Maine Drilling & Blasting

16 Stearns Road
Controlled Blast Plan

Wellesley, MA

February 5, 2019

Prepared For:

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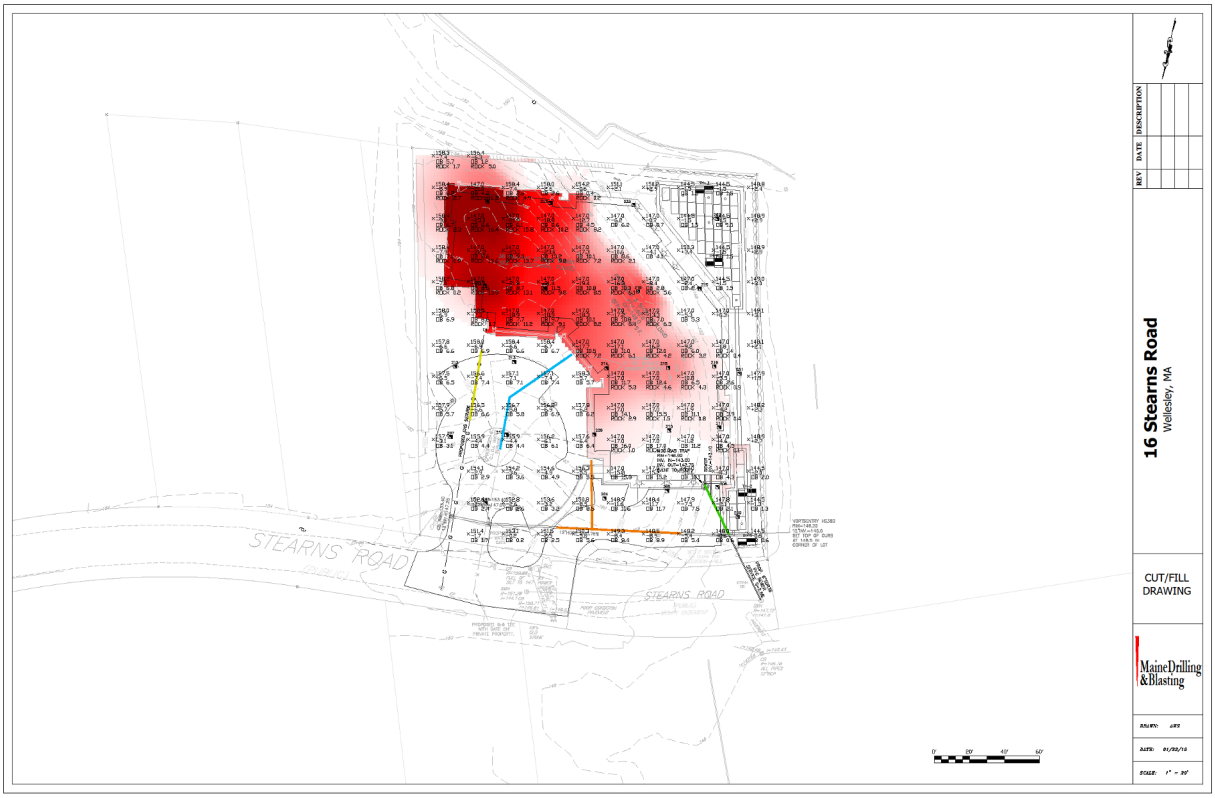
Introduction

This project involves excavation for a three story building. The challenge in this project is design of a practical Blast Plan that affords the degree of control necessary for the setting. The design must be appropriate for the environment. The Controlled Blast Plan must take into consideration the human and structural response presented by the required rock excavation. The purpose of this plan is to advance the best available control technology and be flexible enough to utilize an array of instruments in combination, to best marginalize the invasive nature of the work and delineate the "Blasting Best Practices" that will effectively allow for rock excavation while protecting neighboring public and property; the environment; onsite personnel; as well as those directly involved in the excavation operation. Geotechnical information has identified ledge excavation will be required in the proposed building and site utilities.



Safety must be the priority during all phases of blasting operations.

Details of tools, products, procedures, and process, including Industry and Regulatory guidelines have been included in this plan. Elements included in this plan have been successfully employed in densely populated, vibration and/or environmentally sensitive, research, manufacturing, academic, historic and medical settings.

Maine Drilling & Blasting

Pre-Blast Surveys / Notifications / Communication

In Massachusetts, the standard prescribed by 527 CMR1: 65.9.15 requires all buildings and structures (not controlled by the project) within 250 ft. of the closest bore hole, be surveyed to document their existing condition.

Surveys will be offered to owners / occupants of structures within 250 ft. (see Pre-blast Survey Plan in the Annex) of the blasting. Surveys will be conducted and documented as provided in 527 CMR 1 65.9.15.

Neighbors providing contact information (email / phone) who request daily notification will be notified of blasting events. An informational document entitled "Facts About Blasting for Massachusetts Property Owners" has been developed by the Commonwealth of Massachusetts Department of Fire Services. It delineates key regulation and answers common questions about blasting (a copy is located in the Annex). A positive public relationship is essential to the successful build of any project. It is understood that good relationships are fostered by communication and trust. This is especially true when a project involves blasting.

Blast Monitoring

All blasts will be monitored by a Monitoring Operator who has been properly trained in the setup and use of seismic monitoring equipment. 527 CMR 1 65.9.14.4.3 requires all blasting operations to be monitored. 527 CMR 1 65.9.14.4. requires the seismograph to be placed at the nearest structure. For this project up to two (2) seismographs will be utilized.

- The primary monitoring device will be located at the nearest inhabited building or structure adjacent to the blast area that is not owned, leased or controlled by the blasting operation (CMR1: 65.9.14.4). This is the neighboring house on Stearns Road directly abutting the property, or the house across the street depending on the blast location.
- A second seismograph shall be located at another structure mutually agreed upon by the Blaster and the Head of the Fire Department.

Prior to commencement of blasting operations, permission to monitor will be sought from the home / facilities owner or representative. If access should be denied, as required by CMR1: 65.9.14.4.1. The AHJ will be notified, and an alternate accessible location on public or controlled property will be selected. To represent the ground and air response at the identified structure, the chosen location should best match the distance and direction to the structure. Placement, set-up and use of monitoring equipment will be as specified by the manufacturer and delineated in the 2015 ISEE Field Practice Guidelines for Blasting Seismographs (Guidelines provided in annex). These Guidelines (referenced in CMR1: 65 NFPA 495 11.1.4) were developed by a Standards Committee comprised of seismograph manufacturers, researchers, regulatory personnel and seismograph users. As stated in the opening page of the document. "The goal of the Field Practice Guidelines for Blasting Seismographs is to develop uniform and technically appropriate

standards for seismograph performance. The intent is to improve accuracy and consistency in ground vibration and air wave measurement". The above paragraph concludes with the statement, "Seismograph performance is affected by how the seismograph is built and how it is placed in the field". In Part II, Ground Vibration Monitoring, particular emphasis is given to two critical factors: placement and coupling. The sensor must be placed within 10 ft of the structure, in undisturbed or soil matching sensor density. The sensor must couple effectively to the earth. Acceleration level and soil medium affect proper coupling. The guidelines spell out stepped levels of installation measures required to insure coupling. Collection of accurate data is not only expected from a compliance perspective but is instrumental in accurate evaluation of design performance. Post event, ground and air response data must be analyzed along with other shot performance indicators allowing blast design to be a dynamic process of design refinement. Monitoring equipment must meet the ISEE performance Standards. (Find performance specifications in the annex).

Sequence of Blasting

All blasting operations will be strictly coordinated with project management; construction site supervision and local AHJ. Emphasis will be on the safe and efficient fragmentation of the rock on this project without impact to the environment or surrounding structures. The initial Test Blast will be located furthest away from existing buildings. This will occur on the northern portion of the building where the rock is the shallowest (refer to Test Blast Plan in the Annex). This location will enable the operation to determine ground transmission characteristics in a shallow cut area affording opportunity to refine design as the work approach the existing structures. From there we will work in a southerly developing a working face from east to west. We anticipate one to two blast events per day for duration of 15 working days. Experience has shown advantage to incorporating the following elements into our design strategy:

1. Linear energy dissipation over a long working face (spatial distribution)
2. Relief encouraged by shallow depth to width ratio design
3. Air response and shot cast suppression by deliberate muck pile confinement of face
4. Face confinement compensated by lateral and if required vertical delay sequencing
5. Matting access enhanced by limiting shot depth to excavator reach. Reach maximized by mat placement from graded shot rock of the previous shot.

Hours of Operations

- Drilling and Blasting operations shall coincide with project construction work hours, Monday through Friday.
- Blast events will be scheduled between the hours of 9:00 am and 5:00 pm.
- Blasting cannot be conducted at times different from those announced in the blasting schedule except in emergency situations, such as electrical storms or public safety required unscheduled detonation.

