate peak particle velocity for blasting planning purposes.

$$V_{max} = 160 \left( \frac{D}{W^{1/2}} \right)^{-1.6}$$

Where.

Vmax = peak particle velocity (in/sec)

D = distance between explosion and recording site (ft)

W = weight of explosives detonated per delay interval of 8 milliseconds or more (lbs)

When site specific information is inputted into the above formula the following results:

$$V_{max} = 160 \left( \frac{350 \text{ ft}}{25 \text{ lb}^{1/2}} \right)^{-1.6} \therefore V_{max} = 0.179 \text{ inch/sec}$$

**Note:** For particular sites, the equation may have to be modified as site-specific seismic data become available.

As noted in Section 3.0, to control ground vibration from blasting, some regulatory agencies, Federal, State, or local, require that blasting operations conform to a specified scaled distance ( $D_s$ ). For ground vibrations, scaled distance ( $D_s$ ) is defined as the ratio of the distance "D" from the blast to a location of concern divided by the square root of the explosive weight "W" detonated in any delay interval of 8 milliseconds or greater. The formula for scaled distance is expressed as:

$$D_s = \frac{D}{W^{1/2}}$$

Thus:

$$D_s (\text{ft}/\text{lb}^{1/2}) = \frac{D (\text{ft})}{W^{1/2} (\text{lb})}$$

Usually blasting vibration regulations also specify that the maximum peak particle velocity generated in any of three mutually perpendicular directions, vertical, horizontal, or transverse, may not exceed a certain limit. The USBM study in Bulletin 656 concluded that 2.0 in/sec was a safe blasting limit.

In recent studies (USBM Report of Investigations 8507) the Bureau found that particle velocity is still the best single ground motion descriptor. The Bureau also investigated the roles of blast frequency and building construction as factors in damage potential from blasting vibrations.

As a point of reference for surface coal mine blasting operations, vibration and airblast are regulated by the Office of Surface Mining (O.S.M.) in 30 CFR, Parts 816 and 817. Under the O.M. regulations an operator may elect to use one of the following options to control blasting vibration:

- 1) Maximum allowable peak particle velocity from column 1 of Table 1.
- or
- 2) Scaled distance factor from column 2 of Table 1.

TABLE 1

Distance from Blast Site (In feet)	Maximum Allowable Peak Particle Velocity Inches Per Second (ips)	Scaled Distance Factor (ft/lb <sup>2</sup> ) Applied Without Seismic Monitoring
0-300 ft.	1.25 in/sec	50 ft/lb <sup>2</sup>
301-5000 ft.	1.00 in/sec	55 ft/lb <sup>2</sup>
5001 ft. and Beyond	0.75 in/sec	65 ft/lb <sup>2</sup>

As indicated in Section 3.0, the Rhode Island Fire Marshal has required the use of a scaled distance of 70 ft/lb<sup>2</sup>.

Many airblast complaints from blasting operations are based upon the annoyance that airblast can cause, rather than upon actual structural damage. The startling effect of noise and the rattling of windows causes people to naturally assume that their residence has shaken so violently that structural damage has occurred. Actually, the airblast from normal blasting operations is rather unlikely to cause structural damage. Airblast limits specified by O.M. regulations in 30 CFR for surface coal mining (noted below in Table II) represent acceptable safe limits and these limits are generally accepted by State and local regulatory agencies for commercial blasting operations.

TABLE II

Lower Frequency Limit of Measuring System, Hz ( $\pm$ 3dB)	Maximum Level in decibels
0.1 Hz or lower-flat response*	134 peak
2.1Hz or lower-flat response	133 peak
6.0 Hz or lower-flat response	129 peak
"C" Hz or lower-flat response*	105 peak dBC

\*Only when approved by the regulatory agency.

Hz = Hertz = Cycles per second      dB = Decibels

Airblast can be affected by many factors including blast site orientation, stemming, initiation system, blast pattern and atmospheric conditions such as temperature, wind direction, fog, haze, and

temperature inversion. All of these factors must be evaluated if airblast poses a problem at blasting operations.

When possible, blasts should be scheduled during busy hours of the day when they will be less noticeable and less disturbing. A blasting time schedule shall be developed and a system to provide adequate notification and warning to neighbors shall be implemented. Any complaints involving adverse effects from the blasting operations shall be recorded and investigated as soon as possible by NAIS.

The State Fire Marshal may also require certain precautionary procedures at any time to protect life and property. Where blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, or any other utility, the blaster shall immediately notify the appropriate representatives of such utilities in the advance of blasting, specifying the location and intended time of blasting.

The State Fire Marshal may suspend, revoke or deny a permit to blast to adequately protect life and property

In addition, OSHA requires when blasting is done in congested areas or in proximity to a structure, railway, or highway, or any other installation that may be damaged, the blaster shall take special precautions in the loading, delaying, initiation, and confinement of each blast with mats or other methods so as to control the throw of fragments, and thus prevent bodily injury to employees. When blasting near power lines, no leg or lead wires shall be long enough to come into contact with electric power lines.

#### **4.0 FIRE PROTECTION**

Fire protection shall be achieved by adhering to the Rhode Island Rules and Regulations of the State Fire Marshal, Section 10 and the applicable OSHA codes as outlined in 29 CFR 1926. These rules include, but are not limited to the following:

- There shall be no smoking, matches, or any other source of fire or flame within 100 feet of an area where explosives are being handled or used.
- Each vehicle used for transportation of explosives shall be equipped with a fully charged fire extinguisher, in good condition. An Underwriters Laboratory listed extinguisher of not less than 10-ABC rating will meet the minimum requirement. The driver shall be trained in the use of the extinguisher on his vehicle.
- Fire hoses and extinguishers will be maintained on site during all blasting activities.
- If fire comes into contact with explosives, all personnel shall be removed to a safe location and the area guarded against intruders and no attempt shall be made to fight such a fire except from a safe distance or shelter.

- All flammable and explosive materials, including fuel for on-site equipment will be stored in appropriate containers and stored away from the work area or any work that has the potential for producing heat, friction, sparks, or other sources of ignition. Any “hot work” will be monitored by safety personnel.
- The Rhode Island Fire Marshal, Local Fire Department and US Navy shall be notified 48 hours prior to blasting. The scheduled blasting activities will be outlined so that all parties notified are aware of the blasting events.

## **5.0 DUST CONTROL**

Dust control shall be instituted on-site by wetting the subject blast area prior to detonation and use of water spray from on-site fire hoses where needed for post blasting dust control.

During hole drilling operations within the tanks dust shall be controlled by applying a mist to the tank atmosphere via an exterior air fan. A hose shall supply a mist of water to an air current which will be supplied by a ventilation blower. The blower will be supplied air by an air compressor outside the tank. The volume of water-mist used shall be dictated by the amount of dust generated by the interior drilling activities.

## **6.0 DRILLING METHODS**

NAIS shall enter each UST according to the OSHA Confined Space Regulations 29 CFR 1910.146. Prior to entry an Ingersoll-Rand #750, air blower will be installed to provide air circulation during all confined space drilling operations. Each of the interior UST structural columns will be drilled with eleven (11) horizontal holes, 18 inches on center, along the vertical axis. Each hole will be 16 inches deep and have a diameter of 1.5 inches. The blast holes located at the top of the columns will be accessed by using a four-wheel drive, soft sand, man-lift, or other means of access, such as staging.

The soil cover over the ceiling slab of the UST will be excavated such that a five (5) foot wide strip of the slab is exposed along the perimeter of the tank by Foster Wheeler Environmental Corporation. The excavation walls will be sloped back at a one-on-one ratio. After the excavation is complete, the ceiling slab will be saw-cut eight (8) inches deep, in 10 foot arcs, approximately two feet from the interior tank wall towards the center of the tank. A four (4) foot space between each 10 foot arc will be left uncut. Approximately one (1) foot from the interior tank wall and within the four (4) foot uncut area, two (2), 1.5 inch diameter blast holes will be drilled eight (8) inches deep. The standard size of the explosives used on site shall be one and a quarter inches in diameter.

The drilling will be accomplished using a model CP22 drill with 16 inch steel bars and carbide steel button tip drill heads. Drawings 1 and 2 indicate the placement of the saw cuts and the blast holes.

In addition to the above, drilling will conform with 29 CFR 1926.905, including but not limited to, the following:

- All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives. Holes shall be checked prior to loading to determine depth and conditions.
- Where required, 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 refired before work proceeds. Where a hole has been loaded with explosives, but the explosives have failed to detonate, there shall be no drilling within 50 feet of the hole.
- No person shall be allowed to deepen drill holes which have contained explosives or blasting agents.

## **7.0 HANDLING AND PLACING OF EXPLOSIVES**

The placement of explosive materials shall be conducted and limited to the following.

- Each blast hole within the columns shall be loaded with 3/4 pounds of explosives. The maximum amount of explosives used within each ceiling slab blast hole shall not exceed 1/4 pounds. The ceiling slab will be detonated, using detonating cord trunk line. A maximum of 16.5 pounds of explosives per delay will be used.
- After the explosives have been placed in the ceiling slab, the excavation will be carefully filled with three (3) feet of soil to prevent fly rock by Foster Wheeler Environmental Corporation.
- Tamping shall be done only with wood rods or plastic tamping poles without exposed metal parts, but non-sparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. The primer shall never be tamped.
- No holes shall be loaded except those to be fired in the next round of blasting.
- Machines and all tools not used for loading explosives into bore holes shall be removed from the immediate location of holes before explosives are delivered.
- No activity of any nature other than that which is required for loading holes with explosives shall be permitted in a blast area.
- No explosive shall be loaded or used underground in the presence of combustible gases or combustible dusts.

All blast holes in open work shall be stemmed to the collar or to a point which will confine the charge. Stemming is defined by OSHA as a suitable inert incombustible material or device used to confine or separate explosives in a drill hole, or to cover explosives in mud-capping.

- Warning signs, indicating the 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.
- The blaster shall keep an accurate, up-to-date record of explosives, blasting agents, and blasting supplies used in a blast and shall keep an accurate running inventory of all explosives and blasting agents stored on the operation.
- No primers shall be made up in excess of the immediate needs. No primers shall be made up in a magazine or near an excessive amount of explosives.

#### **7.1 ELECTRICAL DETONATION PREPARATION**

After the column blast holes are drilled and the Powerditch 1000 explosives, primed with a 16 foot Masterdet Blasting Cap are placed, the caps will be wired in series parallel. Five series of 82 caps will be placed and checked for resistance using a galvanometer. To insure a balanced series, the resistance will be 32.8 Ohms plus the bus wire and lead wire. Both bus and lead wires are 14 ga. copper wire. See Drawing 1 for column placement and drawing 2 for delay series. In addition to the above electrical detonation requirements, the following will be adhered to:

- Power lines and portable electric cables for equipment being used shall be kept a safe distance from explosives or blasting agents being loaded into drill holes. Cables in the proximity of the blast area shall be de-energized and locked out by the blaster.
- Electric blasting caps shall not be used where sources of extraneous electricity make the use of electric blasting caps dangerous. Blasting cap leg wires shall be kept short-circuited (shunted) until they are connected into the circuit for firing.
- Before adopting any system of electrical firing, the blaster shall conduct a thorough survey for extraneous currents, and all dangerous currents shall be eliminated before any holes are loaded.
- In any single blast using electric blasting caps, all caps shall be of the same style or function, and of the same manufacture.
- Electric blasting shall be carried out by using blasting circuits or power circuits in accordance with the electric blasting cap manufacturer's recommendations, or an approved contractor or his designated representative.

When firing a circuit of electric blasting caps, care must be exercised to ensure that an adequate quantity of delivered current is available, in accordance with the manufacture's recommendations.

- Connecting wires and lead wires shall be insulated single solid wires of sufficient current-carrying capacity.
- Bus wires shall be solid single wires of sufficient current-carrying capacity. When firing electrically, the insulation on all firing lines shall be adequate and in good condition. A power circuit used for firing electric blasting caps shall not be grounded.
- Blasting machines shall be in good condition and the efficiency of the machine shall be tested periodically to make certain that it can deliver power at its rated capacity. When firing with blasting machines, the connections shall be made as recommended by the manufacturer of the electric blasting caps used. The number of electric blasting caps connected to a blasting machine shall not be in excess of its rated capacity. Furthermore, in primary blasting, a series circuit shall contain no more caps than the limits recommended by the manufacturer of the electric blasting caps in use.
- The blaster shall be in charge of the blasting machines, and no other person shall connect the lead wires to the machine.
- Blasters, when testing circuits to charged holes, shall use only blasting galvanometers equipped with a silver chloride cell especially designed for this purpose.
- In electrical firing, only the man making lead wire connections shall fire the shot. All connections shall be made from the bore hole back to the source of firing current, and the lead wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired.
- After firing an electric blast from a blasting machine, the lead wires shall be immediately disconnected from the machine and short-circuited.

## **8.0 BLASTING SIGNALS**

A code of audible blasting signals, as outlined below, shall be posted on one or more conspicuous places at the blasting operation area.

- Three (3) long horn blasts = 15 minutes to explosive blast.
- Two (2) long horn blasts = 2 minutes to explosive blast.

- One (1) long horn blast = 1 minute to explosive blast.  
Two (2) short horn blasts = All clear.

All employees shall be required to familiarize themselves with the code and conform to it. Danger signs shall also be placed at suitable locations.

Before a blast is fired, the warning signals shall be given by the blaster in charge, who has made certain that all surplus explosives are in a safe place and all employees, vehicles, and equipment are at a safe distance, or under sufficient cover. Flagmen shall be safely stationed on highways passing through the danger zone so as to stop traffic during blasting operations. It shall be the duty of the blaster to fix the time of blasting. Before firing an underground blast, warning shall be given, according to the above schedule, and all possible entries into the blasting area, and any entrances to any working place where a drift, raise, or other opening is about to hole through, shall be carefully guarded. The blaster shall make sure that all employees are out of the blast area before firing a blast.

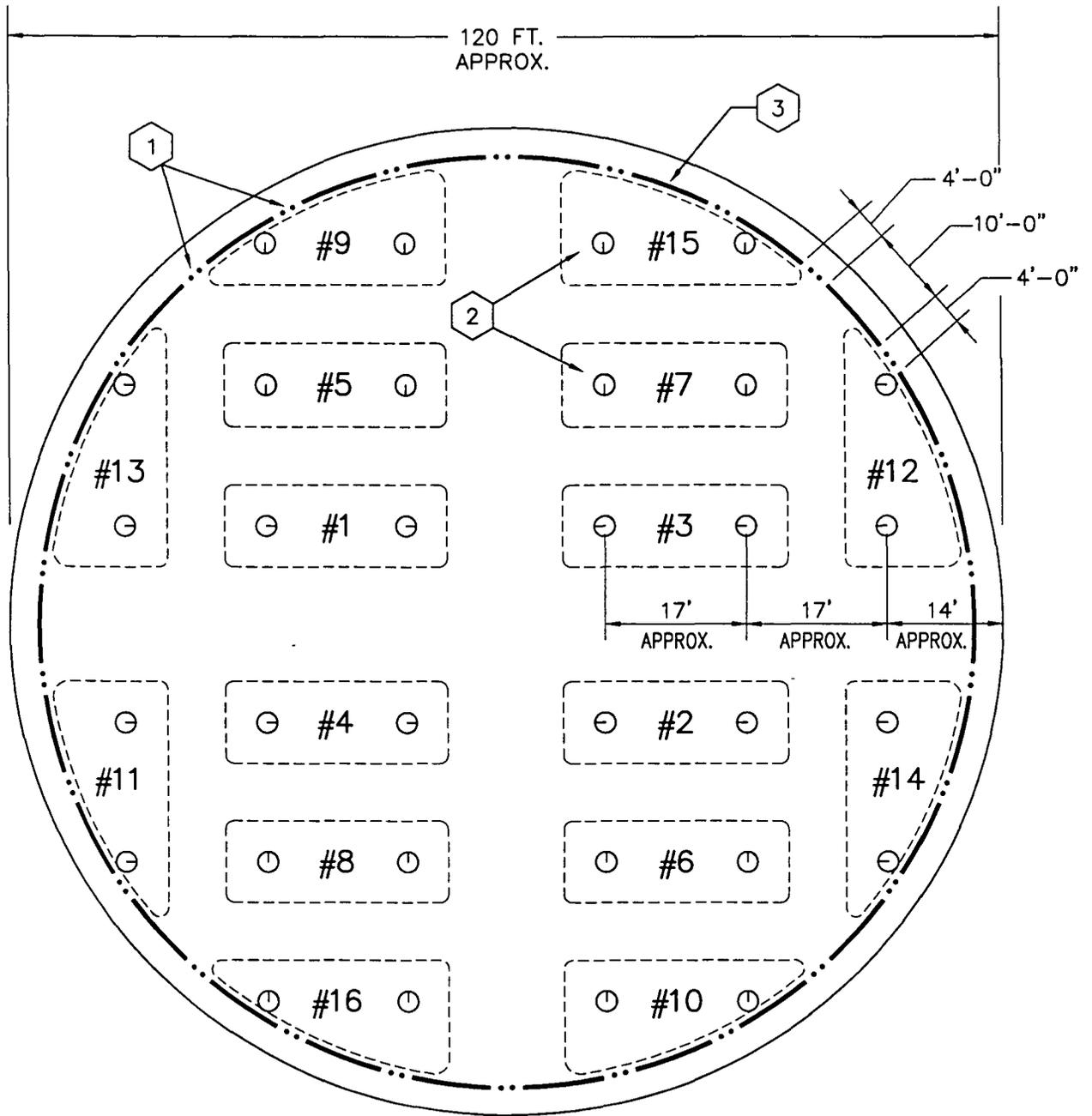
## **9.0 BLASTING SEQUENCE**

After the holes are successfully loaded and the Blaster has cleared the blasting area, the 50 charges in the ceiling slab will be simultaneously detonated. After a 25 millisecond firing delay, column groups of two will be demolished at a 25 millisecond firing delay from each group of two. It is estimated that the loading and blasting of one UST would take one, eight hour day. The blasting event is estimated to take approximately 0.40 seconds per UST. Only one UST would be demolished at a time.