Scheduling

By law, the blaster must limit his blast site access to personnel necessary to the drilling and blasting operation. He will need cooperation from other entities competing for the same footprint. Cost effective site management has recognized a value in dollars and overall schedule by planning and executing required blasting in advance of other competing construction activities. Specifications for green concrete in a blast area will often have a dramatic effect on productivity of both blasting and concrete work. The need to minimize the disruption of onsite or offsite activities by blast events must be balanced with the need to minimize the overall duration of disruption caused by the blast project. Safety must always take precedence over convenience. Our experience has shown a single blast event at a regularly scheduled time, provides the most manageable schedule for all involved. This is accomplished by incorporating a full day's work into a single blast event, at the end of the day (within the allowed window for blasting). However circumstances may present (proximity to structure and applicable limits) that will scale event size making a single blast event impractical. For example, if the limits of blast design, on average incorporated only 25% of one day's work, a single daily blast event would increase the duration of the blast project by a factor of four. The required ledge excavation; vibration limits and proximity to structure will dictate a conservative shot design that may require up to three blast event windows per day.

Some Rules of Thumb:

- Minimize blast events to the degree practical.

- If possible, seek event windows of mutual convenience (within technically achievable limits).

- Inflexible scheduling is invariably achieved at the expense of safety.

- Communicate. Establish representatives to coordinate blast event notification. Minimize links in chain of communication. Establish K.I.S.S. protocol. The blaster in charge should be focused on the safe execution of the blast plan and not wholly absorbed in a complicated notification sequence.

When the Blaster in Charge or the AHJ determines that the blast area security perimeter will include a roadway, pedestrian and vehicular traffic will be briefly interrupted for the event. The secured period will be similar to a traffic light sequence. Management will be coordinated with local AHJ.

Shot Cast Control

Matting, delay sequencing, backfill and berming will be used to control excessive amounts of rock movement. Shot rock will be used to construct a matting access platform that functions as a stable surface to safely and precisely place mats. The platform also serves to both contain horizontal displacement and as a footing support mats draped on grades. Placement and density of mats are based on existing / designed relief, berming and proximity to protected structure. Placement and density based on these metrics are determined by the blaster. Mats will be placed so as to protect all people and structures on, or surrounding the blast site and property. Heavy duty cabled rubber tire type blasting mats will be utilized on this project and will be approximately 12' x 24' in size; Rubber mat @ 12' x 24' 38 lbs. / sf. = 10,944 lbs (Dynamat data sheet can be found in the annex).

Blast Area Security, Warning Signs & Signals

The Blaster in Charge along with site management will develop a written Site Security Plan identifying as a minimum the blast area, equipment requiring removal, blast area access points, sentry locations and designated "safe area(s)". Blast Area and Blast Signal Code signs will be posted per CMR 1, 65.9.8.4.1 requirements. Areas in which charged holes are awaiting firing shall be guarded, barricaded and posted, or flagged against unauthorized entry.

Each blast will be preceded by a security check of the affected area and then a series of warning signals. Communications will be made with job site management, local authority and neighbors as required to ensure the safest possible Blast Operations. All personnel in the vicinity closest to the blast area will be warned. A sign displaying the warning signal sequence will be conspicuously posted at the project. CMR1 requires the signal be audible at a distance of 250ft from blast site.

The warning signal sequence will be:

3 Audible Signal Pulses - 5 Minutes to Blast

2 Audible Signal Pulses - 1 Minute to Blast

1 Audible Signal pulse - All Clear

The blast site will be examined by the blaster prior to the ***all-clear*** signal to determine that it is safe to resume work. No blast will be fired until the area has been secured and determined safe.

Blaster Qualifications and Training

The "Blaster in Charge" on this job will be licensed in the State of MA and have received training in the safe use and handling of explosives. All employees handling explosives will have been granted Employee Possessor Clearance from the DOJ BATFE. All employees transporting explosives will have been granted an HME with USDHS TSA clearance. Blasters will have received training and be familiar with MSHA/OSHA Regulations, State Regulations, and Federal Regulations regarding construction site safety, including transportation, use, and handling of explosive materials. Prior to the commencement of initial work, an in depth, site specific, a Job Hazard Analysis will be developed by project and site management and thoroughly considered with all crew members. Daily site specific Safety Meetings are to be held on site by the job foreman. Contractor input and participation is encouraged. Safety Meeting records are retained by the Blasting Contractor.

Blaster training includes a formal program dedicated to the I.M.E. "Blasting; Best Practices" guidance document for the protection of surface and groundwater.

Licenses and Permits and Insurance

Maine Drilling and Blasting will provide all required documentation to the Wellesley Fire Department AHJ, fully substantiating the license, insurance and bonding requirements for the transportation, use, and handling of explosives have been met.

Safe Limits for Ground and Air Response

Safe limits that have been adopted by industry and regulatory body alike were developed from 40 years of research done by US Bureau of Mines (USBM) and documented in the Bureau of Mines Report of Investigations 8507. These limits provide frequency based protection for sensitive construction materials (plaster) found in older and historic homes. The Safe Limit for old plaster is 0.50 in/s (below 10 Hz). One of the authors of RI 8507 and RI 8485, Dr. Siskind, stated 20 years later in his publication, "Vibrations from Blasting", "Research done since RI's 8485 and 8507 by the USBM and others has reaffirmed the conclusions from those studies even when the authors' intentions were to find exceptions (Siskind 1991)". In part the USBM research have with stood the scrutiny of time because the recommended levels produce strains less that those generate natural and man-made forces (see attached research references for "**Natural and Human Induced Vibrations in Homes**").

The "Safe Levels" for vibration from blasting that were developed in the RI 8507 study, are incorporated into BFPC 32A.01(C), CMR1: 65.9.1 and NFPA 495 11.2.1 (depicted below). This compliance curve is embedded in the compliance modules of blasting seismographs.

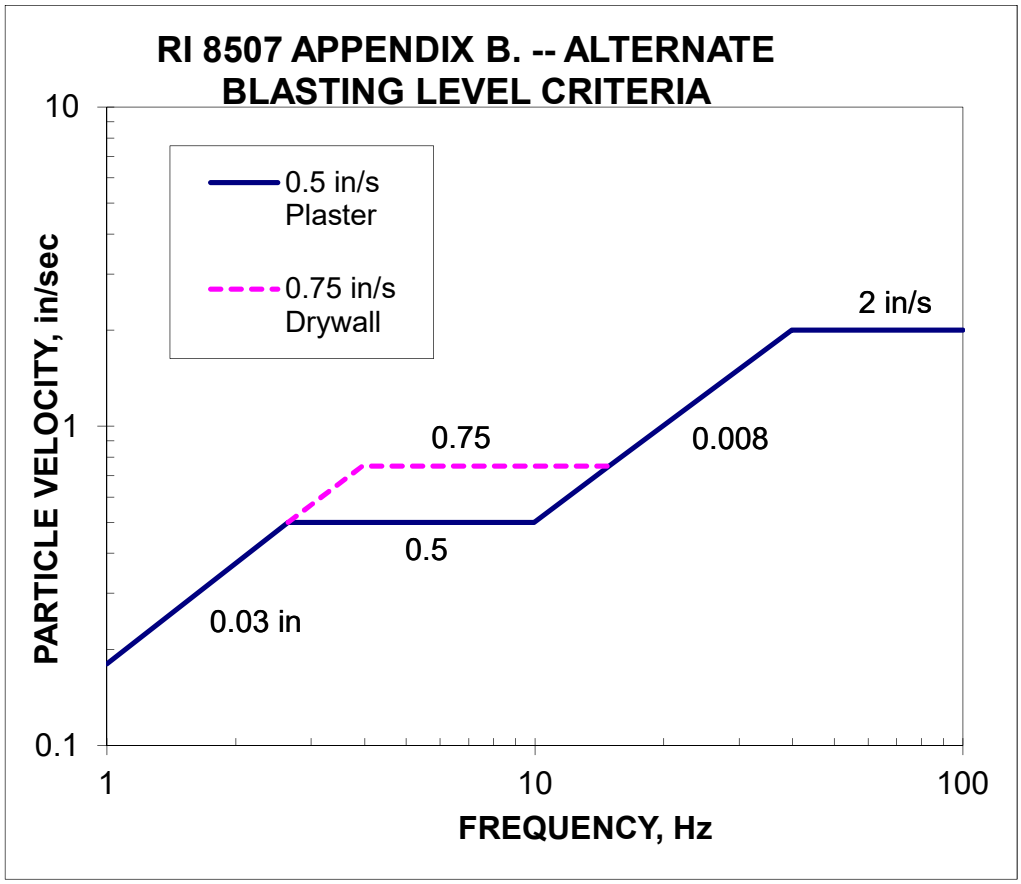


Figure B-1 Safe levels of blasting vibration using a combination of velocity & displacement

In RI 8485, The Bureau of Mines built on research that had previously determined "Safe Limits" for air response. In the Bureaus' conclusions on page 67 of the Report the authors indicate that the former "Safe Level" of 140 dB was "high enough to for significant annoyance" The new recommended level was designed to provide "annoyance acceptability". The recommended annoyance limit from this study (incorporated into CMR1 65.9.1 NFPA 495 11.3.1) for air response (as measured by ISEE approved blasting seismographs) is 133 dBL (.013psi) peak. This level is less than the pressure generated by a 20 mph gust of wind and well below levels that could be damaging. Air overpressure levels will be limited to 133dBL (.013psi)**.** In the report, the authors indicate a 20 mph gust can increase the pressure in the direction of the receiver 10 – 20 dB. The RI 8485 research concluded wind direction and speed have the greatest effect on air overpressure transmission. They identified thermal inversions as the second most influential factor. In addition to identifying natural influences, the report identifies the primary source of overpressure as an Air Pressure Pulse generated by the expansion of rock volume in the fragmentation process displacing the surrounding air mass. This audio is a fundamental part of the process and cannot be appreciably reduced. However, the lack of open faces and relatively small charge weights and volumes generated by project designs will considerably limit the APP as compared to mine blasts. Two other sources related to confinement can be influenced by design. Because the acoustics of any given blast are complex and are comprised of both controllable and uncontrollable elements, it is not uncommon for overpressure histories from well-designed "like" blasts to range 20 dB at a given receiver.

Environmental Considerations

All explosives will be handled according to the current version of the IME Best Practices

INSTITUTE OF MAKERS OF EXPLOSIVES

Blasting; Best Practices

The potential to impact surface or groundwater with the substances used in commercial explosives can be controlled through the implementation of certain measures. Implementing such measures as part of a standard operating procedure will eliminate or minimize the potential for these substances to dissolve in or become associated with water. The specific measures included can be grouped into the following four (4) basic categories:

1. Education/Training of Explosive Users
2. Selection of Appropriate Explosives for the Job and Conditions
3. Explosives Loading and Handling
4. Attention to Technical Matters

1. Education/Training of Explosive Users

Both the owners/operators of the location where explosives are being used and the personnel working with commercial explosives should be well informed of all applicable regulations as well as any potential consequences associated with the products' exposure to water. The federal Clean Water Act, or the equivalent state statute, regulates the release of substances, in particular those that can cause an undue risk to human health or the environment. In addition, the Resource Conservation and Recovery Act, governs the disposal of hazardous wastes.

2. Selection of Appropriate Explosive for the Job and Conditions

Selecting the proper explosive for the particular job is critical to the prevention of surface or groundwater impact.

- ANFO (ammonium nitrate - fuel oil) is not water-resistant and should be avoided if contact with water is likely.
- Various types of commercial explosives are available to withstand exposure to water. Water-resistant explosives include the cartridge forms of gelatinous nitroglycerin, watergels and emulsions and the bulk forms of emulsions which are: 1) Site Mixed Emulsion (ammonium nitrate - fuel oil - emulsifier) is a water-resistant explosive, semi-solid. This is manufactured on site and detonated while still warm assuring complete detonation. 2) Repump Emulsion (ammonium nitrate - fuel oil - emulsifier) is a water-resistant explosive, semi solid, manufactured off site, transported and pumped into the borehole as needed.

3. Explosives Loading and Handling

- All excess product in augers or hoses is to be recovered and used either in the next blasthole or recycled in the mixer/holding tank.
- Explosive spillage around the blasthole collar is to be controlled and any such spillage should be placed into the blasthole before stemming
- Water contacting explosives during cleanup is to be contained and managed in accordance with applicable regulations
- Minimize the amount of time that explosives are exposed to wet conditions within the blasthole. The blast should be initiated as near the time the loading is completed as safety and operational procedures allow.
- Avoid having explosives exposed to precipitation.
- To assure complete detonation of explosives placed into the ground, a sufficient number of boosters must be used.

4. Attention to Technical Matters

- The actual physical conditions into which explosives are being placed must be taken into account.
- Personnel responsible for loading explosives into the boreholes should be in continuous communication with the drillers of those boreholes or supplied with adequate drill logs, so that any knowledge regarding fractures, crevices or cavities is obtained.
- Where Bulk ANFO or Emulsion is used in fractured, creviced or cavitied boreholes, plastic borehole sleeves and/or positioned inert stemming decks will be used to ensure total detonation of the explosives and avoidance of excessive charges.
- Choosing and placing the correct drilling patterns that results in the optimal use of explosives with all the explosives undergoing complete detonation.
- Quality assurance/quality control measures to maintain drilling accuracy that prevents the detonation in one blasthole from impacting the proper detonation in a nearby blasthole.
- Selecting the appropriate drilling equipment so that adequate borehole quality is maintained.
- Where appropriate to ensure complete detonation, two (2) primers will be used in each blasthole; one near the top and one near the bottom of the explosive column.
- Correct selection of delay timing for each blasthole to ensure detonation of the entire pattern, and the prevention of cut-off blastholes.

Dust control during drilling operations is facilitated through the use of integrated vacuum dust collector and vapor systems installed by the manufacturer of the drilling equipment.

All storm water runoff and groundwater plans will be by the site contractor

Explosives

This project will utilize the NONEL® EZ DET® 1.4B Nonelectric Blast Initiation System. Primers will utilize TROJAN SPARTAN cast boosters which provide high density, high energy molecular explosives designed to optimize initiation of all booster sensitive explosives. The column charge will consist of packed emulsion, BLASTEX, a booster sensitive, water resistant, packaged emulsion explosive and/or metered emulsion.

There will be no explosives containing perchlorates used on this site at any time.

SDS (MSDS) and Technical Information data sheets for the explosive products proposed for use on this project are provided in the annex.

All explosives will be delivered to the job site on a daily basis. There will be no overnight storage. Only the amount of explosives required to perform the day's work will be brought to the site. All explosives will be transported in stored in vehicular explosives storage magazines approved and permitted by the State Fire Marshall.

Misfires

Heavy matting is often a contributing factor to the most common causes of misfires. These include: undetected breaks; faulty signal connections and damaged or pinched signal conduit. Physical signal connection and continuity verification and careful placement of blasting mats reduce associaed risks. Although misfire probabilities will minimised a misfire posibiltiy cannot be absolutely ruled out. Regulatory Guidance for the handling of misfires is provided in CMR1: 65.9.1 NFPA 495 10.5. The Technical Guidance from which it is sourced can be found in the I.M.E. Safety Library in SLP 17. Text concerning the proper handling of misfires has been excerpted from the most recent update to SLP 17 and is located in the annex.

Vertical Over-Break Control

Control of over break is a complex and often frustrating issue. Technology at present doesn't afford us the ability to laser cut a uniform and undisturbed bearing surface with explosives. It has always been assumed over break is solely a function of over drilling and over blasting, however consideration must be given as to the nature of the geology presented at the proposed bearing surface. Open seams near or below sub grade design elevation and variation in strata layering and competence will influence depth of excavation. These variations may be difficult to map. In load bearing areas, sub-drilling will be modified if needed as directed to minimize over break to an acceptable degree. Initial sub drilling will be 2-3 ft. Modification direction must be based on evaluation of elevation and condition of bearing surface presented at bottom of excavation. Test excavations should be conducted regularly if rock excavation significantly trails operations to provide relevant data. In all cases, blast dynamics minimally require a borehole to be of adequate depth to safely accommodate both the charge and confinement medium. Some States require that a pre-blast analysis and design consider the fundamental geometric relationship of the blast design. In Massachusetts for example CMR1: 65.9.8.3.1. charges the blaster with developing a "blast design plan which establishes sound relationships between current industry standards and the allowable limits of the effects of blasting." These industry standards or rules of thumb are empirical formulas developed by Dr. Ash, Dr. Bergman and others and were espoused by Joseph Pugliese in USBM RI 8550. After the 1996 extensive rewrite of State explosives regulation, the empirical formulas were written into the State Fire Marshall's Training Course: "Understanding and Regulating Explosives Using the Amended Regulation". Page 11 of this text (please see appendix) provides the formula and associated table for determining appropriate stiffness ratio of shot design. The table indicates a stiffness ratio of 2 or more is desirable. A stiffness ratio of 1 or less requires redesign of shot and specifically states "do not shoot". The unintended consequences of an excessive stiffness ratio (poor fragmentation, excessive ground and air response and "fly rock") can be significantly diminished by insuring design reflects at a minimum that, Bh = 2B.

Where:
Bh = Bench height
B = Burden

In order that over break constraints do not drive blast design into a technically prohibitive or unsafe direction, consideration should be given to a strategy allows some soil overburden to be left in place undisdurbed over shallow ledge cuts to afford minimum confinement requirements. During the stripping operations efforts should be made when possible to insure adequate confinement depth remains above shallow rock cuts. An overburden stripping plan can be developed from geotechnicnical data that will allow removal of overburden to rock or minimum confinement elevation which ever is greater. This will allow for a 10 ft. hole minimum which will support safe design.

Proposed Blast Designs

Proposed initial Test Blast is provided in the attached annex. The design has been scaled based on proximity to the nearest structure. Charge sizes, hole depths, pattern geometry and detailed loading information is provided in the spreadsheets. A detailed vibration analysis of proposed design is also factored in the proposed Blast Design. A Proposed Shot Location Plan is included in the annex as well.

These designs provide a sound calculated starting point. As the work progresses design refinements will be made as required in response to performance indicators and encountered conditions including: ground and air response, displacement control, fragmentation, floor grading requirements, back break, and geology.