## **10.0 PROCEDURES TO DEAL WITH EXPLOSIVE MISFIRES**

If a misfire is found, the blaster shall provide proper safeguards for excluding all employees from the danger zone. No other work shall be done except that necessary to remove the hazard of the misfire and only those employees necessary to do the work shall remain in the danger zone. No attempt shall be made to extract explosives from any charged or misfired hole; a new primer shall be put in and the hole reblasted. If refiring of the misfired hole presents a hazard, the explosives may be removed by washing out with water. If there are any misfires while using cap and fuse, all employees shall remain away from the charge for at least 1 hour. Misfires shall be handled under the direction of the person in charge of the blasting. All wires shall be carefully traced and a search made for unexploded charges. No drilling, digging, or picking shall be permitted until all missed holes have been detonated or the authorized representative has approved that work can proceed.

**DRAWINGS**



**LEGEND:**

- ⊙ STRUCTURAL CONCRETE COLUMN W/BLAST HOLES
- CEILING BLAST HOLES
- COLUMN GROUPS TO BE BLASTED SIMULTANEOUSLY
- #1 BLAST SEQUENCE NUMBER (25ms BLAST DELAY SEQUENCE)

**NOTES:**

- 1 THE CEILING BLAST HOLES WILL BE CHARGED SIMULTANEOUSLY.
- 2 THE REMAINING COLUMN GROUPS WILL BE DEMOLISHED AT 25 MILSEC INTERVALS FROM ONE ANOTHER
- 3 10 FT. LONG SAW EXTERIOR CEILING CUT WITH 4'-0" UN CUT SPACES BETWEEN

N:\MAPS\MULLIN\NAVBILT-2T.DWG 4/23/97 M.C 1=1



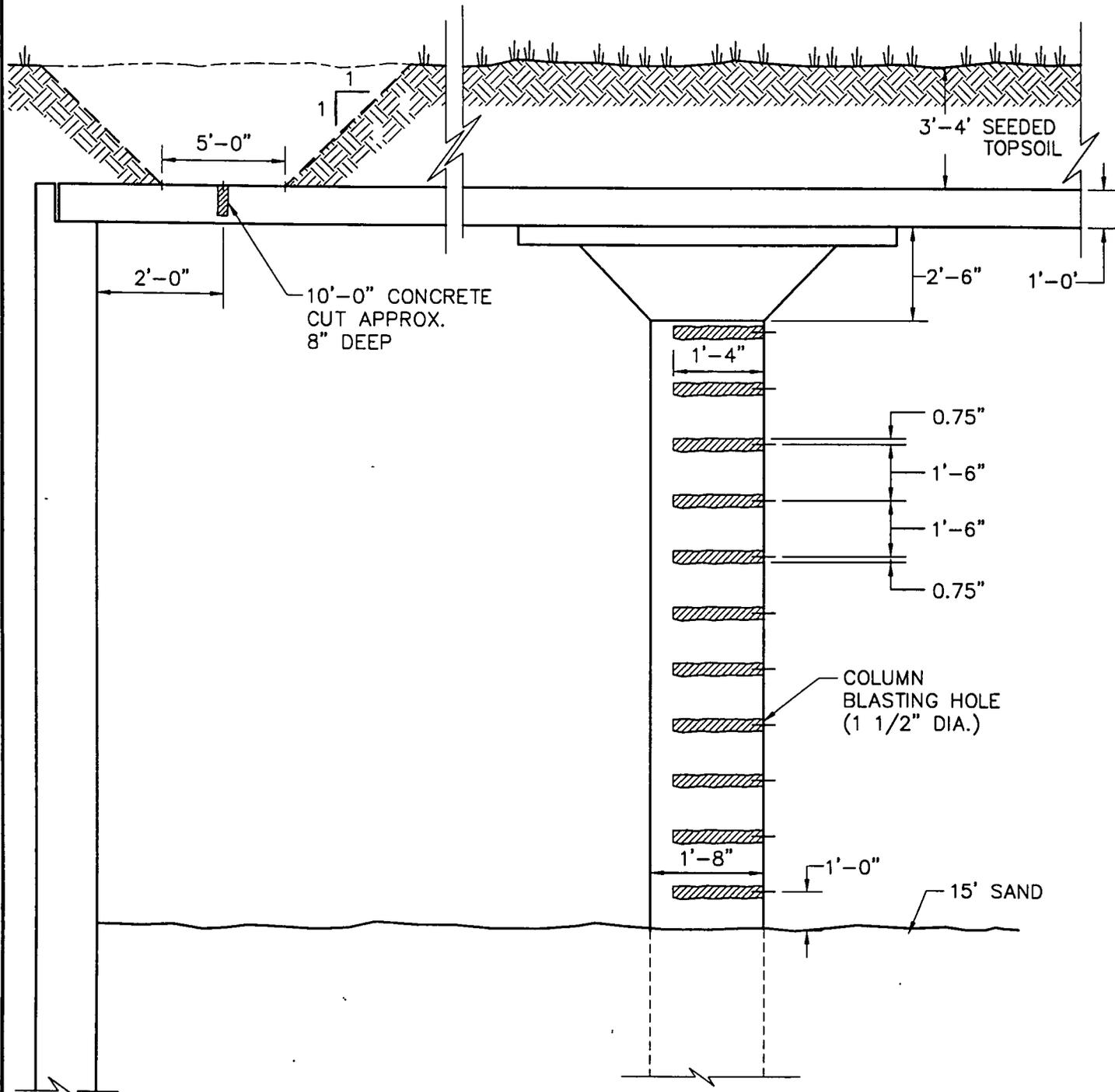
**CLOUGH, HARBOUR & ASSOCIATES LLP**

ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS  
III WINNERS CIRCLE ALBANY, NEW YORK, 12205

6363.14.01

DRAWING 1  
**UST PLAN**

EXPLOSIVE HANDLING & DEMOLITION WORK PLAN  
NAVAL EDUCATION & TRAINING CENTER  
NEWPORT, RHODE ISLAND



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**CLOUGH, HARBOUR & ASSOCIATES LLP**  
 ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS  
 III WINNERS CIRCLE ALBANY, NEW YORK 12205

6363.14.01

DRAWING 2  
**STRUCTURAL COLUMN ELEVATION**

EXPLOSIVE HANDLING & DEMOLITION WORK PLAN  
 NAVAL EDUCATION & TRAINING CENTER  
 NEWPORT, RHODE ISLAND

**APPENDIX A**

**NAIS BLASTING APPLICATIONS FOR PERMIT**



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

LINCOLN ALMOND  
GOVERNOR

IRVING J. OWENS  
FIRE MARSHAL

Executive Department  
RHODE ISLAND STATE FIRE MARSHAL  
272 West Exchange Street  
Providence, R.I. 02903-5872  
(401) 277-2335 TDD: (401)277-2578  
FAX: (401) 273-1222

POSSESSORS PERMIT

(APPLICATION)

DATE: \_\_\_\_\_

NAME: \_\_\_\_\_

STREET: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE: \_\_\_\_\_ ZIP: \_\_\_\_\_

BUSINESS PHONE: \_\_\_\_\_ HOME PHONE: \_\_\_\_\_

MAGAZINE LOCATION: \_\_\_\_\_

Length                      Depth                      Height

MAIN MAGAZINES:    \_\_\_\_\_ X \_\_\_\_\_ X \_\_\_\_\_ DECAL # \_\_\_\_\_

CAP MAGAZINES:    \_\_\_\_\_ X \_\_\_\_\_ X \_\_\_\_\_ DECAL # \_\_\_\_\_

Signed: \_\_\_\_\_

Title: \_\_\_\_\_

FEE: \$35.00 (PAYABLE TO R.I. STATE FIRE MARSHAL)

DATE ISSUED: \_\_\_\_\_ DATE EXPIRES: Dec. 31, \_\_\_\_\_

CHECK NO: \_\_\_\_\_

R.I. State Fire Marshal

(1147b)



State of Rhode Island and Providence Plantations  
 DIVISION OF FIRE SAFETY  
 1270 Mineral Spring Avenue  
 North Providence, R.I. 02904  
 Rhode Island State Fire Marshal  
 272 West Exchange St.  
 Providence, RI 02903  
 (401) 277-2835

**PERMIT TO TRANSPORT CLASS A&B EXPLOSIVES**

In accordance with the provisions of Chapter 28 of Title 23 as provided in the general laws.

This permit is granted to: .....

(date)

NAME: .....  
 (full name of person, firm or corporation)

ADDRESS: .....  
 (street and number) (state)

MAKE OF VEHICLE: ..... TYPE: ..... YEAR: .....

REGISTRATION NO: ..... STATE: ..... SERIAL NO. ....

**MAGAZINE DIMENSIONS:**

POWDER MAGAZINE

Length	Width	Height

CAP MAGAZINE

Length	Width	Height

Expiration Date .....19

STATE FIRE MARSHAL

**THIS PERMIT MUST BE CONSPICUOUSLY POSTED UPON THE VEHICLE**

FMO 2



State of Rhode Island and Providence Plantations  
 DIVISION OF FIRE SAFETY  
 1270 Mineral Spring Avenue  
 North Providence, R.I. 02904  
 Rhode Island State Fire Marshal  
 272 West Exchange St.  
 Providence, RI 02903  
 (401) 277-2835  
 .....19  
 (Date)

**APPLICATION FOR PERMIT TO TRANSPORT CLASS A&B EXPLOSIVES**

In accordance with the provisions of the State Fire Safety Code, Chapter 28 of Title 23 Application is hereby made.

To: STATE FIRE MARSHAL

NAME: .....  
 (full name of person, firm or corporation)

ADDRESS: .....  
 (street and number) (state)

MAKE OF VEHICLE: ..... TYPE: ..... YEAR: .....

REGISTRATION NO: ..... STATE: ..... SERIAL NO. ....

**MAGAZINE DIMENSIONS:**

POWDER MAGAZINE

Length	Width	Height

CAP MAGAZINE

Length	Width	Height

Expiration Date .....19

Date issued — Rejected .....19

.....  
 (Signature of Applicant)



State of Rhode Island and Providence Plantations

Executive Department  
Rhode Island State Fire Marshal

272 West Exchange Street  
Providence, RI 02903  
(401) 277-2335 TDD; (401) 277-2578  
Fax (401) 273-1222

LINCOLN ALMOND  
GOVERNOR

IRVING J OWENS  
STATE FIRE MARSHAL

B L A S T I N G P E R M I T # \_\_\_\_\_

PURSUANT TO TITLE 23, CHAPTER 28.28 OF THE R.I. GENERAL LAWS,  
THE FOLLOWING TYPE OF BLASTING PERMIT:

- 30 Day Regular User Permit
- 1 Year Quarry Permit
- 24 Hour Emergency Permit
- 1 Year Project Permit

HAS BEEN REQUESTED BY:

Person/Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Blaster Certificate #37-\_\_\_\_\_ Bond File #47-\_\_\_\_\_

TO CONDUCT BLASTING AT:

Location: \_\_\_\_\_

Street: \_\_\_\_\_

City/Town: \_\_\_\_\_

Blaster's Signature: \_\_\_\_\_

DATE APPROVED: \_\_\_\_\_

PERMIT EXPIRES: \_\_\_\_\_

CHECK # \_\_\_\_\_  
(To R.I. State Fire Marshal)

\_\_\_\_\_  
State Fire Marshal

(NOTIFICATION)

COPY RECEIVED BY CLERK: \_\_\_\_\_

CITY/TOWN: \_\_\_\_\_ DATE: \_\_\_\_\_

**APPENDIX B**

**NAIS LICENCE TO CONDUCT BLASTING OPERATIONS**

OFFICE OF THE STATE  
FIRE MARSHAL



BLASTING CERTIFICATE  
OF COMPETENCY

EFFECTIVE DATE LIC NO  
3-27-97 37-37

*Henry J. Quenneville*  
STATE FIRE MARSHAL

Not valid until signed by Licensee and officially  
stamped

*Donald W. Herwan*  
Signature of Licensee



STATE OF  
RHODE ISLAND  
AND  
PROVIDENCE  
PLANTATIONS

EXPIRATION DATE  
6-30-97

RESTRICTIONS

NONE



FEE \$60.00  
HEIGHT 6'3"  
DOB 4-29-58

This document must  
be carried on the per-  
son of the holder  
when engaged in this  
occupation

OFFICE OF THE STATE  
FIRE MARSHAL



BLASTING CERTIFICATE  
OF COMPETENCY

EFFECTIVE DATE LIC NO  
3-27-97 37-36

*Henry J. Quenneville*  
STATE FIRE MARSHAL

Not valid until signed by Licensee and officially  
stamped

*James L. McAlister*  
Signature of Licensee



STATE OF  
RHODE ISLAND  
AND  
PROVIDENCE  
PLANTATIONS

EXPIRATION DATE 6-30-97

RESTRICTIONS NONE



FEE \$60.00  
HEIGHT 6'2"  
DOB 4-11-63

This document must  
be carried on the per-  
son of the holder  
when engaged in this  
occupation







INDUSTRIAL EXPLOSIVES • WATER BLASTING • VACUUM TRUCK SERVICES

### Resume of Blasting Experience

**Micheal D. Sexton**  
Branch Manager  
North American Industrial Services Inc.  
1240 Saratoga Rd., Ballston Spa, N. Y. 12020

#### Education

- 1) Explosive Use and Safety training course, given by MPC Inc.. Completed October 1984
- 2) Leadership development Training Course. Phase I and II

#### Experience

- 1) On the Job training for the Use, Safety and Application of Explosive from December 1984 to June 1987
- 2) Supervision of Blasting Operations from 1987 to present, to include all aspects of operations, i.e. Safety, compliance with Federal, State, Local, Laws and Regulations, Type and Quantity of Explosive used, Placement and Detonation of said Explosives and supervision of personnel

- 3) Over 20,000 hours of experience with the following types of explosives, and their related firing systems
  - a) Binary Explosives
  - b) Gelatin Explosives
  - c) Detonating Cord
  - d) Electric Blasting Caps
  - e) Non-Electric Blasting Caps

- 4) First hand knowledge of the following Industrial Blasting & Demolition Applications

##### Power Generations Plants

- a) Boiler/Fire Box Deslag
- b) Economizer Back Pass
- c) Throat Clinkers
- d) Ash Hoppers/Frozen Coal Piles
- e) Scrubbers

##### Ore Processing Plants

- a) Deslag Hydraulic Rams
- b) Seized or Frozen Material in Vessel and Hoppers
- c) Scrubbers

##### Oil Refinery

- a) Removal of Hardened Catalyst
- b) Vessel/Hopper cleaning
- c) Scrubbers

##### Chemical & Plastic Plants

- a) Removal of Hardened Styrene  
& Plastics from vessels and tanks

North American Industrial Services, Inc  
1240 Saratoga Road Ballston Spa New York 12020

518-885-1820  
FAX 518-885-7638



INDUSTRIAL EXPLOSIVES • WATER BLASTING • VACUUM TRUCK SERVICES

### Resume of Blasting Experience

**James L. McAlinden**  
Operations Supervisor  
NorthAmerican Industrial Services Inc.  
1240 Saratoga Rd Ballston Spa, N. Y 12020

### Education

1980-1994 McAlinden corporation. Trained by Father, Joseph McAlinden and Uncle Gerard McAlinden Sr. In the use, and safety of explosives. Trained in the following applications: Demolition of buildings and bridges. Under water demolition of coral reefs and other related under water blasting. Mass excavation, pipeline ditch and tunnels. Industrial explosives and qualified in the use of shaped charges. 1994 to Present, Operations Supervisor for NorthAmerican Industrial Services Inc.