Blast Plan Annex

REV	DATE	DESCRIPTION

16 Stearns Road

Wellesley, MA

Pre-Blast Survey Drawing / Test Blast Location Plan

Maine Drilling & Blasting

DRAWN: AWS

DATE: 02/05/19

SCALE: 1" = 40'

PRE-BLAST DESIGN and VIBRATION ANALYSIS
Wellesley, Ma
February 5, 2019

Blast Data		
Represents the maximum lbs allowed vs. the closest structure		
Scale Distance	25	
Actual Distance	168	ft
Max Charge Weight/Delay	45.16	lbs
Actual vs Allowed Calculations		
Maximum Hole Depth	11	**ft**
Stemming Between Decks	0	ft
Stemming at top	6	ft
Diameter of hole/product	3.5	in
Density	1.26	g/cc
Lbs/ft	5.26	lbs/ft
Max Allowed Feet of Powder/Delay	5.00	ft
Decks Required?	No	
Actual # of Stemming Decks	0.0	
Actual Total ft. of Product	5.00	ft
Actual Total lb's of Product/Hole	26.28	lbs
Actual Feet of Product/Deck	5.00	ft
Actual Lbs/Deck	26.28	lbs
Powder Factor	1.32	
Yardage per hole	19.91	cu. yd's
Sq. ft per hole	48.86	sq. ft
Square Pattern	7.00	ft
Burden	7.0	
Spacing	7.0	ft

Production Blast Vibration Analysis

Estimated PPV's (inches/sec) at closest structures using different "K" factors

Holes or Decks/Delay Factor	**1.00**							
Max lbs/delay	**26.28**	**K Value**	**130.00**		**K Value**	**160.00**	**K Value**	**242.00**
Max ft/delay	**5.00**							
House Across Stearns St	**168.00**							
Scale Distance	**32.77**	**Est. PPV**	**0.49**		**Est. PPV**	**0.60**	**Est. PPV**	**0.91**
House Abutting Project	**184.00**							
Scale Distance	**35.89**	**Est. PPV**	**0.42**		**Est. PPV**	**0.52**	**Est. PPV**	**0.79**
Alzheimer's Facility	**188.00**							
Scale Distance	**36.67**	**Est. PPV**	**0.41**		**Est. PPV**	**0.50**	**Est. PPV**	**0.76**

Department of Fire Services
Commonwealth of Massachusetts

Facts About Blasting

for Massachusetts Property Owners

www.mass.gov/dfs

Department of Fire Services
Division of Fire Safety
P. O. Box 1025 - State Road
Stow, Massachusetts 01775
978-567-3100 • Fax 978-567-3121

Blasting Facts

- The Institute of Makers of Explosives (IME) reports that in 2012 over 12 million pounds of commercial explosives were sold for use in Massachusetts.
- Explosives are used directly or indirectly in almost every aspect of our lives. Car, trucks, roads, bridges, homes, and office buildings are all built with products that had their origins with explosives. Even baby powder has its origin with explosives!
- Mining and construction are the two most common uses of explosives.

Blasting Regulations

Commercial explosives and the blasting industry are regulated by a number of state and federal agencies. In Massachusetts, 527 CMR 1.00 is the primary regulation that applies to explosives licensing, permitting, storage, sales, use, transportation, and manufacture. 527 CMR 1.00 is administered through the Department of Fire Services, Division of Fire Safety.

Federal agencies that regulate explosives include:

- Alcohol, Tobacco, Firearms and Explosives (ATF) – sales and storage
- Department of Transportation (DOT) – transportation
- Occupational Safety and Health Administration (OSHA) – construction use and handling
- Mining Safety and Health Administration (MSHA) – mining use and handling

Massachusetts Regulations

527 CMR 1.00
Key Parts of the Regulation

Section 1.12.8.39.1 Licenses, Permits, Certificates

Certificate of Competency
Explosives Users Certificate
Use and Handling Permit
Sale of Explosive Material

Section 65.9.1 Storage

Section 65.9.1 Transportation

Section 65 Use of Explosive Materials (Blasting)

Blast Analysis
Blast Design Plan
Allowable Limits of Effects of Blasting
Preblast Inspection Surveys
Blasting Damage Complaint

Section 65.9.15.1.1.3 Pre/Post Blast Inspection Waiver

Section 65.9.18 Blasting Regulatory Review Form (FP-296)

Important parts of 527 CMR 1.00 for the homeowner to be aware of:

Section 65.9.8 Blast Analysis

A document from the blasting company considering the effects of blasting on adjacent properties.

Section 65.9.8.3 Blast Design Plan

The blast design plan describes the design of the initial blasts and all the necessary safety precautions that will be taken.

Massachusetts Regulations (continued)

Section 65.9.15 Preblast Inspection Surveys

When blasting takes place within 250 feet of a property not owned or controlled by the project, a free survey must be offered to the property owner.

NFPA 495, 2013 Edition Warnings

The blaster must sound warnings when ready to fire a blast.

NFPA 495, 2013 Edition, Chapter 11
Allowable Limits of Effects of Blasting

Limits that are set for vibration and noise that result from a blast. 527 CMR 1.00 Section 65.9.14.4 contains the requirements for the use of a seismograph.

Section 65.9.18 Blasting Regulatory Review

If a property owner thinks that damage occurred as a result of blasting, they should file a regulatory review form with the fire department within 30 days of the blasting.

A Few Things To Remember

If a blasting project is planned near your property, take a close look at your home or business. You may be surprised at how many cracks in walls, floors, and ceilings already exist just from seasonal changes in humidity, age, and normal wear and tear. Most property owners don't notice these cracks until after blasting has started and mistake them for blasting damage.

The limits set for blasting noise and vibration are conservative and are below the threshold of where damage is known to occur.

The limits set in 527 CMR 1.00 are the result of years of study and research by universities and the Federal Government. The United States Bureau of Mines (USBM) RI 8507 Report is the primary source for establishing noise and vibration damage levels.

Who Do You Contact?

In Massachusetts there are two places to go for blasting help.

Local fire departments issue a ***Permit to Blast***. The permit is issued only if all the correct planning has taken place and all other conditions of 527 CMR 1.00 have been met.

Through the Department of Fire Services, the Division of Fire Safety issues ***Blasting Certificates of Competency*** and ***Explosives Users Certificates*** to blasters and blasting companies. Local fire departments will not issue a blasting permit without these documents. The certificates document that the blaster is competent to conduct blasting operations, and that his company has shown evidence of both bonding and the required insurance.

Other Blasting Information

How is blasting noise and vibration measured?

A seismograph is used to measure blasting noise and vibration. Seismographs are set up next to the closest structure to the blast site. The machines record the ground vibration and noise generated by the blast. The information is used to determine if the blast has exceeded limits set in the regulations.

Does the blaster keep records?

The blaster is required to keep detailed records of each blast. The records contain the size, time, and location of the blast, the amount of explosives used, and the results of the seismograph monitoring.

Will you hear or feel the blast?

You may hear or feel a blast depending on your distance from the blasting site. Humans are sensitive to noise and sound. What you feel does not necessarily mean that damage is occurring. Let the blasting company know if you are being startled or if you have other concerns about what is taking place.

What if I am sure that blasting damage has occurred?

If you feel that damage has occurred to your property, fill out a ***Blasting Regulatory Review Form***. The form (FP-296) is available from the local fire department (and on the DFS website under ***Fire Prevention Forms***), and must be submitted to the local fire department within 30 days of the blasting incident. The blasting company will then be required to submit records to the fire department for the blasts in question. The records will be reviewed by both the fire department and the Division of Fire Safety for any violations of the regulations. The blasting company, or its insurance company, is also required to respond to the claimant and to investigate the claim.

What precautions can be taken before blasting starts?

If you are offered a preblast survey, accept the offer. The survey is an inventory of existing conditions of the property. It is also an opportunity for the property owner to ask questions and the blasting company to educate citizens. If you have any concerns or questions, raise them during the preblast survey. The blasting company should be ready and willing to answer questions and address concerns.

Useful Numbers

Department of Fire Services
P. O. Box – State Road, Stow, MA 01775
(978) 567-3100
www.mass.gov/dfs

Western Massachusetts Office
P. O. Box 389
One Prince Street, Northampton, MA 01060-0389
(413) 587-3181, Fax (413) 587-9819

Division of Fire Safety
Main Telephone: (978) 567-3375, Fax: (978) 567-3199

- Code Compliance & Enforcement Unit - Stow
  Telephone: (978) 567-3375, Fax: (978) 567-3199
- Code Compliance & Enforcement Unit - Northampton
  Telephone: (413) 587-3181, Fax: (413) 587-9819

Contact your local fire department at:

www.mass.gov/dfs

Department of Fire Services
P. O. Box 1025 - State Road
Stow, Massachusetts 01775
978-567-3100 • Fax 978-567-3121

International Society of Explosives Engineers

ISEE FIELD PRACTICE GUIDELINES FOR BLASTING SEISMOGRAPHS 2015

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This edition of *ISEE Field Practice Guidelines for Blasting Seismographs* was revised by the ISEE Standards Committee on July 2, 2015, and supersedes all previous editions. It was approved by the Society's Board of Directors in its role of Secretariat of the Standards at its July 31, 2015, meeting.

International Society of Explosives Engineers (ISEE) – Standards Committee Members[1]
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William Birch, Blastlog
Steven DelloRusso, Simpson Gumpertz & Heger Inc.
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Robert Turnbull, Instantel
Randall Wheeler, White Industrial Seismology
Board Liaison, Dr. Braden Lusk, University of Kentucky

[1]This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred.

Committee Scope: This Committee shall have primary responsibility for documents on the manufacture, transportation, storage, and use of explosives and related materials. This Committee does not have responsibility for documents on consumer and display fireworks, model and high power rockets and motors, and pyrotechnic special effects.

Origin and Development of ISEE Standards for Blasting Seismographs
One of the goals of the ISEE Standards Committee is to develop uniform and technically appropriate standards for blasting seismographs. The intent is to improve accuracy and consistency in vibration and air overpressure measurements. Blasting seismograph performance is affected by how the blasting seismograph is built and how it is placed in the field.

In 1994, questions were raised about the accuracy, reproducibility and defensibility of data from blasting seismographs. To address this issue, the International Society of Explosives Engineers (ISEE) established a Seismograph Standards Subcommittee at its annual conference held in February 1995. The committee was comprised of seismograph manufacturers, researchers, regulatory personnel and seismograph users.
In 1997, the Committee became the Blast Vibrations and Seismograph Section. The initial standards were drafted and approved by the Section in December 1999. Subsequently, the ISEE Board of Directors approved two standards in the year 2000: 1) ISEE Field Practice Guidelines for Blasting Seismographs; and 2) Performance Specifications for Blasting Seismographs.

In 2002, the Society established the ISEE Standards Committee. A review of the ISEE Field Practice Guidelines and the Performance Specifications for Blasting Seismographs fell within the scope of the Committee. Work began on a review of the Field Practice Guidelines in January 2006 and was completed in February 2008 to produce the 2009 edition. A revision to the Performance Specifications was started in 2009 and completed in 2011.

The ISEE Standards Committee takes on the role of keeping the standards up to date every 5 years. This document is the result of the latest effort by the ISEE Standards Committee to keep the standards up to date with current field techniques and technology.

TABLE OF CONTENTS

Disclaimer: These field practice recommendations are intended to serve as general guidelines and cannot describe all types of field conditions. It is important that the operator evaluate these conditions and obtain good coupling between the monitoring instrument and the surface to be monitored. In all cases, the operator is responsible for documenting the field conditions and setup procedures in the permanent record for each blast.

PREFACE

Blasting seismographs are used to establish compliance with Federal, state and local regulations and evaluate explosive performance. Laws and regulations have been established to prevent damage to property and injury to people. The disposition of the rules is strongly dependent on the accuracy of ground vibration and air overpressure data. In terms of explosive performance the same holds true. One goal of the ISEE Standards Committee is to ensure consistent recording of ground vibrations and air overpressure between all blasting seismographs.

ISEE Field Practice Guidelines
for Blasting Seismographs
2015 Edition

PART I. GENERAL GUIDELINES

Blasting seismographs are deployed in the field to record the levels of blast-induced ground vibration and air overpressure. Accuracy of the recordings is essential. These guidelines define the user's responsibilities when deploying blasting seismographs in the field and assume that the blasting seismographs conform to the ISEE "Performance Specifications for Blasting Seismographs" [3].

1. Read the instruction manual and be familiar with the operation of the instrument. Every seismograph comes with an instruction manual. Users are responsible for reading the appropriate sections and understanding the proper operation of the instrument before monitoring a blast.

2. Seismograph calibration. Annual calibration of the seismograph is recommended.

3. Keep proper blasting seismograph records. A user's log should note: the user's name, date, time, place and other pertinent data.

4. Document the location of the seismograph. This includes the name of the structure and where the seismograph was placed on the property relative to the structure. Any person should be able to locate and identify the exact monitoring location at a future date.

5. Know and record the distance to the blast. The horizontal distance from the seismograph to the blast should be known to at least two significant digits. For example, a blast within 1000 meters or feet would be measured to the nearest tens of meters or feet respectively and a blast within 10,000 meters or feet would be measured to the nearest hundreds of feet or meters respectively. Where elevation changes exceed 2.5 horizontal:1 vertical, slant distances or true distance should be used.

6. Record the blast. When seismographs are deployed in the field, the time spent deploying the unit justifies recording an event. As practical, set the trigger levels low enough to record each blast.

7. Record the full time history waveform. Summary or single peak value recording options available on many seismographs should not be used for

monitoring blast generated vibrations. Operating modes that report peak velocities over a specified time interval are not recommended when recording blast induced vibrations.

8. Set the sampling rate. The blasting seismograph should be programmed to record the entire blast event in enough detail to accurately reproduce the vibration trace. In general the sample rate should be at least 1000 samples per second.

9. Know the data processing time of the seismograph. Some units take up to 5 minutes to process and print data. If another blast occurs within this time the second blast may be missed.

10. Know the memory or record capacity of the seismograph. Enough memory must be available to store the event. The full waveform should be saved for future reference in either digital or analog form.

11. Know the nature of the report that is required. For example, provide a hard copy in the field; keep digital data as a permanent record or both. If an event is to be printed in the field, a printer with paper is needed.

12. Allow ample time for proper setup of the seismograph. Many errors occur when seismographs are hurriedly set up. Generally, more than 15 minutes for set up should be allowed from the time the user arrives at the monitoring location until the blast.

13. Know the temperature. Seismographs have varying manufacturer specified operating temperatures.

14. Secure cables. Suspended or freely moving cables from the wind or other extraneous sources can produce false triggers due to microphonics.

PART II. GROUND VIBRATION MONITORING

Placement and coupling of the vibration sensor are the two most important factors to ensure accurate ground vibration recordings.

A. Sensor Placement

The sensor should be placed on or in the ground on the side of the structure towards the blast. A structure can be a house, pipeline, telephone pole, etc. Measurements on driveways, walkways, and slabs are to be avoided where possible.

1. Location relative to the structure. Sensor placement should ensure that the data obtained adequately represents the ground-borne vibration levels received at the structure. The sensor should be placed within 3.05 meters (10 feet) of the structure or less than 10% of the distance from the blast, whichever is less.

2. Soil density evaluation. The soil should be undisturbed or compacted fill. Loose fill material, unconsolidated soils, flower-bed mulch or other

unusual mediums may have an adverse influence on the recording accuracy.

3. The sensor must be nearly level.

4. Typical practice is to point the longitudinal/radial channel towards the blast site. However, other sensor orientations are allowed.

a. For blast-by-blast sensor deployment, the longitudinal/radial channel should be pointed towards the closest blast hole. Records should indicate if this condition is met.

b. For multiple-blast sensor deployment, the azimuth (0-360 degrees, +/- 5 degrees) of the longitudinal/radial channel relative to true north should be recorded.

5. Where access to a structure and/or property is not available, the sensor should be placed closer to the blast in undisturbed soil.

B. Sensor Coupling

If the acceleration exceeds 1.96 m/s^2 (0.2 g), decoupling of the sensor may occur. Depending on the anticipated acceleration levels spiking, burial, or sandbagging of the geophone to the ground may be appropriate.

1. If the acceleration is expected to be:

a. Less than 1.96 m/s^2 (0.2 g), no burial or attachment is necessary.

b. Between 1.96 m/s^2 (0.2 g), and 9.81 m/s^2 (1.0 g), burial or attachment is preferred. Spiking may be acceptable.

c. Greater than 9.81 m/s^2 (1.0 g) , burial or firm attachment is required [7].

The following table exemplifies the particle velocities and frequencies where accelerations are 1.96 m/s^2 (0.2 g) and 9.81 m/s^2 (1.0 g).

Frequency, Hz	4	10	15	20	25	30	40	50	100	200
Particle Velocity mm/s (in/s) at 1.96 m/s^2 (0.2 g)	78.0 (3.07)	31.2 (1.23)	20.8 (0.82)	15.6 (0.61)	12.5 (0.49)	10.4 (0.41)	7.8 (0.31)	6.2 (0.25)	3.1 (0.12)	1.6 (0.06)
Particle Velocity mm/s (in/s) at 9.81 m/s^2 (1.0 g)	390 (15.4)	156 (6.14)	104 (4.10)	78.0 (3.07)	62.4 (2.46)	52.0 (2.05)	39.0 (1.54)	31.2 (1.23)	15.6 (0.61)	7.8 (0.31)

2. Burial or attachment methods.

a. The preferred burial method is excavating a hole that is no less than three times the height of the sensor [1], spiking the sensor to the bottom of the hole, and firmly compacting soil around and over the sensor.

b. Attachment to bedrock is achieved by bolting, clamping or adhering the sensor to the rock surface.

c. The sensor may be attached to the foundation of the structure if it is located within +/- 0.305 meters (1-foot) of ground level [5]. This should only be used if burial, spiking or sandbagging is not practical.

3. Other sensor placement methods.

a. Shallow burial is anything less than described at 2a above.

b. Spiking entails removing the sod, with minimal disturbance of the soil and firmly pressing the sensor with the attached spike(s) into the ground.

c. Sand bagging requires removing the sod with minimal disturbance to the soil and placing the sensor on the bare spot with a sand bag over top. Sand bags should be large and loosely filled with about 4.55 kilograms (10 pounds) of sand. When placed over the sensor the sandbag profile should be as low and wide as possible with a maximum amount of firm contact with the ground.

d. A combination of both spiking and sandbagging gives even greater assurance that good coupling is obtained.

C. Programming Considerations

Site conditions dictate certain actions when programming the seismograph.

1. Ground vibration trigger level. The trigger level should be programmed low enough to trigger the unit from blast vibrations and high enough to minimize the occurrence of false events. The level should be slightly above the expected background vibrations for the area. A good starting level is 1.3mm/s (0.05in/s).

2. Dynamic range and resolution. If the seismograph is not equipped with an auto-range function, the user should estimate the expected vibration level and set the appropriate range. The resolution of the printed waveform should allow verification of whether or not the event was a blast.