### Experience

- 1) Supervision of Blasting operations from 1982 to present. i. e. Type and Quantity of Explosives used, placement and detonation of said explosives. Safety and compliance with all Federal, State, and Local law and regulation. Management of personnel
- 2) Over 25,000 hours of experience with the following types of explosives and their related firing systems
  - a) Gelatin Explosives
  - b) An-fo products
  - c) Binary Explosives
  - d) Electric Blasting caps
  - e) Non-Electric Blasting caps
- 3) First hand knowledge of the following Blasting Applications

#### Demolition from 1982 to Present

- a) Princeton NJ Waste treatment Plant
- b) Jersey City NJ 10 Story Building Imploded
- c) U. S. Steel 200' Brick Smoke stack
- d) Sun Oil Co. Marcus Hook Pa. Mass concrete removal
- e) Aruba, N.A. 200' Concrete Smoke Stack

#### General Construction 1982 to Present

- a) Rock Removal for Road Construction
- b) Pipeline Ditch
- c) Pipeline Tunneling
- d) River crossings Under Water Blasting
- e) Under Water of Coral Reefs

#### Industrial Cleaning 1982 to Present

- a) Power Generation Plants. Removal of Ash Deposits
- b) Oil Refinery. Vessel Hopper cleaning
- c) Ore processing Plants. Deslag hydraulic rams
- d) Chemical & Plastic Plants. Removal of hardened Styrene from Tanks

NorthAmerican Industrial Services, Inc  
1240 Saratoga Road Ballston Spa New York 12020

518-885-1820  
FAX 518-885-7638



INDUSTRIAL EXPLOSIVES • WATER BLASTING • VACUUM TRUCK SERVICES

### Resume of Blasting Experience

#### **Donald W. Howard**

Explosive Division Manager

North American Industrial Services Inc

1240 Saratoga Rd., Ballston Spa, N.Y. 12020

#### Education

- 1) Explosive Use and Safety training course, given by Rust Precision Blasting Inc. Completed October 1986
- 2) Leadership development Training Course, Phase I and II

#### Experience

- 1) On the Job training for the Use, Safety and Application of Explosive from December 1986 to June 1990
- 2) Supervision of Blasting Operations from 1990 to present, to include all aspects of operations, i.e. Safety, compliance with Federal, State, Local Laws and Regulations, Type and Quantity of Explosive used, Placement and Detonation of said Explosives and supervision of personnel
- 3) Over 18,000 hours of experience with the following types of explosives, and their related firing systems
  - a) Binary Explosives
  - b) Gelatin Explosives
  - c) Detonating Cord
  - d) Electric Blasting Caps
  - e) Non-Electric Blasting Caps
- 4) First hand knowledge of the following Industrial Blasting & Demolition Applications

#### Power Generations Plants

- a) Boiler Fire Box Deslag
- b) Economizer Back Pass
- c) Throat Clinkers
- d) Ash Hoppers Frozen Coal Piles
- e) Scrubbers

#### Ore Processing Plants

- a) Deslag Hydraulic Rams
- b) Seized or Frozen Material in Vessel and Hoppers
- c) Scrubbers

#### Oil Refinery

- a) Removal of Hardened Catalyst
- b) Vessel Hopper cleaning
- c) Scrubbers

#### Chemical & Plastic Plants

- a) Removal of Hardened Styrene  
& Plastics from vessels and tanks

North American Industrial Services, Inc.

1240 Saratoga Road Ballston Spa New York 12020

518-885-1820

FAX 518-885-7638

**APPENDIX C**  
**APPLICABLE REGULATIONS**

**APPENDIX C-1**

**RHODE ISLAND FIRE SAFETY CODE SECTION 10**

**FIRE SAFETY CODE SECTION 10**

**THE KEEPING, USING, TRANSPORTING  
AND STORAGE OF EXPLOSIVES**

**L. GENERAL PROVISIONS:**

- 10-1-1. The handling and firing of explosives shall be performed by a person possessing a license to conduct blasting operations and a user's permit.
- 10-1-2. A permit to blast shall be obtained from the State Fire Marshal at least three (3) working days prior to requested blast time. Working days are Monday through Friday; with Saturday, Sunday and Holidays excluded.
- 10-1-3. No person shall handle explosives while under the influence of intoxicants or narcotics, or while in an emotional state.
- 10-1-4. Blasting shall be conducted so as to prevent injury, hazards or unsafe conditions to persons or damage to property outside the controlled blasting site, and the State Fire Marshal may require certain precautionary procedures at any time to protect life and property. The State Fire Marshal may suspend, revoke or deny a permit to blast at any location for just cause if no precautionary steps are available to adequately protect life and property.
- 10-1-5. No person shall carry matches or smoke while handling explosives, or while in the vicinity thereof. There shall be no open flame in the vicinity.
- 10-1-6. Blasting operations shall be conducted between sunrise and sunset; exceptions may be authorized by the State Fire Marshal.
- 10-1-7. Precautions shall be taken to prevent accidental discharge of blasting caps and explosives from current induced by radios, radar transmitters, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity. These shall include:
- a. The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electrical storm.
  - b. The posting of signs warning against the use of mobile radio transmitters on all roads within three hundred feet (300') of the blasting site.

- c. Caution must be taken by following the recommendations of the Institute of Makers of Explosives, and/or by the use of non-electric blasting caps, in the one and one-half (1 1/2) mile radius of radios, transmitters, or high tension power lines.
- 10-1-8. Whenever blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, or any other utility, the blaster shall immediately notify the appropriate representatives of such utilities in advance of blasting, specifying the location and intended time of blasting.
- 10-1-9. Persons authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution; including, but not limited to, warning signals, flags, barricades, or woven wire mats to ensure the safety of the general public and workmen.
- 10-1-10. Water-gels, binary energy agents, or any similar agents manufactured for the purpose of producing an explosive material shall be transported, stored, and used as specified for explosives in these rules and regulations.
- 10-1-11. Empty boxes and paper and fiber packaging materials which have previously contained explosives shall not be used again for any purpose, but shall be destroyed by burning at an approved isolated location out of doors and no person shall be nearer than one hundred feet (100') after burning has started.

**II. USE OF EXPLOSIVES:** *Handling + Placing of explosives.*

- 10-2-1. No spark-producing tools shall be used to open kegs or wooden cases or any other explosives container.
- 10-2-2. Wood containers of explosive materials shall not be opened within fifty feet (50') of any magazine.
- 10-2-3. No explosives shall be carried in the pockets, on clothing, or elsewhere on a person.
- 10-2-4. No explosive materials shall be abandoned in any location, or for any reason. No explosives shall be left unattended where they may be accessible to unauthorized persons or children.
- 10-2-5. No primers shall be made up in excess of the immediate needs.
- 10-2-6. No primers shall be made up in a magazine or near an excessive

amount of explosives.

10-2-7. Nothing other than a fuse shall be inserted into the open end of a blasting cap and no blasting cap shall be tampered with.

10-2-8. When a safety fuse is used, the blasting cap shall be securely attached to the fuse only with an approved cap crimper.

10-2-9. No blasting cap shall be forced into any explosive, but shall be inserted into a hole made with suitable punch.

10-2-10. Primers shall be made up with proven and established methods from the Dupont Blasters' Handbook. The cap shall be securely encased in the explosive and so secured that no tension be placed on the wires or the fuse at the point of entry into the cap.

10-2-11. No explosives that have been water-soaked shall be reclaimed for use without first determining from the manufacturer if explosives are usable.

10-2-12. When blasting is done in a congested area, or in close proximity to a structure, railway, or highway, or any other installation that may be damaged, the blast shall be covered before firing with a mat constructed so that it is capable of preventing fragments from being thrown.

10-2-13. Before a blast is fired, the person in charge shall make certain all surplus explosives are in a safe place; all persons vehicles and equipment are at a safe distance or under sufficient cover, and that a loud warning signal has been sounded.

*Misfires*

10-2-14. If there are any misfires while using cap-and-fuse, all persons shall remain away from the charge for at least one (1) hour. If electric blasting caps are used and a misfire occurs, this waiting period may be reduced to thirty (30) minutes. Misfires shall be handled under the direction of the person in charge of the blasting and wires shall be carefully traced and a search made for unexploded charges.

10-2-15. Blasters, when testing circuits to charged holes, shall use only blasting galvanometers designed for this purpose, or other instruments approved for the purpose by a nationally recognized testing laboratory.

10-2-16. Only the man making leading wire connections in electrical firing shall fire the shot. All connections shall be made from the bore hole back to the source of firing current, and the lead wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired.

- 10-2-17. All explosives shall be handled carefully at all times and be protected against sudden shock or any such source which may cause detonation or deflagration.
- 10-2-18. There shall be no smoking, matches, or any source of fire or flame within one hundred feet (100') of an area in which explosives are being handled or used, nor shall explosives be placed where they may be exposed to flame, excessive heat, sparks, or impact.
- 10-2-19. All connections, such as the connecting of blasting caps to detonating cord, shall be done according to methods recommended by the manufacturer.
- 10-2-20. Dynamite that has been removed from the cartridge shall not be tamped.
- 10-2-21. Explosives in bore holes shall be confined with sand, earth, clay, or other suitable non-combustible stemming material.
- 10-2-22. Caution shall be taken so as not to kink or damage fuse or electric blasting cap wires when tamping or loading.
- 10-2-23. The electric firing circuit shall be completely insulated from the ground and other conductors.
- 10-2-24. Only electric blasting caps of the same type and function from the same manufacturer shall be used in the same circuit.
- 10-2-25. All electric blasting caps shall be connected with good contact made and all firing shall be done with no less than the minimum current specified by the manufacturer.
- 10-2-26. Fuse shall be handled carefully so as to avoid damaging the covering or separating the filler.
- 10-2-27. A sufficient length of fuse shall be used so as to allow ample time to reach a place of safety. Never use less than two feet (2').
- 10-2-28. In cutting, seating and crimping the fuse to the cap, the recommended methods from the Dupont Blaster's Handbook shall be used.
- 10-2-29. All drill holes shall be sufficiently large to admit freely the insertion of the packages of explosive material.
- 10-2-30. No holes shall be loaded, except those to be fired in the next round of blasting. after loading, all remaining explosives shall be immediately

returned to an authorized magazine.

10-2-31.No person shall be allowed to deepen drill holes which have contained explosives.

10-2-32.Drilling shall not be started until all remaining butts of old holes are examined with a wooden stick for unexploded charges and, if any are found, they shall be refired before work proceeds.

10-2-33.Upon the discovery of any unfired explosives, all working operations in that area shall be stopped until such explosives are properly disposed of.

10-2-34.Pneumatic loading of blasting agents into blast holes primed with electric blasting caps or other static systems shall conform to the following requirements:

- a. A positive grounding device shall be used to prevent the accumulation of static electricity.
- b. A semi-conductor discharge hose shall be used.
- c. A qualified person shall evaluate all systems to assure that they will adequately dissipate static potential under field conditions.

10-2-35.No explosive material shall be extracted from a hole that has once been charged or has misfired unless it is impossible or hazardous to detonate the unexploded charge by insertion of an additional primer.

10-2-36.Tamping shall be done only with wood rods without exposed metal parts but, non-sparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. Primed cartridges shall not be tamped.

10-2-37.No holes shall be loaded, except those that are to be fired the same day.

10-2-38.No bore hole shall be loaded until it has been carefully checked with a wooden tamping pole to determine its condition.

10-2-39.Surplus explosives shall not be kept near the working area during loading.

10-2-40.Detonating cord, extending into a bore hole, shall be cut from the spool before the remainder of the charge is loaded.

10-2-41.No bore hole shall be loaded after being drilled or sprung until it is certain that it is cool and that it does not contain any hot metal or burning or smoldering material. No bore hole shall be loaded if its internal temperature approaches or exceeds 150 degrees.

10-2-42. No Bore hole shall be sprung with explosives while near another bore hole loaded with explosives.

10-2-43. No hole, or series of holes, shall be fired in the vicinity of another loaded hole or series of loaded holes unless they are to be fired in an instantaneous or delayed series as approved by the manufacturer.

10-2-44. No damaged leading or connecting wire shall be used in any blasting circuits.

10-2-45. Frozen or partially frozen explosives shall not be placed or used in bore holes.

10-2-46. Caution shall be taken not to drop a large size heavy cartridge directly on the primer.

10-2-47. When blasting near power lines, no leg or lead wires shall be long enough to come into contact with the electric power lines.

### III. STORAGE OF EXPLOSIVES ON LAND:

10-3-1. Explosives shall be stored only in magazines which are clean, dry, well ventilated where appropriate, reasonably cool, properly located, substantially constructed, bullet and fire resistant, and securely locked.

10-3-2. No explosives shall be stored near oil, gas, cleaning solvents, or any other flammable or corrosive substances.

10-3-3. Explosives shall be stored in an approved magazine at least five hundred feet (500') away from blasting operations.

10-3-4. No explosives shall be stored near any source of possible heat, fire or flame, nor shall combustible or flammable debris be allowed to accumulate near explosives.

10-3-5. In the event that nitroglycerin from deteriorated explosives has leaked onto a floor or other area, the manufacturer shall be consulted as to the desensitizing process. The State Fire Marshal shall also be notified.

10-3-6. No smoking, burning, discharging of firearms, or other possible source which could cause detonation or deflagration of explosives shall be allowed in the vicinity of any explosives magazine.

10-3-7. Each magazine shall at all times be under the control of a competent person.

#### IV. TRANSPORTATION OF EXPLOSIVES:

- 10-4-1. No person shall deliver to any other person any Class "A" or Class "B" explosives unless the person to whom such explosives are delivered exhibits a license to conduct blasting operations and a permit to possess or a permit to use explosives issued by the State Fire Marshal. All such explosives shall, except as otherwise provided, be delivered directly to an approved magazine as required by State and Federal Law. No person shall buy, receive, or accept delivery of any Class "A" or Class "B" explosives unless he possesses adequate storage facilities as required by State and Federal Law.
- 10-4-2. The provisions of this rule as they apply to storage facilities of the receiver may be waived if delivery is made in an approved magazine direct to the job site for immediate placement in previously prepared drill holes and further provided that the explosives are to be detonated in their entirety prior to sunset of the day of delivery.
- 10-4-3. All explosive contents of portable magazines shall be removed and placed into an approved permanent magazine at the end of each day. No explosives shall be stored in a portable magazine overnight.
- 10-4-4. If fire should come into contact with explosives, all personnel shall be removed to a safe location and the area guarded against intruders and no attempt shall be made to fight such a fire except from a safe distance or shelter.
- 10-4-5. Any vehicle used to transport explosives shall be in proper working condition and shall be equipped with the proper magazine or magazines which shall be securely attached to the vehicle to prevent falling off. The explosives shall be so located so as not to be in contact with any source of heat, such as an exhaust pipe.
- 10-4-6. No metal, flammable, or corrosive substances shall be transported with explosives.
- 10-4-7. All explosives shall be handled carefully and never thrown from the vehicle.
- 10-4-8. Radio transmitters shall be shut off on vehicles transporting explosives.
- 10-4-9. No smoking shall be allowed on any vehicle containing Class "A" or Class "B" Explosives.

## V. ADDITIONAL REQUIREMENTS

10-5-1. Any situation not covered by these Rules and Regulations shall be covered by N.F.P.A. Standard No. 495, 1973 Edition, the Institute of Makers of Explosives, and/or Manufactures' specifications.

## VI. ALL EXISTING RELATED ADMINISTRATIVE REGULATIONS REPEALED AND SUPERSEDED BY SECTION 10 HEREIN

10-6-1. All previously adopted administrative rules and regulations, including, but not limited to those adopted, and filed with the Secretary of State's Office, by the State Fire Marshal and/or the Division of Fire Safety on July 23, 1979, July 5, 1979 and December 6, 1977, related to the keeping, using, transporting, and storage of explosives, are hereby repealed and superseded by the provisions of the Fire Safety Code Section 10 as outlined above.

*70 Sealed Distance*

*IME 8507*

**APPENDIX C-2**

**29 CFR 1910.109  
EXPLOSIVES AND BLASTING AGENTS - OSHA**

# 1910.109

Title	Explosives and blasting agents.
Subpart	H
Subpart Title	Hazardous Materials

(a) "Definitions applicable to this section" - (1) "Blasting agent." Blasting agent - any material or mixture, consisting of a fuel and oxidizer, intended for blasting, not otherwise classified as an explosive and in which none of the ingredients are classified as an explosive, provided that the finished product, as mixed and packaged for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.

(2) "Explosive-actuated power devices." Explosive-actuated power device - any tool or special mechanized device which is actuated by explosives, but not including propellant-actuated power devices. Examples of explosive-actuated power devices are jet tappers and jet perforators.

(3) "Explosive." Explosive - any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, i.e., with substantially instantaneous release of gas and heat, unless such compound, mixture, or device is otherwise specifically classified by the U.S. Department of Transportation; see 49 CFR chapter I. The term "explosives" shall include all material which is classified as Class A, Class B, and Class C explosives by the U.S. Department of Transportation, and includes, but is not limited to dynamite, black powder, pellet powders, initiating explosives, blasting caps, electric blasting caps, safety fuse, fuse lighters, fuse igniters, squibs, cordeau detonant fuse, instantaneous fuse, igniter cord, igniters, small arms ammunition, small arms ammunition primers, smokeless propellant, cartridges for propellant-actuated power devices, and cartridges for industrial guns. Commercial explosives are those explosives which are intended to be used in commercial or industrial operations.

Note 1: Classification of explosives is described by the U.S. Department of Transportation as follows (see 49 CFR chapter I):

(i) "Class A explosives." Possessing, detonating, or otherwise maximum hazard; such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.

(ii) "Class B explosives." Possessing flammable hazard, such as propellant explosives (including some smokeless propellants), photographic flash powders, and some special fireworks.

(iii) "Class C explosives." Includes certain types of manufactured articles which contain Class A or Class B explosives, or both, as components but in restricted quantities.

(iv) "Forbidden or not acceptable explosives." Explosives which are forbidden or not acceptable for transportation by common 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.

(4) "Highway." Highway - any public street, public alley, or public road.

(5) [Reserved]

(6) "Magazine." Magazine - any building or structure, other than an explosives manufacturing building, used for the storage of explosives.

(7) "Motor vehicle." Motor vehicle - any self-propelled vehicle, truck, tractor, semitrailer, or truck-full trailers used for the transportation of freight over public highways.

(8) "Propellant-actuated power devices." Propellant-actuated power devices - any tool or special mechanized device or gas generator system which is actuated by a smokeless propellant or which releases and directs work through a smokeless propellant charge.

(9) [Reserved]

(10) "Pyrotechnics." Pyrotechnics - any combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects which are commonly referred to as fireworks.

(11) [Reserved]

(12) "Semiconductive hose." Semiconductive hose - a hose with an electrical resistance high enough to limit flow of stray electric currents to safe levels, yet not so high as to prevent drainage of static electric charges to ground; hose of not more than 2 megohms resistance over its entire length and of not less than 5,000 ohms per foot meets the requirement.

(13) "Small arms ammunition." Small arms ammunition - any shotgun, rifle, pistol, or revolver cartridge, and cartridges for propellant-actuated power devices and industrial guns. Military - type ammunition containing explosive - bursting charges, incendiary, tracer, spotting, or pyrotechnic projectiles is excluded from this definition.

(14) "Small arms ammunition primers." Small arms ammunition primers - small percussion-sensitive explosive charges, encased in a cup, used to ignite propellant powder.

(15) "Smokeless propellants." Smokeless propellants - solid propellants, commonly called smokeless powders in the trade, used in small arms ammunition, cannon, rockets, propellant-actuated power devices, etc.

(16) "Special industrial explosives devices." Special industrial explosives devices - explosive-actuated power devices and propellant-actuated power devices.

(17) "Special industrial explosives materials." Special industrial explosives materials - shaped materials and sheet forms and various other extrusions, pellets, and packages of high explosives, which include dynamite, trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), hexahydro-1,3,5-trinitro-s-triazine (RDX), and other similar compounds used for high-energy-rate forming, expanding, and shaping in metal fabrication, and for dismemberment and quick reduction of scrap metal.

(18) "Water gels or slurry explosives." These comprise a wide variety of materials used for blasting. They all contain substantial proportions of water and high proportions of ammonium nitrate, some of which is in solution in the water. Two broad classes of water gels are (i) those which are sensitized by a material classed as an explosive, such as TNT or smokeless powder, (ii) those which contain no ingredient classified as an explosive; these are sensitized with metals such as aluminum or with other fuels. Water gels may be premixed at an explosives plant or mixed at the site immediately before delivery into the borehole.

(19) "DOT specifications." Regulations of the Department of Transportation published in 49 CFR chapter I.

(b) "Miscellaneous provisions" - (1) "General hazard." No person shall store, handle, or transport explosives or blasting agents when such storage, handling, and transportation of explosives or blasting agents constitutes an undue hazard to life.

(c) "Storage of explosives" - (1) "General provisions." (i) All Class A, Class B, Class C explosives, and special industrial explosives, and any newly developed and unclassified explosives,

shall be kept in magazines which meet the requirements of this paragraph.

(ii) Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives.

(iii) Ground around magazines shall slope away for drainage. The land surrounding magazines shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 25 feet.

(iv) Magazines as required by this paragraph shall be of two classes; namely, Class I magazines, and Class II magazines.

(v) Class I magazines shall be required where the quantity of explosives stored is more than 50 pounds. Class II magazines may be used where the quantity of explosives stored is 50 pounds or less.

(vi) Class I magazines shall be located away from inhabited buildings, passenger railways, and public highways and from other magazines in conformity with Table H-21.

TABLE H-21-AMERICAN TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES  
(Footnotes 1-5)  
[As revised and approved by the Institute of Makers of  
Explosives, June 5, 1964]

Explosives		Distances in feet when storage is barricaded: Separation of magazines
Pounds over	Pounds not over	
2	5	6
5	10	8
10	20	10
20	30	11
30	40	12
40	50	14
50	75	15
75	100	16
100	125	18
125	150	19
150	200	21
200	250	23
250	300	24
300	400	27
400	500	29
500	600	31
600	700	32
700	800	33
800	900	35
900	1,000	36
1,000	1,200	39
1,200	1,400	41
1,400	1,600	43
1,600	1,800	44
1,800	2,000	45
2,000	2,500	49
2,500	3,000	52
3,000	4,000	58
4,000	5,000	61
5,000	6,000	65
6,000	7,000	68
7,000	8,000	72
8,000	9,000	75
9,000	10,000	78
10,000	12,000	82
12,000	14,000	87

14,000	16,000	90
16,000	18,000	94
18,000	20,000	98
20,000	25,000	105
25,000	30,000	112
30,000	35,000	119
35,000	40,000	124
40,000	45,000	129
45,000	50,000	135
50,000	55,000	140
55,000	60,000	145
60,000	65,000	150
65,000	70,000	155
70,000	75,000	160
75,000	80,000	165
80,000	85,000	170
85,000	90,000	175
90,000	95,000	180
95,000	100,000	185
100,000	110,000	195
110,000	120,000	205
120,000	130,000	215
130,000	140,000	225
140,000	150,000	235
150,000	160,000	245
160,000	170,000	255
170,000	180,000	265
180,000	190,000	275
190,000	200,000	285
200,000	210,000	295
210,000	230,000	315
230,000	250,000	335
250,000	275,000	360
275,000	300,000	385

Footnote(1) "Natural barricade" means natural features of the ground, 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.

Footnote(2) "Artificial barricade" means an artificial mound or revetted wall of earth of a minimum thickness of three feet.

Footnote(3) "Barricaded" means that a building containing explosives is effectually screened from a magazine, building, railway, or highway, either by a natural barricade, or by an artificial barricade of such height that a straight line from the top of any sidewall of the building containing explosives to the eave line of any magazine, or building, or to a point 12 feet above the center of a railway or highway, will pass through such intervening natural or artificial barricade.

Footnote(4) 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 should be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. 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 explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways, and highways.

Footnote(5) This table applies only to the manufacture and

permanent storage of commercial explosives. It is not applicable to transportation of explosives, or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.

(vii) Except as provided in subdivision (viii) of this subparagraph, class II magazines shall be located in conformity with Table H-21, but may be permitted in warehouses and in wholesale and retail establishments when located on a floor which has an entrance at outside grade level and the magazine is located not more than 10 feet from such an entrance. Two class II 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.

(viii) When used for temporary storage at a site for blasting operations, class II magazines shall be located away from other magazines. A distance of at least one hundred and fifty (150) feet shall be maintained between class II magazines and the work in progress when the quantity of explosives kept therein is in excess of 25 pounds, and at least 50 feet when the quantity of explosives is 25 pounds, or less.

(ix) This paragraph (c) does not apply to:

{a} Stocks of small arms ammunition, propellant-actuated power cartridges, small arms ammunition primers in quantities of less than 750,000, or of smokeless propellants in quantities less than 750 pounds;

{b} Explosive-actuated power devices when in quantities less than 50 pounds net weight of explosives;

{c} Fuse lighters and fuse igniters;

{d} Safety fuses other than cordeau detonant fuses.

(2) "Construction of magazines - general." (i) Magazines shall be constructed in conformity with the provisions of this paragraph.

(ii) Magazines for the storage of explosives, other than black powder, Class B and Class C explosives shall be bullet resistant, weather resistant, fire resistant, and ventilated sufficiently to protect the explosive in the specific locality. Magazines used only for storage of black powder, Class B and Class C explosives shall be weather resistant, fire-resistant, and have ventilation. Magazines for storage of blasting and electric blasting caps shall be weather resistant, fire-resistant, and ventilated.

(iii) Property upon which Class I magazines are located and property where Class II magazines are located outside of buildings shall be posted with signs reading "Explosives-Keep Off."

(iv) Magazines requiring heat shall be heated by either hot-water radiant heating with the magazine building; or air directed into the magazine building over either hot water or low pressure steam (15 p.s.i.g.) coils located outside the magazine building.

(v) The magazine heating systems shall meet the following requirements:

{a} The radiant heating coils within the building shall be installed in such a manner that the explosives or explosives containers cannot contact the coils and air is free to circulate between the coils and the explosives or explosives containers.

{b} The heating ducts shall be installed in such a manner that the hot-air discharge from the duct is not directed against the explosives or explosives containers.

{c} The heating device used in connection with a magazine shall have controls which prevent the ambient building temperature from exceeding 130 deg. F.

{d} 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.

{e} 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 subpart S of this part. All electrical switch gear shall be located a minimum distance of 25 feet from the magazine.

{f} 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.

{g} The storage of explosives and explosives containers in the magazine shall allow uniform air circulation so product temperature uniformity can be maintained.

(vi) When lights are necessary inside the magazine, electric safety flashlight, or electric safety lanterns shall be used.

(3) "Construction of Class I magazines." (i) Class I magazines shall be of masonry construction or of wood or of metal construction, or a combination of these types. Thickness of masonry units shall not be less than 8 inches. Hollow masonry units used in construction required to be bullet resistant shall have all hollow spaces filled with weak cement or well-tamped sand. Wood constructed walls, required to be bullet resistant, shall have at least a 6-inch space between interior and exterior sheathing and the space between sheathing shall be filled with well-tamped sand. Metal wall construction, when required to be bullet resistant, shall be lined with brick at least 4 inches in thickness or shall have at least a 6-inch sandfill between interior and exterior walls.

(ii) Floors and roofs of masonry magazines may be of wood construction. Wood floors shall be tongue and grooved lumber having a nominal thickness of 1 inch.

(iii) Roofs required to be bullet resistant shall be protected by a sand tray located at the line of eaves and covering the entire area except that necessary for ventilation. Sand in the sand tray shall be maintained at a depth of not less than 4 inches.

(iv) All wood at the exterior of magazines, including eaves, shall be protected by being covered with black or galvanized steel or aluminum metal of thickness of not less than No. 26 gage. All nails exposed to the interior of magazines shall be well countersunk.

(v) Foundations for magazines shall be of substantial construction and arranged to provide good cross ventilation.

(vi) Magazines shall be ventilated sufficiently to prevent dampness and heating of stored explosives. Ventilating openings shall be screened to prevent the entrance of sparks.

(vii) Openings to magazines shall be restricted to that necessary for the placement and removal of stocks of explosives. Doors for openings in magazines for Class A explosives shall be bullet resistant. Doors for magazines not required to be bullet resistant shall be designed to prevent unauthorized entrance to the magazine.

(viii) [Reserved]

(ix) Provisions shall be made to prevent the piling of stocks of explosives directly against masonry walls, brick-lined or sand-filled metal walls and single-thickness metal walls; such protection, however, shall not interfere with proper ventilation at the interior of side and end walls.

(4) "Construction of Class II magazines." (i) Class II magazines shall be of wood or metal construction, or a combination thereof.

(ii) Wood magazines of this class shall have sides, bottom, and cover constructed of 2-inch hardwood boards well braced at corners and protected by being entirely covered with sheet metal of not less than No. 20 gage. All nails exposed to the interior of the magazine shall be well countersunk. All metal magazines of this class shall have sides, bottom, and cover constructed of sheet metal, and shall be lined with three-eighths-inch plywood or equivalent. Edges of metal covers shall overlap sides at least 1 inch.

(iii) Covers for both wood- and metal-constructed magazines of this class shall be provided with substantial strap hinges and shall be provided with substantial means for locking.

(iv) Magazines of this class shall be painted red and shall bear

lettering in white, on all sides and top, at least 3 inches high, "Explosives - Keep Fire Away." Class II magazines when located in warehouses, and in wholesale and retail establishments shall be provided with substantial wheels or casters to facilitate easy removal in the case of fire. Where necessary due to climatic conditions, Class II magazines shall be ventilated.

(5) "Storage within magazines." (i) Packages of explosives shall be laid flat with top side up. Black powder when stored in magazines with other explosives shall be stored separately. Black powder stored in kegs shall be stored on ends, bungs down, or on side, seams down. Corresponding grades and brands 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 of explosives shall be piled in a stable manner. When any kind of explosive is removed from a magazine for use, the oldest explosive of that particular kind shall always be taken first.

(ii) Packages of explosives shall not be unpacked or repacked in a magazine nor within 50 feet of a magazine or in close proximity to other explosives. Tools used for opening packages of explosives shall be constructed of nonsparking materials, except that metal slitters may be used for opening fiberboard boxes. A wood wedge and a fiber, rubber, or wood mallet shall be used for opening or closing wood packages of explosives. Opened packages of explosives shall be securely closed before being returned to a magazine.

(iii) Magazines shall not be used for the storage of any metal tools nor any commodity except explosives, but this restriction shall not apply to the storage of blasting agents and blasting supplies.

(iv) Magazine floors shall be regularly swept, kept clean, dry, free of grit, paper, empty used packages, and rubbish. Brooms and other cleaning utensils shall not have any spark-producing metal parts. Sweepings from floors of magazines shall be properly disposed of. Magazine floors stained with nitroglycerin shall be cleaned according to instructions by the manufacturer.

(v) When any explosive has deteriorated to an extent that it is in an unstable or dangerous condition, or if nitroglycerin leaks from any explosives, then the person in possession of such explosive shall immediately proceed to destroy such explosive in accordance with the instructions of the manufacturer. Only experienced persons shall be allowed to do the work of destroying explosives.

(vi) When magazines need inside repairs, all explosives shall be removed therefrom and the floors cleaned. In making outside repairs, if there is a possibility of causing sparks or fire the explosives shall be removed from the magazine. Explosives 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, when they shall be returned to the magazine.

(vii) Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 50 feet of magazines. The land surrounding a magazine shall be kept clear of all combustible materials for a distance of at least 25 feet. Combustible materials shall not be stored within 50 feet of magazines.

(viii) Magazines shall be in the charge of a competent person at all times and who shall be held responsible for the enforcement of all safety precautions.

(ix) Explosives recovered from blasting misfires shall be placed in a separate magazine until competent personnel has determined from the manufacturer the method of disposal. Caps recovered from blasting misfires shall not be reused. Such explosives and caps shall then be disposed of in the manner recommended by the manufacturer.

(d) "Transportation of explosives" - (1) "General provisions." (i) No employee shall be allowed to smoke, carry matches or any other flame-producing device, or carry any firearms or loaded cartridges while in or near a motor vehicle transporting explosives; or drive,

load, or unload such vehicle in a careless or reckless manner.

(ii) [Reserved]

(iii) Explosives shall not be transferred from one vehicle to another within the confines of any jurisdiction (city, county, State, or other area) without informing the fire and police departments thereof. In the event of breakdown or collision the local fire and police departments shall be promptly notified to help safeguard such emergencies. Explosives shall be transferred from the disabled vehicle to another only, when proper and qualified supervision is provided.

(iv) Blasting caps or electric blasting caps shall not be transported over the highways on the same vehicles with other explosives.

(2) "Transportation vehicles." (i) Vehicles used for transporting explosives 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 flameproof and moistureproof tarpaulin or other effective protection against moisture and sparks. All vehicles used for the transportation of explosives 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 explosives. Packages of explosives shall not be loaded above the sides of an open-body vehicle.

(ii) Every vehicle used for transporting explosives and oxidizing materials listed in paragraph (d) (2) (ii) (a) of this section shall be marked as follows:

{a} Exterior markings or placards required on applicable vehicles shall be as follows for the various classes of commodities:

Commodity	Type of marking or placard
Explosives, Class A, any quantity or a combination of Class A and Class B explosives.	Explosives A (Red letters on white background).
Explosives, Class B, and quantity.	Explosives B (Red letters on white background).
Oxidizing material (blasting agents, ammonium nitrate, etc.), 1,000 pounds or more gross weight.	Oxidizers (Yellow letters on black background).

{b} [Reserved]

{c} Such markings or placards shall be displayed at the front, rear, and on each side of the motor vehicle or trailer, or other cargo carrying body while it contains explosives or other dangerous articles of such type and in such quantity as specified in paragraph (d) (1) (ii) (a) of this subdivision. The front marking or placard may be displayed on the front of either the truck, truck body, truck tractor or the trailer.

{d} Any motor vehicle, trailer, or other cargo-carrying body containing more than one kind of explosive as well as an oxidizing material requiring a placard under the provisions of paragraph (d) (2) (ii) (a), the aggregate gross weight of which totals 1,000 pounds or more, shall be marked or placarded "Dangerous" as well as "Explosive A" or "Explosive B" as appropriate. If explosives Class A and explosives Class B are loaded on the same vehicle, the "Explosives B" marking need not be displayed.

{e} In any combination of two or more vehicles containing explosives or other dangerous articles each vehicle shall be marked

or placarded as to its contents and in accordance with paragraphs (d)(2)(ii) (a) and (c) of this subdivision.

(iii) Each motor vehicle used for transporting explosives shall be equipped with a minimum of two extinguishers, each having a rating of at least 10-BC.