3. Recording duration. Set the record time for 2 seconds longer than the blast duration plus 1 second for each 335 meters (1100 feet) from the blast.

PART III. AIR OVERPRESSURE MONITORING

Placement of the microphone relative to the structure is the most important factor.

A. Microphone Placement

The microphone should be placed along the side of the structure, nearest the blast.

1. The microphone should be mounted near the geophone with the manufacturer's wind screen attached.

2. The microphone may be placed at any height above the ground [2].

3. If practical, the microphone should not be shielded from the blast by nearby buildings, vehicles or other large barriers. If such shielding cannot be avoided, the horizontal distance between the microphone and shielding object should be greater than the height of the shielding object above the microphone.

4. If placed too close to a structure, the air overpressure may reflect from the house surface and record higher amplitudes. Structure response noise may also be recorded. Reflection can be minimized by placing the microphone near a corner of the structure. [6].

5. The orientation of the microphone is not critical for air overpressure frequencies below 1,000 Hz [6].

6. The microphone element must be kept dry to help maintain proper calibration and minimize the potential for corrosion. A common practice is to place a windscreen (typically provided by the manufacturer) on the microphone and cover it loosely with a thin plastic bag, or "rain shield." Other methods can be used to protect the microphone from moisture; however, the pressure around the microphone sensing element must be able to change in relation to the pressure change caused by the blast overpressure.

a. When using a plastic bag as a rain shield, the bag should be tied loosely around the microphone, allowing some exchange of air between the inside and outside of the shield. Completely sealing a rain shield could result in the following:

i. Condensation – water accumulates inside the shield. A small hole in the bottom of the shield can help mitigate this issue.
ii. Static Pressure – over time pressure could build in the shield.
iii. Rain Triggers – rain drops striking a tightly sealed shield will cause pressure pulses that could trigger the seismograph.

b. It is acceptable to keep microphones inside security boxes or other protective covers as long as the pressure change in the enclosure reflects the pressure change outside of the protective cover in the surrounding environment.

B. Programming Considerations
Site conditions dictate certain actions when programming the seismograph to record air overpressure.

1. Trigger Level – When only an air overpressure measurement is desired, the trigger level should be low enough to trigger the unit from the air overpressure and high enough to minimize the occurrence of false events. The level should be slightly above the expected background noise for the area. A good starting level is 20 Pa (0.20 millibars or 120 dB).

2. Recording Duration – When only recording air overpressure, set the recording time for at least 2 seconds more than the blast duration. When ground vibrations and air overpressure measurements are desired on the same record, follow the guidelines for ground vibration programming (Part II C.3).

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1. American National Standards Institute, Vibration of Buildings – Guidelines for the Measurement of Vibrations and Evaluation of Their Effects on Buildings. ANSI S2.47-1990, R1997.

2. Eltschlager, K. K., White, R. M. Microphone Height Effects on Blast-Induced Air Overpressure Measurements, 31st Annual Conference on Explosives and Blasting Technique, International Society of Explosives Engineers, 2005.

3. International Society of Explosives Engineers. ISEE Performance Specifications for Blasting Seismographs, 2011.

4. Siskind, D. E., Stagg, M. S., Kopp, J. W., Dowding, C. H. Structure Response and Damage by Ground Vibration From Mine Blasting. US Bureau of Mines Report of Investigations 8507, 1980.

5. Siskind, D. E., Stagg, M. S. Blast Vibration Measurements Near and On Structure Foundations, US Bureau of Mines Report of Investigations 8969, 1985.

6. Stachura, V. J., Siskind, D. E., Engler, A. J., Airblast Instrumentation and Measurement for Surface Mine Blasting, US Bureau of Mines Report of Investigations 8508, 1981.

7. Stagg, M. S., Engler, A. J., Measurement of Blast –Induced Ground Vibrations and Seismograph Calibration, US Bureau of Mines Report of Investigations 8506, 1980.

b) Series III Specifications

Seismic	Range	10 in/s (254 mm/s).
	Resolution	0.005 in/s (0.127 mm/s), to 0.000625 in/s (0.0159 mm/s) with built–in preamp.
	Trigger Levels	0.005 to 10 in/s (0.127 to 254 mm/s) in steps of 0.001 in/s (0.01 mm).
	Frequency Analysis	National and Local Standards for all countries (see text).
	Accuracy	3% at 15 Hz.
	Acceleration, Displacement	Calculated using entire waveform, not estimated at peak.
Air Linear	Range	88–148 dB, 7.25 x 10^{-5} psi to 0.0725 psi, 0.5 Pa to 500 Pa.
	Resolution	0.1 dB above 120 dB (0.25 Pa).
	Trigger Levels	100–148 dB in 1 dB steps.
	Accuracy	0.2 dB at 30 Hertz and 127 dB.
"A" Weight (optional)	Range	50 to 110 dB in steps of 0.1 dB. (Impulse Response – 35 milliseconds)
Sampling Rate		Standard 1024 samples per second per channel to 16,384 (8,192 for 8 channel).
Event Storage	Full Waveform Events	300 standard and 1500 optional at standard sample rate of 1024.
	Summary Events	1750 standard and 8750 optional at standard sample rates of 1024.
Frequency Response	2 to 300 Hz	Ground and Air, Independent of record time.
Full Waveform Recording	Fixed Record Modes	Manual, single shot, continuous and programmed start/stop.
	Fixed Record Time	1 to 100, 300 or 500 sec plus 0.25 sec pre-trigger.
	Auto Record Mode	1 to 100, 300 or 500 sec plus 0.25 sec pre-trigger.
Strip Chart Recording	Record Method	Record to memory and/or internal printer. Program interval 2, 5, 15, 60, 300 or 900 sec.
	Days Storage	2.8 or 14 days at 5 second interval. 34 or 170 days at 60 second interval.
Histogram Combo Mode	Histogram Record Method	Record to memory and/or internal printer. Program interval 2, 5, 15, 60, 300 or 900 sec.
	Histogram Days Storage	2.4 or 12 days at 5 second interval. 29 or 147 days at 60 second interval.
	Waveform Events	Up to 13 one-second events (1024 sample rate, four channels recording).
	Waveform Record Times	1 to 13 seconds plus 0.25 sec pre-trigger.
Special Functions	Timer Operation	Programmed start/stop.
	Self Check	Programmable daily check.
	Scaled Distance	Weight and distance stored with event.
	Monitor Log	History printout programmable up to all events stored.
	Automatic download	Automatic downloading of data from a unattended monitor with Auto Call Home.
	Measurement Units	Imperial or metric, dB or linear air pressure, or in units of custom sensors.
Printer	Resolution	576 dots/line and 0.0049 inches (0.125 mm) per dot.
	Print Time	Less than 10 seconds for typical 1 second event with full analysis.
	Paper Control	Paper tear slot or automatic paper takeup, separate keys for feed and takeup.
	Rated Life – print head	18 miles (30 km) of printing.
	Number of Copies	1 to 10 copies automatic, any number manual.
User interface	Keyboard	64 domed tactile with separate keys for common functions.
	Display	4 line by 20 character high contrast backlit display with on line help.
Battery Life		30 days continuous recording, 70 days with timer, printing will decrease life.
Fuse		5 A/250 V

Series III Specifications (continued)

Dimensions		10.6 " x 14.0 " x 6.5 " (269 mm x 355 mm x 165 mm).
Weight		14 lbs. (6.4 kg).
Warranty	2 Years Parts and Labor	Calibration and equipment check required at 1 year to maintain warranty.
Environmental	Printer/ LCD	14 to 122 degrees F (–10 to 50 degrees C) operating.
	Electronics	–4 to 140 degrees F (–20 to 60 degrees C) operating.
	Humidity	5 – 90% RH non – condensing
	Storage	–4 to 160 degrees F (–20 to 70 degrees C).

Instantel reserves the right to change specifications without notice.