{a} Only extinguishers listed or approved by a nationally recognized testing laboratory shall be deemed suitable for use on explosives-carrying vehicles. Refer to 1910.155(c)(3)(iv)(A) for definition of listed and 1910.7 for nationally recognized testing laboratory.

{b} Extinguishers shall be filled and ready for immediate use and located near the driver's seat. Extinguishers shall be examined periodically by a competent person.

(iv) A motor vehicle used for transporting explosives shall be given the following inspection to determine that it is in proper condition for safe transportation of explosives:

{a} Fire extinguishers shall be filled and in working order.

{b} All electrical wiring shall be completely protected and securely fastened to prevent short-circuiting.

{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.

{g} The vehicle shall be in proper condition in every other respect and acceptable for handling explosives.

(3) "Operation of transportation vehicles." (i) Vehicles transporting explosives shall only be driven by and be in the charge of a driver who is familiar with the traffic regulations, State laws, and the provisions of this section.

(ii) Except under emergency conditions, no vehicle transporting explosives shall be parked before reaching its destination, even though attended, on any public street adjacent to or in proximity to any place where people work.

(iii) Every motor vehicle transporting any quantity of Class A or Class B explosives shall, at all times, be attended by a driver or other attendant of the motor carrier. This attendant shall have been made aware of the class of the explosive material 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 the public from those dangers. He shall have been made familiar with the vehicle he is assigned, and shall be trained, supplied with the necessary means, and authorized to move the vehicle when required.

{a} For the purpose of this subdivision, 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 his field of vision and can reach it quickly and without any kind of interference "attended" also means that the driver or attendant is awake, alert, and not engaged in other duties or activities which may divert his attention from the vehicle, except for necessary communication with public officers, or representatives of the carrier shipper, or consignee, or except for necessary absence from the vehicle to obtain food or to provide for his physical comfort.

{b} 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 otherwise permissible, or at a magazine site established solely for the purpose of storing explosives.

(iv) No spark-producing metal, spark-producing metal tools, oils, matches, firearms, electric storage batteries, flammable substances, acids, oxidizing materials, or corrosive compounds shall be carried in the body of any motor truck and/or vehicle transporting explosives, unless the loading of such dangerous articles and the explosives comply with U.S. Department of Transportation regulations.

(v) Vehicles transporting explosives shall avoid congested areas and heavy traffic. Where routes through congested areas have been designated by local authorities such routes shall be followed.

(vi) Delivery shall only be made to authorized persons and into authorized magazines or authorized temporary storage or handling areas.

(e) "Use of explosives and blasting agents" - (1) "General provisions."

(i) While explosives are being handled or used, smoking shall not be permitted and no one near the explosives shall possess matches, open light or other fire or flame. No person shall be allowed to handle explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs.

(ii) Original containers or Class II magazines shall be used for taking detonators and other explosives from storage magazines to the blasting area.

(iii) When blasting is done in congested areas or in close proximity to a structure, or any other installation that may be damaged, the blast shall be covered before firing with a mat constructed so that it is capable of preventing fragments from being thrown.

(iv) Persons authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution, including but not limited to warning signals, flags, barricades, or woven wire mats to insure the safety of the general public and workmen.

(v) Blasting operations shall be conducted during daylight hours.

(vi) Whenever blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, telegraph, and steam utilities, the blaster shall notify the appropriate representatives of such 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.

(vii) Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include:

{a} The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.

{b} The posting of signs warning against the use of mobile radio transmitters on all roads within 350 feet of the blasting operations.

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

(ii) Containers of explosives shall not be opened in any magazine or within 50 feet of any magazine. In opening kegs or wooden cases, no sparking metal tools shall be used; wooden wedges and either wood, fiber or rubber mallets shall be used. Nonsparking metallic slitters may be used for opening fiberboard cases.

(iii) Explosives or blasting equipment that are obviously deteriorated or damaged shall not be used.

(iv) No explosives shall be abandoned.

(3) "Loading of explosives in blast holes." (i) All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives.

(ii) Tamping shall be done only with wood rods without exposed metal parts, but nonsparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. Primed cartridges shall not be tamped.

(iii) When loading blasting agents pneumatically over electric blasting caps, semiconductive delivery hose shall be used and the equipment shall be bonded and grounded.

(iv) No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives shall be immediately returned to an authorized magazine.

(v) Drilling shall not be started until all remaining butts of old holes are examined with a wooden stick for unexploded charges, and if any are found, they shall be refired before work proceeds.

(vi) No person shall be allowed to deepen drill holes which have contained explosives.

(vii) After loading for a blast is completed, all excess blasting caps or electric blasting caps and other explosives shall immediately be returned to their separate storage magazines.

(4) "Initiation of explosive charges."

(i) [Reserved]

(ii) When fuse is used, the blasting cap shall be securely attached to the safety fuse with a standard-ring type cap crimper. All primers shall be assembled at least 50 feet from any magazine.

(iii) Primers shall be made up only as required for each round of blasting.

(iv) No blasting cap shall be inserted in the explosives without first making a hole in the cartridge for the cap with a wooden punch of proper size or standard cap crimper.

(v) Explosives shall not be extracted from a hole that has once been charged or has misfired unless it is impossible to detonate the unexploded charge by insertion of a fresh additional primer.

(vi) If there are any misfires while using cap and fuse, all persons shall be required to remain away from the charge for at least 1 hour. If electric blasting caps are used and a misfire occurs, this waiting period may be reduced to 30 minutes. Misfires shall be handled under the direction of the person in charge of the blasting and all wires shall be carefully traced and search made for unexploded charges.

(vii) Blasters, when testing circuits to charged holes, shall use only blasting galvanometers designed for this purpose.

(viii) Only the employee making leading wire connections in electrical firing shall be allowed to fire the shot. Leading wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired.

(5) "Warning required." Before a blast is fired, the employer shall require that a loud warning signal be given by the person in charge, who has made certain that all surplus explosives are in a safe place, all persons and vehicles are at a safe distance or under sufficient cover, and that an adequate warning has been given.

(f) "Explosives at piers, railway stations, and cars or vessels not otherwise specified in this standard" - (1) "Railway cars." Except in an emergency and with permission of the local authority, no person shall have or keep explosives in a railway car unless said car and contents and methods of loading are in accordance with the U.S. Department of Transportation Regulations for the Transportation of Explosives, 49 CFR Chapter I.

(2) "Packing and marking." No person shall deliver any explosive to any carrier unless such explosive conforms in all respects, including marking and packing, to the U.S. Department of Transportation Regulations for the Transportation of Explosives.

(3) "Marking cars." Every railway car containing explosives which has reached its designation, or is stopped in transit so as no longer to be in interstate commerce, shall have attached to both sides and ends of the car, cards with the words "Explosives-Handle Carefully-Keep Fire Away" in red letters at least 1 1/2 inches high on a white background.

(4) "Storage." Any explosives at a railway facility, truck terminal, pier, wharf harbor facility, or airport terminal whether for delivery to a consignee, or forwarded to some other destination shall be kept in a safe place, isolated as far as practicable and in such manner that they can be easily and quickly removed.

(5) "Hours of transfer." Explosives shall not be delivered to or

received from any railway station, truck terminal, pier, wharf, harbor facility, or airport terminal between the hours of sunset and sunrise.

(g) "Blasting agents" - (1) "General." Unless otherwise set forth in this paragraph, blasting agents, excluding water gels, shall be transported, stored, and used in the same manner as explosives. Water gels are covered in paragraph (h) of this section.

(2) "Fixed location mixing." (i) [Reserved]

(ii) Buildings used for the mixing of blasting agents shall conform to the requirements of this section.

{a} Buildings shall be of noncombustible construction or sheet metal on wood studs.

{b} Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.

{c} All fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.

{d} The building shall be well ventilated.

{e} Heating units which do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside the mixing building.

{f} All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

(iii) Equipment used for mixing blasting agents shall conform to the requirements of this subdivision.

{a} The design of the mixer shall minimize the possibility of frictional heating, compaction, and especially confinement. All bearings and drive assemblies shall be mounted outside the mixer and protected against the accumulation of dust. All surfaces shall be accessible for cleaning.

{b} Mixing and packaging equipment shall be constructed of materials compatible with the fuel-ammonium nitrate composition.

{c} Suitable means shall be provided to prevent the flow of fuel oil to the mixer in case of fire. In gravity flow systems an automatic spring-loaded shutoff valve with fusible link shall be installed.

(iv) The provisions of this subdivision shall be considered when determining blasting agent compositions.

{a} The sensitivity of the blasting agent shall be determined by means of a No. 8 test blasting cap at regular intervals and after every change in formulation.

{b} Oxidizers of small particle size, such as crushed ammonium nitrate prills or fines, may be more sensitive than coarser products and shall, therefore, be handled with greater care.

{c} No hydrocarbon liquid fuel with flashpoint lower than that of No. 2 diesel fuel oil 125 deg. F. minimum shall be used.

{d} Crude oil and crankcase oil shall not be used.

{e} Metal powders such as aluminum shall be kept dry and shall be stored in containers or bins which are moisture-resistant or weathertight. Solid fuels shall be used in such manner as to minimize dust explosion hazards.

{f} Peroxides and chlorates shall not be used.

(v) All electrical switches, controls, motors, and lights located in the mixing room shall conform to the requirements in subpart S of this part for Class II, Division 2 locations; otherwise they shall be located outside the mixing room. The frame of the mixer and all other equipment that may be used shall be electrically bonded and be provided with a continuous path to the ground.

(vi) Safety precautions at mixing plants shall include the requirements of this subdivision.

{a} Floors shall be constructed so as to eliminate floor drains and

pipng into which molten materials could flow and be confined in case of fire.

{b} The floors and equipment of the mixing and packaging room shall be cleaned regularly and thoroughly to prevent accumulation of oxidizers or fuels and other sensitizers.

{c} The entire mixing and packaging plant shall be cleaned regularly and thoroughly to prevent excessive accumulation of dust.

{d} Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents.

{e} The land surrounding the mixing plant shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 25 feet.

{f} Empty ammonium nitrate bags shall be disposed of daily in a safe manner.

{g} No welding shall be permitted or open flames used in or around the mixing or storage area of the plant unless the equipment or area has been completely washed down and all oxidizer material removed.

{h} 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 with a minimum one-half inch diameter opening.

{i} Explosives shall not be permitted inside of or within 50 feet of any building or facility used for the mixing of blasting agents.

(3) "Bulk delivery and mixing vehicles." (i) The provisions of this paragraph shall apply to off-highway private operations as well as to all public highway movements.

(ii) A bulk vehicle body for delivering and mixing blasting agents shall conform with the requirements of this paragraph (ii).

{a} The body shall be constructed of noncombustible materials.

{b} Vehicles used to transport bulk premixed blasting agents on public highways shall have closed bodies.

{c} All moving parts of the mixing system shall be designed as to prevent a heat buildup. Shafts or axles which contact the product shall have outboard bearings with 1-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.

{d} A bulk delivery vehicle shall be strong enough to carry the load without difficulty and be in good mechanical condition.

(iii) Operation of bulk delivery vehicles shall conform to the requirements of this subdivision. These include the placarding requirements as specified by Department of Transportation.

{a} The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. The employer shall assure that the operator is familiar with the commodities being delivered and the general procedure for handling emergency situations.

{b} The hauling of either blasting caps or other explosives but not both, shall be permitted on bulk trucks provided that a special wood or nonferrous-lined container is installed for the explosives. Such blasting caps or other explosives shall be in DOT-specified shipping containers: see 49 CFR Chapter I.

{c} No person shall smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing transfer or down-the-hole loading of blasting agents at or near the blasting site.

{d} 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, cap wires, or explosive materials. The employer shall assure that the driver, in moving the vehicle, has assistance of a second person to guide his movements.

{e} No intransit mixing of materials shall be performed.

(iv) Pneumatic loading from bulk delivery vehicles into blastholes primed with electric blasting caps or other static-sensitive systems shall conform to the requirements of this subdivision.

{a} A positive grounding device shall be used to prevent the accumulation of static electricity.

{b} A discharge hose shall be used that has a resistance range that will prevent conducting stray currents, but that is conductive enough to bleed off static buildup.

{c} A qualified person shall evaluate all systems to determine if they will adequately dissipate static under potential field conditions.

{v} Repairs to bulk delivery vehicles shall conform to the requirements of this section.

{a} 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.

{b} Before welding or making repairs to hollow shafts, the shaft shall be thoroughly cleaned inside and out and vented with a minimum one-half-inch diameter opening.

(4) "Bulk storage bins." (i) The bin, including supports, shall be constructed of compatible materials, 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 with the support legs.

(ii) The bin discharge gate shall be designed to provide a closure tight enough to prevent leakage of the stored product. Provision shall also be made so that the gate can be locked.

(iii) Bin loading manways or access hatches shall be hinged or otherwise attached to the bin and be designed to permit locking.

(iv) Any electrically driven conveyors for loading or unloading bins shall conform to the requirements of subpart S of this part. They shall be designed to minimize damage from corrosion.

(v) Bins containing blasting agent shall be located, with respect to inhabited buildings, passenger railroads, and public highways, in accordance with Table H-21 and separation from other blasting agent storage and explosives storage shall be in conformity with Table H-22.

(vi) Bins containing ammonium nitrate shall be separated from blasting agent storage and explosives storage in conformity with Table H-22.

TABLE H-22 - TABLE OF RECOMMENDED SEPARATION DISTANCES OF AMMONIUM NITRATE AND BLASTING AGENTS FROM EXPLOSIVES OR BLASTING AGENTS (Footnotes 1-6)

Donor weight		Minimum separation distance of receptor when barricaded(2) (ft.)		Minimum thickness of artificial barricades (5) (in.)
Pounds over	Pounds not over	Ammonium nitrate(3)	Blasting agent(4)	
	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

Footnote(1) These distances apply to the separation of stores only. Table H-21 shall be used in determining separation distances from inhabited buildings, passenger railways, and public highways.

Footnote(2) When the ammonium nitrate and/or blasting agent is not barricaded, the distances shown in the table 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 container, 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 H-21 are not required.

Footnote(3) 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 National Plant Food Institute\*; and ammonium nitrate failing to pass said test shall be stored at separation distances determined by competent persons. (\*Definition and Test Procedures for Ammonium Nitrate Fertilizer, National Plant Food Institute, November 1964.)

Footnote(4) These distances apply to nitro-carbo-nitrates and blasting agents which pass the insensitivity test prescribed in the U.S. Department of Transportation (DOT) regulations.

Footnote(5) 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.

Footnote(6) When the ammonium nitrate must be counted in determining the distances to be maintained from inhabited buildings, passenger railways and public highways, it may be counted at one-half its actual weight because its blast effect is lower.

{a} Sketch location of all potential donor and acceptor materials together with the maximum mass of material to be allowed in that

vicinity. (Potential donors are high explosives, blasting agents, and combination of masses of detonating materials. Potential acceptors are high explosives, blasting agents, and ammonium nitrate.)

{b} Consider separately each donor mass in combination with each acceptor mass. If the masses are closer than table allowance (distances measured between nearest edges), the combination of masses becomes a new potential donor of weight equal to the total mass. When individual masses are considered as donors, distances to potential acceptors shall be measured between edges. When combined masses within propagating distance of each other are considered as a donor, the appropriate distance to the edge of potential acceptors shall be computed as a weighted distance from the combined masses.

Calculation of weighted distance from combined masses:

Let  $M(2), M(3) \dots M(n)$  be donor masses to be combined.

$M(1)$  is a potential acceptor mass.

$D(12)$  is distance from  $M(1)$  to  $M(2)$  (edge to edge).

$D(13)$  is distance from  $M(1)$  to  $M(3)$  (edge to edge), etc.

To find weighted distance  $[D(1)((2), (3) \dots (n))]$  from combined masses to  $M(1)$ , add the products of the individual masses and distances and divide the total by the sum of the masses thus:

$$D(1)((2), (3) \dots (n)) = \frac{M(2) \times D(12) + M(3) \times D(13) \dots + M(n) \times D(1n)}{M(2) + M(3) \dots + M(n)}$$

Propagation is possible if either an individual donor mass is less than the tabulated distance from an acceptor or a combined mass is less than the weighted distance from an acceptor.

{c} In determining the distances separating highways, railroads, and inhabited buildings from potential explosions (as prescribed in Table H-21), the sum of all masses which may propagate (i.e., lie at distances less than prescribed in the Table) from "either" individual or combined donor masses are included. However, when the ammonium nitrate must be included, only 50 percent of its weight shall be used because of its reduced blast effects. In applying Table H-21 to distances from highways, railroads, and inhabited buildings, distances are measured from the nearest edge of potentially explodable material as prescribed in Table H-21, Note 5.

{d} When all or part of a potential acceptor comprises Explosives Class A as defined in DOT regulations, storage in bullet-resistant magazines is required. Safe distances to stores in bullet-resistant magazines may be obtained from the intermagazine distances prescribed in Table H-21.

{e} Barricades must not have line-of-sight openings between potential donors and acceptors which permit blast or missiles to move directly between masses.

{f} 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 25 feet of such bin. Accumulation of spilled product on the ground shall be prevented.

(5) "Storage of blasting agents and supplies." (i) Blasting agents and oxidizers used for mixing of blasting agents shall be stored in the manner set forth in this subdivision.

{a} Blasting agents or ammonium nitrate, when stored in conjunction with explosives, shall be stored in the manner set forth in paragraph (c) of this section for explosives. The mass of blasting agents and one-half the mass of ammonium nitrate shall be included when computing the total quantity of explosives for determining distance requirements.

{b} Blasting agents, when stored entirely separate from explosives,

may be stored in the manner set forth in paragraph (c) of this section or in one-story warehouses (without basements) which shall be:

- {1} Noncombustible or fire resistive;
- {2} Constructed so as to eliminate open floor drains and piping into which molten materials could flow and be confined in case of fire;
- {3} Weather resistant;
- {4} Well ventilated; and
- {5} Equipped with a strong door kept securely locked except when open for business.

{c} Semitrailer or full-trailer vans used for highway or onsite transportation of the blasting agents are satisfactory for temporarily storing these materials, provided they are located in accordance with Table H-22 with respect to one another. Trailers shall be provided with substantial means for locking, and the trailer doors shall be kept locked, except during the time of placement and removal of stocks of blasting agents.

(ii) Warehouses used for the storage of blasting agents separate from explosives shall be located as set forth in this subdivision.

{a} Warehouses used for the storage of blasting agents shall be located in Table H-22 with respect to one another.

{b} If both blasting agents and ammonium nitrate are handled or stored within the distance limitations prescribed through paragraph (g) (2) of this section, one-half the mass of the ammonium nitrate shall be added to the mass of the blasting agent when computing the total quantity of explosives for determining the proper distance for compliance with Table H-21.

(iii) Smoking, matches, open flames, spark producing devices, and firearms are prohibited inside of or within 50 feet of any warehouse used for the storage of blasting agents. Combustible materials shall not be stored within 50 feet of warehouses used for the storage of blasting agents.

(iv) The interior of warehouses used for the storage of blasting agents shall be kept clean and free from debris and empty containers. Spilled materials shall be cleaned up promptly and safely removed. Combustible materials, flammable liquids, corrosive acids, chlorates, or nitrates shall not be stored in any warehouse used for blasting agents unless separated therefrom by a fire resistive separation of not less than 1 hour resistance. The provisions of this subdivision shall not prohibit the storage of blasting agents together with nonexplosive blasting supplies.

(v) Piles of ammonium nitrate and warehouses containing ammonium nitrate shall be adequately separated from readily combustible fuels.

(vi) Caked oxidizers, either in bags or in bulk, shall not be loosened by blasting.

(vii) Every warehouse used for the storage of blasting agents shall be under the supervision of a competent person.

(6) "Transportation of packaged blasting agents." (i) When blasting agents are transported in the same vehicle with explosives, all of the requirements of paragraph (d) of this section shall be complied with.

(ii) Vehicles transporting blasting agents shall only be driven by and be in charge of a driver in possession of a valid motor vehicle operator's license. Such a person shall also be familiar with the State's vehicle and traffic laws.

(iii) No matches, firearms, acids, or other corrosive liquids shall be carried in the bed or body of any vehicle containing blasting agents.

(iv) No person shall be permitted to ride upon, drive, load, or unload a vehicle containing blasting agents while smoking or under the influence of intoxicants, narcotics, or other dangerous drugs.

(v) [Reserved]

(vi) Vehicles transporting blasting agents shall be in safe operating condition at all times.

(7) "Use of blasting agents." Persons using blasting agents shall comply with all of the applicable provisions of paragraph (e) of this section.

(h) "Water gel (Slurry) explosives and blasting agents" - (1) "General provisions." Unless otherwise set forth in this paragraph, water gels shall be transported, stored and used in the same manner as explosives or blasting agents in accordance with the classification of the product.

(2) "Types and classifications." (i) Water gels containing a substance in itself classified as an explosive shall be classified as an explosive and manufactured, transported, stored, and used as specified for "explosives" in this section, except as noted in subdivision (iv) of this subparagraph.

(ii) Water gels containing no substance in itself classified as an explosive and which are cap-sensitive as defined in paragraph (a) of this section under Blasting Agent shall be classified as an explosive and manufactured, transported, stored and used as specified for "explosives" in this section.

(iii) Water gels containing no substance in itself classified as an explosive and which are not cap-sensitive as defined in paragraph (a) of this section under Blasting Agent shall be classified as blasting agents and manufactured, transported, stored, and used as specified for "blasting agents" in this section.

(iv) When tests on specific formulations of water gels result in Department of Transportation classification as a Class B explosive, bullet-resistant magazines are not required, see paragraph (c) (2) (ii) of this section.

(3) "Fixed location mixing."

{i} [Reserved].

{ii} Buildings used for the mixing of water gels shall conform to the requirements of this subdivision.

{a} Buildings shall be of noncombustible construction or sheet metal on wood studs.

{b} Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.

{c} Where fuel oil is used all fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.

{d} The building shall be well ventilated.

{e} Heating units that do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside of the mixing building.

{f} All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

{iii} Ingredients of water gels shall conform to the requirements of this subdivision.

{a} Ingredients in themselves classified as Class A or Class B explosives shall be stored in conformity with paragraph (c) of this section.

{b} Nitrate-water solutions may be stored in tank cars, tank trucks, or fixed tanks without quantity or distance limitations. Spills or leaks which may contaminate combustible materials shall be cleaned up immediately.

{c} Metal powders such as aluminum shall be kept dry and shall be stored in containers or bins which are moisture-resistant or weathertight. Solid fuels shall be used in such manner as to minimize dust explosion hazards.

{d} Ingredients shall not be stored with incompatible materials.

{e} Peroxides and chlorates shall not be used.

{iv} Mixing equipment shall comply with the requirements of this

subdivision.

{a} The design of the processing equipment, including mixing and conveying equipment, shall be compatible with the relative sensitivity of the materials being handled. Equipment shall be designed to minimize the possibility of frictional heating, compaction, overloading, and confinement.

{b} Both equipment and handling procedures shall be designed to prevent the introduction of foreign objects or materials.

{c} Mixers, pumps, valves, and related equipment shall be designed to permit regular and periodic flushing, cleaning, dismantling, and inspection.

{d} All electrical equipment including wiring, switches, controls, motors, and lights, shall conform to the requirements of subpart S of this part.

{e} All electric motors and generators shall be provided with suitable overload protection devices. Electrical generators, motors, proportioning devices, and all other electrical enclosures shall be electrically bonded. The grounding conductor to all such electrical equipment shall be effectively bonded to the service-entrance ground connection and to all equipment ground connections in a manner so as to provide a continuous path to ground.

{v} Mixing facilities shall comply with the fire prevention requirements of this subdivision.

{a} The mixing, loading, and ingredient transfer areas where residues or spilled materials may accumulate shall be cleaned periodically. A cleaning and collection system for dangerous residues shall be provided.

{b} A daily visual inspection shall be made of mixing, conveying, and electrical equipment to establish that such equipment is in good operating condition. A program of systematic maintenance shall be conducted on regular schedule.

{c} Heaters which are not dependent on the combustion process within the heating unit may be used within the confines of processing buildings, or compartments, if provided with temperature and safety controls and located away from combustible materials and the finished product.

(4) "Bulk delivery and mixing vehicles." (i) The design of vehicles shall comply with the requirements of this subdivision.

{a} Vehicles used over public highways for the bulk transportation of water gels or of ingredients classified as dangerous commodities, shall meet the requirements of the Department of Transportation and shall meet the requirements of paragraphs (d) and (g)(6) of this section.

{b} When electric power is supplied by a self-contained motor generator located on the vehicle the generator shall be at a point separate from where the water gel is discharged.

{c} The design of processing equipment and general requirements shall conform to subparagraphs (3)(iii) and (iv) of this paragraph.

{d} A positive action parking brake, which will set the wheel brakes on at least one axle shall be provided on vehicles when equipped with air brakes and shall be used during bulk delivery operations. Wheel chocks shall supplement parking brakes whenever conditions may require.

(ii) Operation of bulk delivery and mixing vehicles shall comply with the requirements of this subdivision.

{a} The placarding requirements contained in DOT regulations apply to vehicles carrying water gel explosives or blasting agents.

{b} The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. He shall be familiar with the commodities being delivered and the general procedure for handling emergency situations.

{c} The hauling of either blasting caps or other explosives, but not both, shall be permitted on bulk trucks provided that a special wood or nonferrous-lined container is installed for the explosives. Such blasting caps or other explosives shall be in DOT-specified

shipping containers; see 49 CFR Chapter I.

{d} No person shall be allowed to smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing, transfer, or down-the-hole loading of water gels at or near the blasting site.

{e} 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, cap wires, or explosive materials. The employer shall furnish the driver the assistance of a second person to guide the driver's movements.

{f} No intransit mixing of materials shall be performed.

{g} The location chosen for water gel or ingredient transfer from a support vehicle into the borehole loading vehicle shall be away from the blasthole site when the boreholes are loaded or in the process of being loaded.

(i) "Storage of ammonium nitrate" - (1) "Scope and definitions."

(i) - {a} Except as provided in paragraph (i) (1) (i) (d) of this paragraph 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.

{b} This paragraph does not apply to the transportation of ammonium nitrate.

{c} This paragraph does not apply to storage under the jurisdiction of and in compliance with the regulations of the U.S. Coast Guard (see 46 CFR parts 146-149).

{d} The storage of ammonium nitrate and ammonium nitrate mixtures that are more sensitive than allowed by the "Definition of Test Procedures for Ammonium Nitrate Fertilizer" is prohibited.

(ii) - {a} [Reserved]

{b} The standards for ammonium nitrate (nitrous oxide grade) are those found in the "Specifications, Properties, and Recommendations for Packaging, Transportation, Storage, and Use of Ammonium Nitrate", available from the Compressed Gas Association, Inc., which is incorporated by reference as specified in Sec. 1910.6.

(2) "General provisions." (i) This paragraph applies to all persons storing, having, or keeping ammonium nitrate, and to the owner or lessee of any building, premises, or structure in which ammonium nitrate is stored in quantities of 1,000 pounds or more.

(ii) Approval of large quantity storage shall be subject to due consideration of the fire and explosion hazards, including exposure to toxic vapors from burning or decomposing ammonium nitrate.

(iii) {a} Storage buildings shall not have basements unless the basements are open on at least one side. Storage buildings shall not be over one story in height.

{b} Storage buildings shall have adequate ventilation or be of a construction that will be self-ventilating 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. The roof coverings shall be Class C or better, as defined in the Manual on Roof Coverings, NFPA 203M-1970, which is incorporated by reference as specified in Sec. 1910.6.

{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} The continued use of an existing storage building or structure not in strict conformity with this paragraph may be approved in cases where such continued use will not constitute a hazard to life.

{f} Buildings and structures shall be dry and free from water seepage through the roof, walls, and floors.

(3) "Storage of ammonium nitrate in bags, drums, or other containers."

(i) - {a} Bags and containers used for ammonium nitrate must comply with specifications and standards required for use in interstate commerce (see 49 CFR Chapter I).

{b} Containers used on the premises in the actual manufacturing or processing need not comply with provisions of paragraph (i) (3) (i) (a) of this paragraph.

(ii) {a} Containers of ammonium nitrate shall not be accepted for storage when the temperature of the ammonium nitrate exceeds 130 deg. F.

{b} Bags of ammonium nitrate shall not be stored within 30 inches of the storage building walls and partitions.

{c} The height of piles shall not exceed 20 feet. The width of piles 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.

{d} 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.

(4) "Storage of bulk ammonium nitrate." (i) - {a} Warehouses shall have adequate ventilation or be capable of adequate ventilation in case of fire.

{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.

(ii) {a} Bins shall be clean and free of materials which may contaminate ammonium nitrate.

{b} 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 a bin construction unless suitably protected. Aluminum bins and wooden bins protected against impregnation by ammonium nitrate are permissible. The partitions dividing the ammonium nitrate storage from other products which would contaminate the ammonium nitrate shall be of tight construction.

{c} The ammonium nitrate storage bins or piles shall be clearly identified by signs reading "Ammonium Nitrate" with letters at least 2 inches high.

(iii) {a} 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.

{b} Height or depth of piles shall be limited by the pressure-setting 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.

{c} Ammonium nitrate shall not be accepted for storage when the temperature of the product exceeds 130 deg. F.

{d} Dynamite, other explosives, and blasting agents shall not be used to break up or loosen caked ammonium nitrate.

(5) "Contaminants." (i) - {a} Ammonium nitrate shall be in a separate building or shall be separated by approved type firewalls of not less than 1 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, including but not limited to animal fats, baled cotton, baled rags, baled scrap paper, bleaching powder, burlap or cotton bags, caustic soda, coal, coke, charcoal, cork, camphor, excelsior, fibers of any kind, fish oils, fish meal, foam rubber, hay, lubricating oil, linseed oil, or other oxidizable or drying oils, naphthalene, oakum, oiled clothing, oiled paper, oiled textiles,

paint, straw, sawdust, wood shavings, or vegetable oils. Walls referred to in this subdivision need extend only to the underside of the roof.

{b} In lieu of separation walls, ammonium nitrate may be separated from the materials referred to in paragraph (a) of this section by a space of at least 30 feet.

{c} Flammable liquids such as gasoline, kerosene, solvents, and light fuel oils shall not be stored on the premises except when such storage conforms to 1910.106, and when walls and sills or curbs are provided in accordance with paragraphs (i) (5) (i) (a) or (b) of this section.

{d} LP-Gas shall not be stored on the premises except when such storage conforms to 1910.110.

(ii){a} Sulfur and finely divided metals shall not be stored in the same building with ammonium nitrate except when such storage conforms to paragraphs (a) through (h) of this section.

{b} Explosives and blasting agents shall not be stored in the same building with ammonium nitrate except on the premises of makers, distributors, and user-compounders of explosives or blasting agents.

{c} Where explosives or blasting agents are stored in separate buildings, other than on the premises of makers, distributors, and user-compounders of explosives or blasting agents, they shall be separated from the ammonium nitrate by the distances and/or barricades specified in Table H-22 of this subpart, but by not less than 50 feet.

{d} Storage and/or operations on the premises of makers, distributors, and user-compounders of explosives or blasting agents shall be in conformity with paragraphs (a) through (h) of this section.

(6) "General precautions." (i) Electrical installations shall conform to the requirements of subpart S of this part, for ordinary locations. They shall be designed to minimize damage from corrosion.

(ii) In areas where lightning storms are prevalent, lightning protection shall be provided. (See the Lightning Protection Code, NFPA 78-1968, which is incorporated by reference as specified in Sec. 1910.6.)

(iii) Provisions shall be made to prevent unauthorized personnel from entering the ammonium nitrate storage area.

(7) "Fire protection." (i) Not more than 2,500 tons (2270 tonnes) of bagged ammonium nitrate shall be stored in a building or structure not equipped with an automatic sprinkler system. Sprinkler systems shall be of the approved type and installed in accordance with 1910.159.

(ii){a} Suitable fire control devices such as small hose or portable fire extinguishers shall be provided throughout the warehouse and in the loading and unloading areas. Suitable fire control devices shall comply with the requirements of 1910.157 and 1910.158.

{b} Water supplies and fire hydrants shall be available in accordance with recognized good practices.

(j) "Small arms ammunition, small arms primers, and small arms propellants" - (1) "Scope." This paragraph does not apply to in-process storage and intraplant transportation during manufacture of small arms ammunition, small arms primers, and smokeless propellants.

(2) "Small arms ammunition." (i) No quantity limitations are imposed on the storage of small arms ammunition in warehouses, retail stores, and other general occupancy facilities, except those imposed by limitations of storage facilities.

(ii) Small arms ammunition shall be separated from flammable liquids, flammable solids as classified in 49 CFR part 172, and from oxidizing materials, by a fire-resistive wall of 1-hour rating or by a distance of 25 feet.

(iii) Small arms ammunition shall not be stored together with Class A or Class B explosives unless the storage facility is adequate for

this latter storage.

(3) "Smokeless propellants." (i) All smokeless propellants shall be stored in shipping containers specified in 49 CFR 173.93 for smokeless propellants.

(ii) [Reserved]

(iii) Commercial stocks of smokeless propellants over 20 pounds and not more than 100 pounds shall be stored in portable wooden boxes having walls of at least 1 inch nominal thickness.

(iv) Commercial stocks in quantities not to exceed 750 pounds shall be stored in nonportable storage cabinets having wooden walls of at least 1 inch nominal thickness. Not more than 400 pounds shall be permitted in any one cabinet.

(v) Quantities in excess of 750 pounds shall be stored in magazines in accordance with paragraph (c) of this section.

(4) "Small arms ammunition primers." (i) Small arms ammunition primers shall not be stored except in the original shipping container in accordance with the requirements of 49 CFR 173.107 for small arms ammunition primers.

(ii) [Reserved]

(iii) Small arms ammunition primers shall be separated from flammable liquids, flammable solids as classified in 49 CFR part 172, and oxidizing materials by a fire-resistive wall of 1-hour rating or by a distance of 25 feet.

(iv) Not more than 750,000 small arms ammunition primers shall be stored in any one building, except as provided in paragraph (j) (4) (v) of this paragraph. Not more than 100,000 shall be stored in any one pile. Piles shall be at least 15 feet apart.