b) Specifications

		DS-477	DS-677
Seismic	Maximum Range	10 in/s (254 mm/s).	
	Minimum Resolution	0.000625 in/s (0.0159 mm/s) with built–in 8x preamp.	
	Trigger Levels	0.005 to 9.999 in/s (0.127 to 253.99 mm/s) in steps of 0.001 in/s (0.01 mm/s).	
	Peak Acceleration	0.01 to 30 g's calculated.	
	Peak Displacement	0.0001 to 1.5 in. (0.00254 to 38.1 mm) calculated.	
	Frequency Analysis	Freq. at Peak, plus USBM/OSMRE and DIN 4150 field frequency analysis.	
	Accuracy	Calibrated to within 1% of B & K* reference accelerometer @ 15 Hz	
Air Linear & "C" Weight	Range	88 to 148 dB, 0.03625 psi, 250 Pa. (Peak).	
	Minimum Resolution	7.25×10^{-5} (0.5 Pa).	
	Trigger Levels	100, 102, 104, and 105 to 142 dB in steps of 1 dB. 0.00029 to 0.03625 psi, in steps of 7.25 x 10-5 psi (2 to 250 Pa, steps of 0.5 Pa).	
	Frequency Analysis	Frequency at Air Pressure Peak standard.	
	Accuracy	Linear calibration to within 0.2 dB of B & K* reference @ 30 Hz and 127 dB.	
"A" Weight	Range	55 to 110 dB.	
	Resolution	0.2 dB.	
	Trigger Levels	55 to 110 dB in steps of 0.2 dB.	
	Frequency Response	0.5 to 8 kHz, independent of record time, impulse filtering.	
Frequency	Sampling Rate	1024 samples per second, all channels, all record modes.	
	Frequency Response (-3 dB points)	Seismic and Linear Air 1.5 to 250 Hz, independent of record time. Hardware "Anti-alias" filters to ensure accurate frequency measurement.	
Full Waveform Recording	Record Modes	Manual, single shot, continuous and auto.	
	Fixed Record Time	1 to 10 sec in 1 sec increments, plus 0.25 sec pretrigger.	
	Auto Record Mode	1 to 24 sec.	1 to 60 sec.
	Cycle Time	Complete data analysis and storage < 5 seconds per second record time.	
Strip Chart Recording	Record Method	Record to memory and/or internal printer.	
	Intervals	5, 15, 60, 300 sec.	
	Analysis	Peak, frequency of peak, and peak vector sum for each interval.	
	Max Record Time @ 5 min Intervals	20 days continuous recording to memory.	110 days continuous recording to memory.
	Print from Memory	Graphic plot of ground and air peaks, text plot of peaks and frequencies.	
Event Storage	No. of Full Wave Events	40	300
	No. of Summary Events	250	1750
	Storage method	Solid State Memory with >10 year storage life. Events and program still retained with battery removed.	

* Bruel and Kjaer

b) Specifications (continued)

		DS-477	DS-677
Special Functions	Timer Operation	Programmed start/stop.	
	Self Check	Programmable daily check.	
	Measurement Units	Imperial or metric, dB or linear air pressure.	
	Languages	English or French standard, others optional.	
	Microphone	Disable/Enable Mic for recording.	
Documentation	Notes	Up to 60 lines of notes (620 characters) stored with each event. Flexible format editing with standard and custom titles.	
	Scaled Distance	Weight and distance stored with event.	
	Monitor Log	History printout programmable up to all events stored.	
User interface	Keyboard	63 domed tactile with separate keys for common functions.	
	Display	2 line by 20 character high contrast display with on line help.	
Printer	Selectable Output	Setups, Frequency Analysis, Waveform, Sensorcheck, Strip Chart.	
	Plot Scales	2x, 1x, condensed, super condensed.	
	No. of Print Copies	Selectable from 1 to 10 copies, automatic or manual printing.	
	Condensed Print Time	<2 min including full analysis, frequency and waveform plot.	
	Plotter	Precision high resolution, 0.00787 in/step (0.2 mm/step).	
	Paper	Continuous 4.5" (11.4 cm) roll, unlimited shelf life.	
	Pen	Minimum 810 ft (250 m) plot life.	
	Paper Takeup	Paper tear slot or automatic paper takeup for unattended printing.	
	Manual Print Control	Separate keys for manual paper feed and paper takeup.	
Battery	Battery Type	Rechargeable 6V sealed gel cell 10 AHr capacity.	
	Battery Life	30 days continuous recording, 45 days with timer, printing will decrease life.	
Fuse	5 A/250 V		
Physical	Dimensions	10.6 " x 14.0 " x 6.5 " (269 mm x 355 mm x 165 mm).	
	Weight	15 lbs. (6.8 kg).	
	Case	Structural ABS foam with integral splash tight seal. Hinged lid is supported with a locking lid stay.	
Warranty	1 Years Parts and Labor.		
Environmental	Electronics	–4 to 140 degrees F (–20 to 60 degrees C) operating.	
	Printer/ LCD	14 to 122 degrees F (–10 to 50 degrees C) operating.	
	Storage	–4 to 160 degrees F (–20 to 70 degrees C).	

Instantel reserves the right to change specifications without notice.

The Reporting of Anomalous Data

Once the explosives user becomes aware of the manner in which various factors affect the vibration intensity, especially for close-in blasting, he recognizes the need for caution in the manner in which he reports his data. It may happen that the manner of reporting data can be quite misleading to readers and have an adverse effect on the way they evaluate future project conditions.

In general terms, the simplest suggestion that can be offered is to recommend that reports of data include an explanation of why certain results are anomalous, or, at the minimum to point out that the data are unusual and/or questionable, and to be treated with caution. We might illustrate this point with an example from urban blasting. In one case, there was a long row of charges adjacent to the wall of a building. Although many holes detonated simultaneously, their effect was not additive at any given point along the wall. The charge per delay was large, but the vibration intensity was low. This arrangement constituted a line of charges, not a point charge. If conventional procedures had been followed for reporting the data or plotting a graph, the results would have been seriously misleading to readers. The data was treated separately and explained for readers. For more discussion of line sources, see Oriard (1991, 1994).

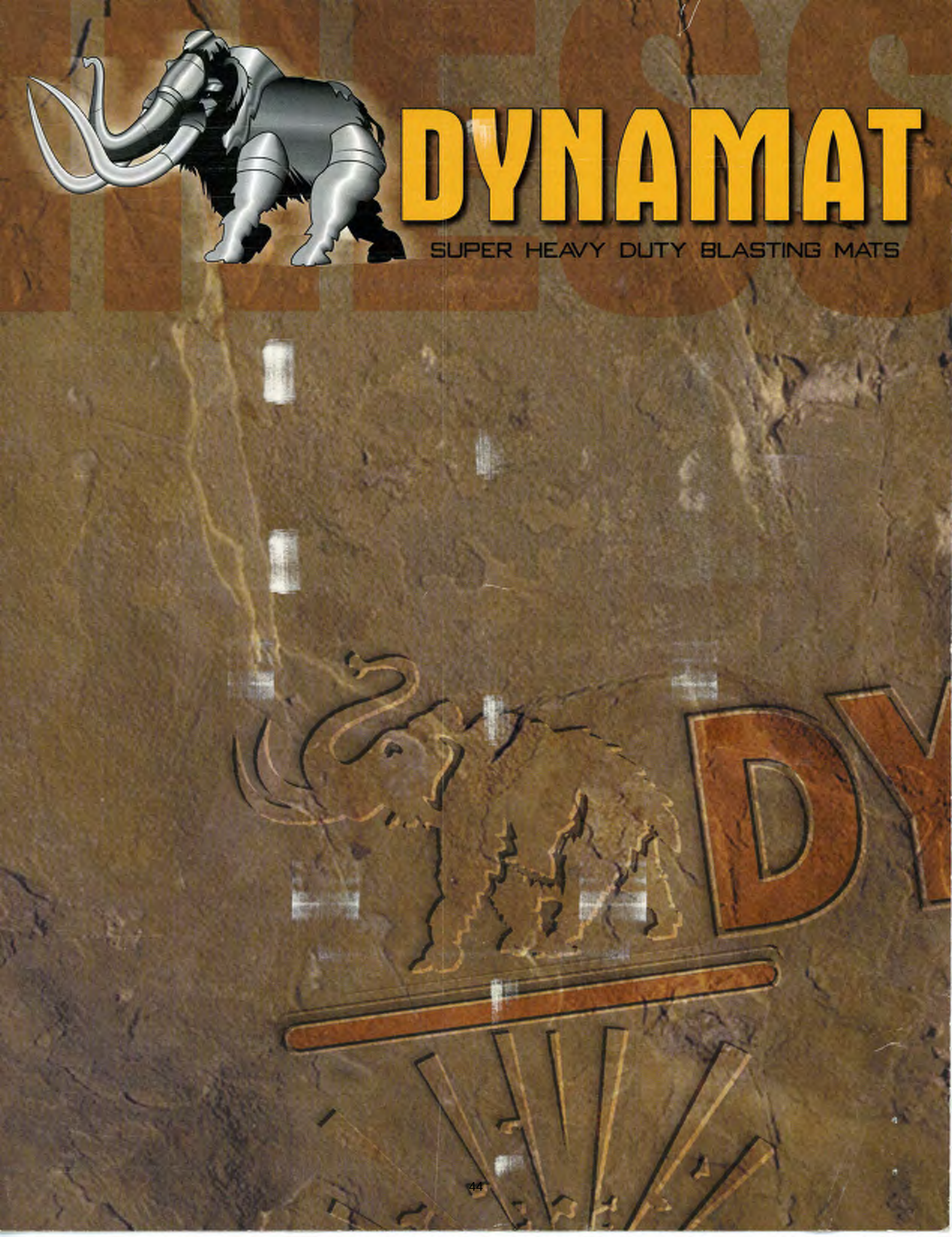
Readers should be very cautious about accepting anomalous data, such as those indicating unusually high intensities for very small charges, or very low intensities for very large charges, or reports of damage at very low vibration intensities. Unless the reader can verify authenticity, these data should be rejected because of the failure of the authors to describe details which might reveal that they are products of incomplete data gathering, such as timing scatter, sequence overlap, inadequate inspection, unverified damage reports, or other forms of inaccurate or incomplete descriptions.