(v) Quantities of small arms ammunition primers in excess of 750,000 shall be stored in magazines in accordance with paragraph (c) of this section.

(k) "Scope." (1) This section applies to the manufacture, keeping, having, storage, sale, transportation, and use of explosives, blasting agents, and pyrotechnics. This section does not apply to the sale and use (public display) of pyrotechnics, commonly known as fireworks, nor to the use of explosives in the form prescribed by the official U.S. Pharmacopeia.

(2) The manufacture of explosives as defined in paragraph (a) (3) of this section shall also meet the requirements contained in 1910.119.

(3) The manufacture of pyrotechnics as defined in paragraph (a) (10) of this section shall also meet the requirements contained in 1910.119.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49747, Oct. 24, 1978; 45 FR 60704, Sept. 12, 1980; 53 FR 12122, Apr. 12, 1988; 57 FR 6403, Feb. 24, 1992; 58 FR 16496, March 29, 1993; 58 FR 35309, June 30, 1993; 61 FR 9227, March 7, 1996]

**APPENDIX C-3**

**29 CFR 1926.900-914**

**BLASTING AND THE USE OF EXPLOSIVES - OSHA**

1926.900

Title General provisions.  
Subpart U  
Subpart Title Blasting and the Use of Explosives.  
Applicable Standards 1910.109(a)(12)

(a) The employer shall permit only authorized and qualified persons to handle and use explosives.

(b) Smoking, firearms, matches, open flame lamps, and other fires, flame or heat producing devices and sparks shall be prohibited in or near explosive magazines or while explosives are being handled, transported or used.

(c) No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs.

(d) All explosives shall be accounted for at all times. Explosives not being used shall be kept in a locked magazine, unavailable to persons not authorized to handle them. The employer shall maintain an inventory and use record of all explosives. Appropriate authorities shall be notified of any loss, theft, or unauthorized entry into a magazine.

(e) No explosives or blasting agents shall be abandoned.

(f) No fire shall be fought where the fire is in imminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area guarded against intruders.

(g) Original containers, or Class II magazines, shall be used for taking detonators and other explosives from storage magazines to the blasting area.

(h) When blasting is done in congested areas or in proximity to a structure, railway, or highway, or any other installation that may be damaged, the blaster shall take special precautions in the loading, delaying, initiation, and confinement of each blast with mats or other methods so as to control the throw of fragments, and thus prevent bodily injury to employees.

(i) Employees authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution including, but not limited to, visual and audible warning signals, flags, or barricades, to ensure employee safety.

(j) Insofar as possible, blasting operations above ground shall be conducted between sunup and sundown.

(k) Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include:

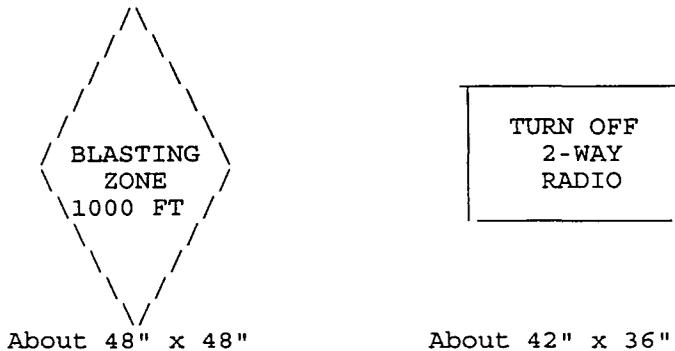
(1) Detonators shall be short-circuited in holes which have been primed and shunted until wired into the blasting circuit.

(2) The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm;

(3) - (i) The prominent display of adequate signs, warning against the use of mobile radio transmitters, on all roads within 1,000 feet of

blasting operations. Whenever adherence to the 1,000-foot distance would create an operational handicap, a competent person shall be consulted to evaluate the particular situation, and alternative provisions may be made which are adequately designed to prevent any premature firing of electric blasting caps. A description of any such alternatives shall be reduced to writing and shall be certified as meeting the purposes of this subdivision by the competent person consulted. The description shall be maintained at the construction site during the duration of the work, and shall be available for inspection by representatives of the Secretary of Labor.

(ii) Specimens of signs which would meet the requirements of paragraph (k) (3) of this section are the following:



(4) Ensuring that mobile radio transmitters which are less than 100 feet away from electric blasting caps, in other than original containers, shall be deenergized and effectively locked;

(5) Compliance with the recommendations of The Institute of the Makers of Explosives with regard to blasting in the vicinity of radio transmitters as stipulated in Radio Frequency Energy-A Potential Hazard in the Use of Electric Blasting Caps, IME Publication No. 20, March 1971.

(1) Empty boxes and paper and fiber packing materials, which have previously contained high explosives, shall not be used again for any purpose, but shall be destroyed by burning at an approved location.

(m) Explosives, blasting agents, and blasting supplies that are obviously deteriorated or damaged shall not be used.

(n) Delivery and issue of explosives shall only be made by and to authorized persons and into authorized magazines or approved temporary storage or handling areas.

(o) Blasting operations in the proximity of overhead power lines, communication lines, utility services, or other services and structures shall not be carried on until the operators and/or owners have been notified and measures for safe control have been taken.

(p) The use of black powder shall be prohibited.

(q) All loading and firing shall be directed and supervised by competent persons thoroughly experienced in this field.

(r) All blasts shall be fired electrically with an electric blasting machine or properly designed electric power source, except as provided in 1926.906 (a) and (r).

(s) Buildings used for the mixing of blasting agents shall conform to the requirements of this section.

(1) Buildings shall be of noncombustible construction or sheet metal on wood studs.

(2) Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.

(3) All fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.

(4) The building shall be well ventilated.

(5) Heating units which do not depend on combustion processes, when properly designed and located, may be used in the building. All direct

sources of heat shall be provided exclusively from units located outside the mixing building.

(6) All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

(t) Buildings used for the mixing of water gels shall conform to the requirements of this subdivision.

(1) Buildings shall be of noncombustible construction or sheet metal on wood studs.

(2) Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.

(3) Where fuel oil is used all fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.

(4) The building shall be well ventilated.

(5) Heating units that do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside of the mixing building.

(6) All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as amended at 58 FR 35183, June 30, 1993]

1926.901

Blaster qualifications.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

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

(b) A blaster shall be in good physical condition and not be addicted to narcotics, intoxicants, or similar types of drugs.

(c) A blaster shall be qualified, by reason of training, knowledge, or experience, in the field of transporting, storing, handling, and use of explosives, and have a working knowledge of State and local laws and regulations which pertain to explosives.

(d) Blasters shall be required to furnish satisfactory evidence of competency in handling explosives and performing in a safe manner the type of blasting that will be required.

(e) The blaster shall be knowledgeable and competent in the use of each type of blasting method used.

1926.902

Title Surface transportation of explosives.

Subpart U

Subpart Title Blasting and the Use of Explosives.

Applicable Standards 1910.109(a)(12)

(a) Transportation of explosives shall meet the provisions of Department of Transportation regulations contained in 46 CFR Parts 146-149, Water Carriers; 49 CFR Parts 171-179, Highways and Railways; 49 CFR Part 195, Pipelines; and 49 CFR Parts 390-397, Motor Carriers.

(b) Motor vehicles or conveyances transporting explosives shall only be driven by, and be in the charge of, a licensed driver who is physically fit. He shall be familiar with the local, State, and Federal regulation governing the transportation of explosives.

(c) No person shall smoke, or carry matches or any other flame-producing device, nor shall firearms or loaded cartridges be carried while in or near a motor vehicle or conveyance transporting explosives.

(d) Explosives, blasting agents, and blasting supplies shall not be transported with other materials or cargoes. Blasting caps (including electric) shall not be transported in the same vehicle with other explosives.

(e) Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty, and shall be in good mechanical condition.

(f) When explosives are transported by a vehicle with an open body, a Class II magazine or original manufacturer's container shall be securely mounted on the bed to contain the cargo.

(g) All vehicles used for the transportation of explosives shall have tight floors and any exposed spark-producing metal on the inside of the body shall be covered with wood, or other nonsparking material, to prevent contact with containers of explosives.

(h) Every motor vehicle or conveyance used for transporting explosives shall be marked or placarded on both sides, the front, and the rear with the word "Explosives" in red letters, not less than 4 inches in height, on white background. In addition to such marking or placarding, the motor vehicle or conveyance may display, in such a manner that it will be readily visible from all directions, a red flag 18 inches by 30 inches, with the word "Explosives" painted, stamped, or sewed thereon, in white letters, at least 6 inches in height.

(i) Each vehicle used for transportation of explosives shall be equipped with a fully charged fire extinguisher, in good condition. An Underwriters Laboratory-approved extinguisher of not less than 10-ABC rating will meet the minimum requirement. The driver shall be trained in the use of the extinguisher on his vehicle.

(j) Motor vehicles or conveyances carrying explosives, blasting agents, or blasting supplies, shall not be taken inside a garage or shop for repairs or servicing.

(k) No motor vehicle transporting explosives shall be left unattended.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as amended]

at 58 FR 35311, June 30, 1993]

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1926.903

Underground transportation of explosives.

Subpart U

Subpart Title Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) All explosives or blasting agents in transit underground shall be taken to the place of use or storage without delay.

(b) The quantity of explosives or blasting agents taken to an underground loading area shall not exceed the amount estimated to be necessary for the blast.

(c) Explosives in transit shall not be left unattended.

(d) The hoist operator shall be notified before explosives or blasting agents are transported in a shaft conveyance.

(e) Trucks used for the transportation of explosives underground shall have the electrical system checked weekly to detect any failures which may constitute an electrical hazard. A certification record which includes the date of the inspection; the signature of the person who performed the inspection; and a serial number, or other identifier, of the truck inspected shall be prepared and the most recent certification record shall be maintained on file.

(f) The installation of auxiliary lights on truck beds, which are powered by the truck's electrical system, shall be prohibited.

(g) Explosives and blasting agents shall be hoisted, lowered, or conveyed in a powder car. No other materials, supplies, or equipment shall be transported in the same conveyance at the same time.

(h) No one, except the operator, his helper, and the powderman, shall be permitted to ride on a conveyance transporting explosives and blasting agents.

(i) No person shall ride in any shaft conveyance transporting explosives and blasting agents.

(j) No explosives or blasting agents shall be transported on any locomotive. At least two car lengths shall separate the locomotive from the powder car.

(k) No explosives or blasting agents shall be transported on a man haul trip.

(l) The car or conveyance containing explosives or blasting agents shall be pulled, not pushed, whenever possible.

(m) The powder car or conveyance especially built for the purpose of transporting explosives or blasting agents shall bear a reflectorized sign on each side with the word "Explosives" in letters, not less than 4 inches in height; upon a background of sharply contrasting color.

(n) Compartments for transporting detonators and explosives in the same car or conveyance shall be physically separated by a distance of 24 inches or by a solid partition at least 6 inches thick.

(o) Detonators and other explosives shall not be transported at the same time in any shaft conveyance.

(p) Explosives, blasting agents, or blasting supplies shall not be transported with other materials.

(q) Explosives or blasting agents, not in original containers, shall be

placed in a suitable container when transported manually.

(r) Detonators, primers, and other explosives shall be carried in separate containers when transported manually.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as amended at 52 FR 36382, Sept. 28, 1987]

## 1926.904

Title Storage of explosives and blasting agents.

Subpart U

Subpart Title Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) Explosives and related materials shall be stored in approved facilities required under the applicable provisions of the Bureau of Alcohol, Tobacco and Firearms regulations contained in 27 CFR part 55.

(b) Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents.

(c) Smoking and open flames shall not be permitted within 50 feet of explosives and detonator storage magazine.

(d) No explosives or blasting agents shall be permanently stored in any underground operation until the operation has been developed to the point where at least two modes of exit have been provided.

(e) Permanent underground storage magazines shall be at least 300 feet from any shaft, adit, or active underground working area.

(f) Permanent underground magazines containing detonators shall not be located closer than 50 feet to any magazine containing other explosives or blasting agents.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as amended at 58 FR 35311, June 30, 1993]

Title Loading of explosives or blasting agents:

Subpart U

Subpart Title Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) Procedures that permit safe and efficient loading shall be established before loading is started.

(b) All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives.

(c) Tamping shall be done only with wood rods or plastic tamping poles without exposed metal parts, but nonsparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. The primer shall never be tamped.

(d) No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives and detonators shall be immediately returned to an authorized magazine.

(e) 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 refired before work proceeds.

(f) No person shall be allowed to deepen drill holes which have contained explosives or blasting agents.

(g) No explosives or blasting agents shall be left unattended at the blast site.

(h) Machines and all tools not used for loading explosives into bore holes shall be removed from the immediate location of holes before explosives are delivered. Equipment shall not be operated within 50 feet of loaded holes.

(i) No activity of any nature other than that which is required for loading holes with explosives shall be permitted in a blast area.

(j) Powerlines and portable electric cables for equipment being used shall be kept a safe distance from explosives or blasting agents being loaded into drill holes. Cables in the proximity of the blast area shall be deenergized and locked out by the blaster.

(k) Holes shall be checked prior to loading to determine depth and conditions. Where a hole has been loaded with explosives but the explosives have failed to detonate, there shall be no drilling within 50 feet of the hole.

(l) When loading a long line of holes with more than one loading crew, the crews shall be separated by practical distance consistent with efficient operation and supervision of crews.

(m) No explosive shall be loaded or used underground in the presence of combustible gases or combustible dusts.

(n) No explosives other than those in Fume Class 1, as set forth by the Institute of Makers of Explosives, shall be used; however, explosives complying with the requirements of Fume Class 2 and Fume Class 3 may be used if adequate ventilation has been provided.

(o) All blast holes in open work shall be stemmed to the collar or to a point which will confine the charge.

(p) 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.

(q) A bore hole shall never be sprung when it is adjacent to or near a hole that is loaded. Flashlight batteries shall not be used for springing holes.

(r) Drill holes which have been sprung or chambered, and which are not water-filled, shall be allowed to cool before explosives are loaded.

(s) No loaded holes shall be left unattended or unprotected.

(t) The blaster shall keep an accurate, up-to-date record of explosives, blasting agents, and blasting supplies used in a blast and shall keep an accurate running inventory of all explosives and blasting agents stored on the operation.

(u) When loading blasting agents pneumatically over electric blasting caps, semiconductive delivery hose shall be used and the equipment shall be bonded and grounded.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as ammended at 58 FR 35184, June 30, 1993]

Title Initiation of explosive charges-electric blasting.

Subpart U

Subpart Title Blasting and the Use of Explosives.

Applicable Standards 1910.109(a)(12)

(a) Electric blasting caps shall not be used where sources of extraneous electricity make the use of electric blasting caps dangerous. Blasting cap leg wires shall be kept short-circuited (shunted) until they are connected into the circuit for firing.

(b) Before adopting any system of electrical firing, the blaster shall conduct a thorough survey for extraneous currents, and all dangerous currents shall be eliminated before any holes are loaded.

(c) In any single blast using electric blasting caps, all caps shall be of the same style or function, and of the same manufacture.

(d) Electric blasting shall be carried out by using blasting circuits or power circuits in accordance with the electric blasting cap manufacturer's recommendations, or an approved contractor or his designated representative.

(e) When firing a circuit of electric blasting caps, care must be exercised to ensure that an adequate quantity of delivered current is available, in accordance with the manufacturer's recommendations.

(f) Connecting wires and lead wires shall be insulated single solid wires of sufficient current-carrying capacity.

(g) Bus wires shall be solid single wires of sufficient current-carrying capacity.

(h) When firing electrically, the insulation on all firing lines shall be adequate and in good condition.

(i) A power circuit used for firing electric blasting caps shall not be grounded.

(j) In underground operations when firing from a power circuit, a safety switch shall be placed in the permanent firing line at intervals. This switch shall be made so it can be locked only in the "Off" position and shall be provided with a short-circuiting arrangement of the firing lines to the cap circuit.

(k) In underground operations there shall be a "lightning" gap of at least 5 feet in the firing system ahead of the main firing switch; that is, between this switch and the source of power. This gap shall be bridged by a flexible jumper cord just before firing the blast.

(l) When firing from a power circuit, the firing switch shall be locked in the open or "Off" position at all times, except when firing. It shall be so designed that the firing lines to the cap circuit are automatically short-circuited when the switch is in the "Off" position. Keys to this switch shall be entrusted only to the blaster.

(m) Blasting machines shall be in good condition and the efficiency of the machine shall be tested periodically to make certain that it can deliver power at its rated capacity.

(n) When firing with blasting machines, the connections shall be made as recommended by the manufacturer of the electric blasting caps used.

(o) The number of electric blasting caps connected to a blasting machine

shall not be in excess of its rated capacity. Furthermore, in primary blasting, a series circuit shall contain no more caps than the limits recommended by the manufacturer of the electric blasting caps in use.

(p) The blaster shall be in charge of the blasting machines, and no other person shall connect the leading wires to the machine.

(q) Blasters, when testing circuits to charged holes, shall use only blasting galvanometers equipped with a silver chloride cell especially designed for this purpose.

(r) Whenever the possibility exists that a leading line or blasting wire might be thrown over a live powerline by the force of an explosion, care shall be taken to see that the total length of wires are kept too short to hit the lines, or that the wires are securely anchored to the ground. If neither of these requirements can be satisfied, a nonelectric system shall be used.

(s) In electrical firing, only the man making leading wire connections shall fire the shot. All connections shall be made from the bore hole back to the source of firing current, and the leading wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired.

(t) After firing an electric blast from a blasting machine, the leading wires shall be immediately disconnected from the machine and short-circuited.

1926.907

Use of safety fuse.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) Safety fuse shall only be used where sources of extraneous electricity make the use of electric blasting caps dangerous. The use of a fuse that has been hammered or injured in any way shall be forbidden.

(b) The hanging of a fuse on nails or other projections which will cause a sharp bend to be formed in the fuse is prohibited.

(c) Before capping safety fuse, a short length shall be cut from the end of the supply reel so as to assure a fresh cut end in each blasting cap.

(d) Only a cap crimper of approved design shall be used for attaching blasting caps to safety fuse. Crimpers shall be kept in good repair and accessible for use.

(e) No unused cap or short capped fuse shall be placed in any hole to be blasted; such unused detonators shall be removed from the working place and destroyed.

(f) No fuse shall be capped, or primers made up, in any magazine or near any possible source of ignition.

(g) No one shall be permitted to carry detonators or primers of any kind on his person.

(h) The minimum length of safety fuse to be used in blasting shall be as required by State law, but shall not be less than 30 inches.

(i) At least two men shall be present when multiple cap and fuse blasting is done by hand lighting methods.

(j) Not more than 12 fuses shall be lighted by each blaster when hand lighting devices are used. However, when two or more safety fuses in a group are lighted as one by means of igniter cord, or other similar fuse-lighting devices, they may be considered as one fuse.

(k) The so-called "drop fuse" method of dropping or pushing a primer or any explosive with a lighted fuse attached is forbidden.

(l) Cap and fuse shall not be used for firing mudcap charges unless charges are separated sufficiently to prevent one charge from dislodging other shots in the blast.

(m) When blasting with safety fuses, consideration shall be given to the length and burning rate of the fuse. Sufficient time, with a margin of safety, shall always be provided for the blaster to reach a place of safety.

## Use of detonating cord.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) Care shall be taken to select a detonating cord 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 with the same respect and care given other explosives.

(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 and hooking-up.

(e) Detonating cord connections shall be competent and positive in accordance with approved and recommended methods. 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.

## Firing the blast.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) A code of blasting signals equivalent to Table U-1, shall be posted on one or more conspicuous places at the operation, and all employees shall be required to familiarize themselves with the code and conform to it. Danger signs shall be placed at suitable locations.

(b) Before a blast is fired, a loud warning signal shall be given by the blaster in charge, who has made certain that all surplus explosives are in a safe place and all employees, vehicles, and equipment are at a safe distance, or under sufficient cover.

(c) Flagmen shall be safely stationed on highways which pass through the danger zone so as to stop traffic during blasting operations.

(d) It shall be the duty of the blaster to fix the time of blasting.

(e) Before firing an underground blast, warning shall be given, and all possible entries into the blasting area, and any entrances to any working place where a drift, raise, or other opening is about to hole through, shall be carefully guarded. The blaster shall make sure that all employees are out of the blast area before firing a blast.

TABLE U-1

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WARNING SIGNAL	-	A 1-minute series of long blasts 5 minutes prior to blast signal.
BLAST SIGNAL	-	A series of short blasts 1 minute prior to the shot.
ALL CLEAR SIGNAL	-	A prolonged blast following the inspection of blast area.

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1926.910

Inspection after blasting.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) Immediately after the blast has been fired, the firing line shall be disconnected from the blasting machine, or where power switches are used, they shall be locked open or in the off position.

(b) Sufficient time shall be allowed, not less than 15 minutes in tunnels, for the smoke and fumes to leave the blasted area before returning to the shot. An inspection of the area and the surrounding rubble shall be made by the blaster to determine if all charges have been exploded before employees are allowed to return to the operation, and in tunnels, after the muck pile has been wetted down.

1926.911

Misfires.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) If a misfire is found, the blaster shall provide proper safeguards for excluding all employees from the danger zone.

(b) No other work shall be done except that necessary to remove the hazard of the misfire and only those employees necessary to do the work shall remain in the danger zone.

(c) No attempt shall be made to extract explosives from any charged or misfired hole; a new primer shall be put in and the hole reblasted. If refiring of the misfired hole presents a hazard, the explosives may be removed by washing out with water or, where the misfire is under water, blown out with air.

(d) If there are any misfires while using cap and fuse, all employees shall remain away from the charge for at least 1 hour. Misfires shall be handled under the direction of the person in charge of the blasting. All wires shall be carefully traced and a search made for unexploded charges.

(e) No drilling, digging, or picking shall be permitted until all missed holes have been detonated or the authorized representative has approved that work can proceed.

1926.912

Underwater blasting.

Subpart

U

Subpart Title

Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) A blaster shall conduct all blasting operations, and no shot shall be fired without his approval.

(b) 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.

(c) Only water-resistant blasting caps and detonating cords shall be used for all marine blasting. Loading shall be done through a nonsparking metal loading tube when tube is necessary.

(d) 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.

(e) 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.

(f) Blasting flags shall be displayed.

(g) 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.

(h) When more than one charge is placed under water, a float device shall be attached to an element of each charge in such manner that it will be released by the firing. Misfires shall be handled in accordance with the requirements of 1926.911.

1926.913

Blasting in excavation work under compressed air.

Subpart U

Subpart Title Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) Detonators and explosives shall not be stored or kept in tunnels, shafts, or 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 powderman, 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 blaster or powderman shall be responsible for the receipt, unloading, storage, and on-site transportation of explosives and detonators.

(e) 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.

(f) The explosives suitable for use in wet holes shall be water-resistant and shall be Fume Class 1.

(g) When tunnel excavation in rock face is approaching mixed face, and when tunnel excavation is in mixed face, blasting shall be performed with light charges and with light burden on each hole. Advance drilling shall be performed as tunnel excavation in rock face approaches mixed face, to determine the general nature and extent of rock cover and the remaining distance ahead to soft ground as excavation advances.

## Definitions applicable to this subpart.

Subpart U

Subpart Title Blasting and the Use of Explosives

Applicable Standards 1910.109(a)(12)

(a) "American Table of Distances" (also known as Quantity Distance Tables) means American Table of Distances for Storage of Explosives as revised and approved by the Institute of the Makers of Explosives, June 5, 1964.

(b) "Approved storage facility"-A facility for the storage of explosive materials conforming to the requirements of this part and covered by a license or permit issued under authority of the Bureau of Alcohol, Tobacco and Firearms. (See 27 CFR part 55.)

(c) "Blast area" - The area in which explosives loading and blasting operations are being conducted.

(d) "Blaster" - The person or persons authorized to use explosives for blasting purposes and meeting the qualifications contained in 1926.901.

(e) "Blasting agent" - A blasting agent is any material or mixture consisting of a fuel and oxidizer used for blasting, but not classified an explosive provided the furnished (mixed) product cannot be detonated with a No. 8 test blasting cap when confined. A common blasting agent presently in use is a mixture of ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) and carbonaceous combustibles, such as fuel oil or coal, and may either be procured, premixed and packaged from explosives companies or mixed in the field.

(f) "Blasting cap" - A metallic tube closed at one end, containing a charge of one or more detonating compounds, and designed for and capable of detonation from the sparks or flame from a safety fuse inserted and crimped into the open end.

(g) "Block holing" - The breaking of boulders by firing a charge of explosives that has been loaded in a drill hole.

(h) "Conveyance" - Any unit for transporting explosives or blasting agents, including but not limited to trucks, trailers, rail cars, barges, and vessels.

(i) "Detonating cord" - A flexible cord containing a center core of high explosives which when detonated, will have sufficient strength to detonate other cap - sensitive explosives with which it is in contact.

(j) "Detonator" - Blasting caps, electric blasting caps, delay electric blasting caps, and nonelectric delay blasting caps.

(k) "Electric blasting cap" - A blasting cap designed for and capable of detonation by means of an electric current.

(1) "Electric blasting circuitry" -

(1) Bus wire. An expendable wire, used in parallel or series, in parallel circuits, to which are connected the leg wires of electric blasting caps.

(2) Connecting wire. An insulated expendable wire used between electric blasting caps and the leading wires or between the bus wire and the leading wires.

(3) Leading wire. An insulated wire used between the electric power

source and the electric blasting cap circuit.

(4) Permanent blasting wire. A permanently mounted insulated wire used between the electric power source and the electric blasting cap circuit.

(m) "Electric delay blasting caps" - Caps designed to detonate at a predetermined period of time after energy is applied to the ignition system.

(n) "Explosives" - (1) Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion; that is, with substantially instantaneous release of gas and heat, unless such compound, mixture or device is otherwise specifically classified by the U.S. Department of Transportation.

(2) All material which is classified as Class A, Class B, and Class C Explosives by the U.S. Department of Transportation.

(3) Classification of explosives by the U.S. Department of Transportation is as follows:

Class A Explosives. Possessing detonating hazard, such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.

Class B Explosives. Possessing flammable hazard, such as propellant explosives, including some smokeless propellants.

Class C Explosives. Include certain types of manufactured articles which contain Class A or Class B explosives, or both, as components, but in restricted quantities.

(o) "Fuse lighters" - Special devices for the purpose of igniting safety fuse.

(p) "Magazine" - Any building or structure, other than an explosives manufacturing building, used for the storage of explosives.

(q) "Misfire" - An explosive charge which failed to detonate.

(r) "Mud-capping" (sometimes known as bulldozing, adobe blasting, or dobying). The blasting of boulders by placing a quantity of explosives against a rock, boulder, or other object without confining the explosives in a drill hole.

(s) "Nonelectric delay blasting cap" - A blasting cap with an integral delay element in conjunction with and capable of being detonated by a detonation impulse or signal from miniaturized detonating cord.

(t) "Primary blasting" - The blasting operation by which the original rock formation is dislodged from its natural location.

(u) "Primer" - A cartridge or container of explosives into which a detonator or detonating cord is inserted or attached.

(v) "Safety fuse" - A flexible cord containing an internal burning medium by which fire is conveyed at a continuous and uniform rate for the purpose of firing blasting caps.

(w) "Secondary blasting" - The reduction of oversize material by the use of explosives to the dimension required for handling, including mudcapping and blockholing.

(x) "Stemming" - A suitable inert incombustible material or device used to confine or separate explosives in a drill hole, or to cover explosives in mud-capping.

(y) "Springing" - The creation of a pocket in the bottom of a drill hole by the use of a moderate quantity of explosives in order that larger quantities or explosives may be inserted therein.

(z) "Water gels, or slurry explosives" - A wide variety of materials used for blasting. They all contain substantial proportions of water and high proportions of ammonium nitrate, some of which is in solution in the water. Two broad classes of water gels are: (1) Those which are sensitized by a material classed as an explosive, such as TNT or smokeless powder, and (2) those which contain no ingredient classified as an explosive; these are sensitized with metals such as aluminum or with other fuels. Water gels may be premixed at an explosives plant or mixed at the site immediately before delivery into the bore hole.

(aa) "Semiconductive hose." Semiconductive hose - a hose with an electrical resistance high enough to limit flow of stray electric currents

to safe levels, yet not so high as to prevent drainage of static electric charges to ground; hose of not more than 2 megohms resistance over its entire length and of not less than 5,000 ohms per foot meets the requirement.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as ammended at 58 FR 35184 and 35311, June 30, 1993]

**APPENDIX C-4**

**29 CFR 1926.850; Subpart T  
DEMOLITION - OSHA**



U.S. Department of Labor  
Occupational Safety & Health Administration

## 1926.850 - Preparatory operations.

- **Standard Number:** 1926 850
- **Standard Title:** Preparatory operations.
- **SubPart Number:** T
- **SubPart Title:** Demolition

Produced by USDOL OSHA - Directorate of Safety Standards &  
Directorate of Health Standards

Maintained by USDOL OSHA - OCIS

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(a) Prior to permitting employees to start demolition operations, an engineering survey shall be made, by a competent person, of the structure to determine the condition of the framing, floors, and walls, and possibility of unplanned collapse of any portion of the structure. Any adjacent structure where employees may be exposed shall also be similarly checked. The employer shall have in writing evidence that such a survey has been performed.

(b) When employees are required to work within a structure to be demolished which has been damaged by fire, flood, explosion, or other cause, the walls or floor shall be shored or braced.

(c) All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped, or otherwise controlled, outside the building line before demolition work is started. In each case, any utility company which is involved shall be notified in advance.

(d) If it is necessary to maintain any power, water or other utilities during demolition, such lines shall be temporarily relocated, as necessary, and protected.

(e) It shall also be determined if any type of hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous substances have been used in any pipes, tanks, or other equipment on the property. When the presence of any such substances is apparent or suspected, testing and purging shall be performed and the hazard eliminated before demolition is started.

### ..1926.850 (f)

(f) Where a hazard exists from fragmentation of glass, such hazards shall be removed.

(g) Where a hazard exists to employees falling through wall openings, the opening shall be protected to a height of approximately 42 inches.

(h) When debris is dropped through holes in the floor without the use of chutes, the area onto which the material is dropped shall be completely enclosed with barricades not less than 42 inches high and not less than 6 feet back from the projected edge of the opening above. Signs, warning of the hazard of falling materials, shall be posted at each level. Removal shall not be permitted in this lower area until debris handling ceases above.

(i) All floor openings, not used as material drops, shall be covered over with material substantial enough to support the weight of any load which may be imposed. Such material shall be properly secured to prevent its accidental movement.

(j) Except for the cutting of holes in floors for chutes, holes through which to drop materials, preparation of storage space, and similar necessary preparatory work, the demolition of exterior walls and floor construction shall begin at the top of the structure and proceed downward. Each story of exterior wall and floor construction shall be removed and dropped into the storage space before commencing the removal of exterior walls and floors in the story next below.

**..1926.850 (k)**

(k) Employee entrances to multistory structures being demolished shall be completely protected by sidewalk sheds or canopies, or both, providing protection from the face of the building for a minimum of 8 feet. All such canopies shall be at least 2 feet wider than the building entrances or openings (1 foot wider on each side thereof), and shall be capable of sustaining a load of 150 pounds per square foot.

**APPENDIX D**

**CALCULATIONS OF POWDER FACTOR**



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### Calculating Powder Factor / Blasting Theory

Powder factor is defined as the ratio of a quantity of explosives needed to break a quantity of rock/concrete. By this definition powder factor could be expressed as pounds of explosives per ton of rock (lb/ton), pounds of explosive per cubic yard of rock (lb/yd<sup>3</sup>), or in any other units of measure that would specify explosives and rock amounts. Pounds per cubic yard seems to be the most widely accepted form of expressing the powder factor, and the one on which the following problems are based.

The powder factor will vary for all blasting operations depending on how hard the rock is, the density and strength of the explosive used, the blast pattern, the geology, the degree of fragmentation required as well as a host of other factors.

On large scale operations such as quarries, mines, and highway excavation, powder factors may vary from 0.5 lb/yd<sup>3</sup> to 2.0 lb/yd<sup>3</sup>. For smaller operations, powder factors may range from 1.0 lb/yd<sup>3</sup> for wide trenches and easy shooting to 8.0 lb/yd<sup>3</sup> for narrow trenches and hard shooting.

The normal way of calculating powder factor is to find the cubic yards of rock a borehole will break and divide this into the pounds of explosive loaded in that

borehole: 
$$\text{Powder Factor (lb/yd}^3\text{)} = \frac{\text{amount of explosive (lb)}}{\text{volume of rock broken (yd}^3\text{)}}$$

Powder factor can also be used as a method of blast design or at least as a way of determining the amount of explosives to be used in a borehole. The formula above can be rewritten as :

$$\text{Pounds of Explosives} = \text{Powder Factor} \times \text{Volume of Rock Broken}$$
 This assumes that the blaster has experience with the type of blasting to be done and knows the powder factor to be used and can calculate the volume of the rock from the burden, spacing, and depth of rock.

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### Blasting Theory for demolition of columns by NAIS

#### Composition of columns :

- 1) concrete 20 inches in diameter
- 2) Estimated height to be demolished 16 feet
- 3) Reinforced with ½ inch steel rebar every 4 inches through the columns.

Drill Pattern and amount of explosives in theory to demolish one column with reinforced steel rebar.

- 1) 11 holes drilled vertically spaced by 1 foot 4 inches from top to bottom.
- 2) Hole diameter will be 1 and a half inches
- 3) Hole depth will be 18 inches

Estimated Powder Factor for columns to included the added factor of reinforced ½ in steel rebar.

.75 lbs per hole with a total of 8.25 lbs per column

#### Composition of Top Slab :

- 1) concrete 1 ft thick
- 2) 370 ft in diameter
- 3) Reinforced with 1 inch steel rebar every 1 ft.

Drill pattern and amount of explosives in theory to demolish the Top Slab.

- 1) 50 holes 8 inches deep
- 2) Hole diameter will be 1 and a half inches

Estimated Powder Factor to demolish the Top Slab to include the added factor of reinforced 1 inch steel rebar.

.25 lbs per hole with a total of 12.5 lbs for the Top Slab

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