Poor Seismometer Coupling

The usual purpose of routine vibration monitoring in residential areas is to obtain measurements of ground vibrations which represent those transmitted to building foundations in the area. It is important that there be good coupling between the vibration sensor (seismometer) and the ground. The most common result of poor coupling is to amplify (exaggerate) the true motion of the ground. Examples of improper placement of seismometers would be placing them within grass roots or other plant roots, or on the surface of loose fill soil, even when an anchoring spike is used. It is not unusual for such monitoring to register motions which are from 1.5 to 3 times that of the true ground motion. In a recent case, the writer observed that a seismometer spiked into a planter area registered a particle velocity 3.7 times that measured on the adjacent building foundation. When such locations cannot be avoided, a hole can be dug to the bottom of the loose area so that the seismometer can be placed in the firm, underlying soil and held firmly with packed backfill. If the seismometer is equipped with a spike, that can be used also. If available, a firmly packed dirt road will provide a suitable surface, as will most paved surfaces. However, loose slabs or those over hollows can give inaccurate readings, such as resonant responses to high frequencies. If the surface is very smooth, the seismometer should be prevented from slipping sideways, as well as from rocking or "jumping" from the surface. These tendencies are dependent on the size, shape and mass of the seismometer as well as the supporting surface. Sand bags can prevent movement at moderate levels, but should be large enough to contact the ground all around a seismometer to prevent its movement. A small bag that does not touch the ground is not useful. It merely adds to the weight of the seismometer. Ground spikes can also prevent slippage or wobbling at moderate levels. At high levels, positive anchoring is recommended. For paved surfaces, or other smooth surfaces, bolting or various chemical substances may be used to provide that anchoring. In soils, burial and firm backfilling may be needed. Burial is most effective when the density of the seismometer package matches that of the soil, often around 120 lbs/ft^3 (kg/m^3)

Further comment can be found in other publications. Several Bureau of Mines Reports of Investigation offer reviews of seismometer experiments conducted by the Bureau from 1961 to recent years. Duvall (1961) provides some insights into the question. Additional

information is provided in later Bureau reports, as well as lists of previously published information on the subject. Stagg and Engler (1980) offer recommendations that some type of anchoring should generally be provided for seismometer packages if acceleration levels over 0.2 g are expected. Ground spikes or large sand bags (that contact the ground) are usually effective to fairly high levels for small seismometers. Above 1 g, burial is recommended in soils, or bolting or gluing on smooth surfaces.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SUPER HEAVY DUTY BLASTING MATS

THE SUPER HEAVY DUTY BLASTING MATS

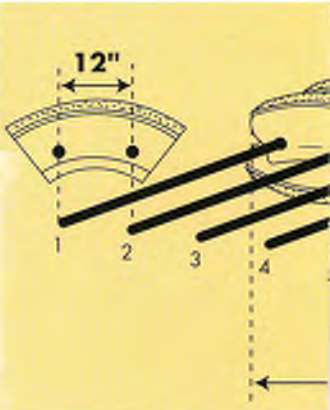
Made only by DYNAMAT and distributed around the world, our super heavy duty blasting mats are well-known for their flexibility, reliability, safety and their economic value.

The rubber parts are assembled in such a way that, at the time of the blasting, a certain amount of air goes through while flyrock is controlled.

QUALITY CONTROL SYSTEM

Our quality control system makes it possible to closely supervise each step of the manufacturing process. All our rubber pieces are perforated to minimize any tearing, which reduces potential flying parts, increases their durability and makes them even safer than ever.

Super Heavy Duty



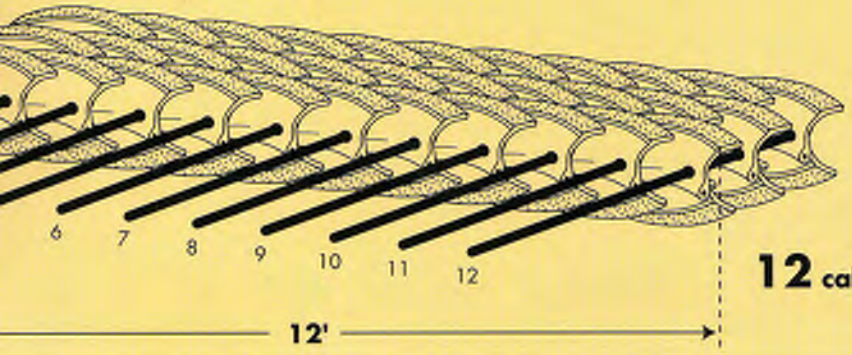
Regular

LIFTING RINGS

All our super heavy duty blasting mats are equipped with lifting rings at each end to make handling easier and to avoid premature breaking of the cables.

QUALITY CABLE

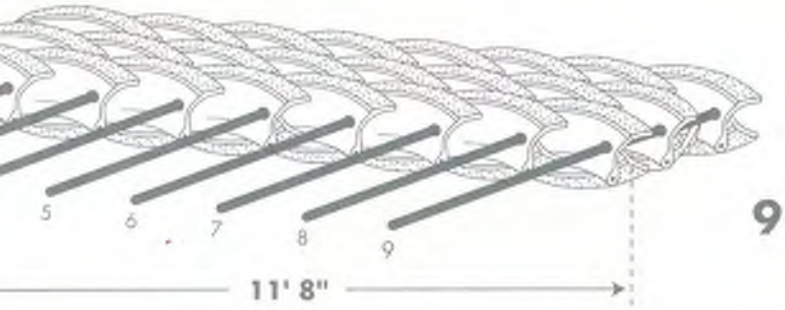
Dynamat manufactures super heavy duty blasting mats by using only new steel cable especially made for Dynamat.



12 cables

NEW CABLE

Breaking load 36,000 lbs



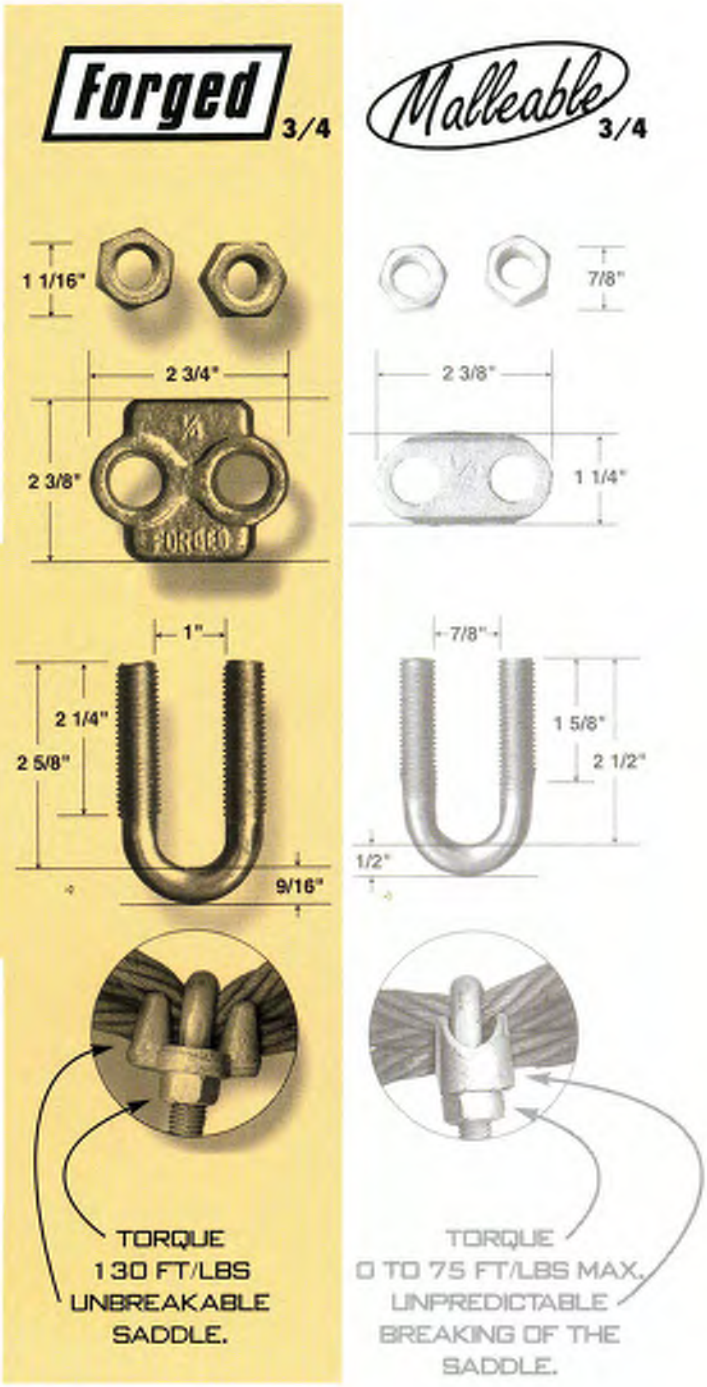
9 cables

USED CABLE

Unknown and unpredictable breaking load

QUICK DELIVERY

Thanks to our huge inventory that includes numerous sizes of super heavy duty blasting mats and an efficient delivery system, we guarantee a quick service around the world.



IMPORTANCE OF FORGED CLIPS

For every super heavy duty blasting mat, we only use the forged clips because they permit to reach the requisite tightening pressure in order to avoid the slipping away of steel cables. Besides, the quantity and the disposition of the forged clips allow all steel cables of our super heavy duty blasting mats to be solicited uniformly at the time of the lifting and by making it even, one avoids the premature wear and the overcharge on only one cable.

STANDARD SIZE IN STOCK

8 X 8	**10 X 15**
8 X 10	**10 X 20**
8 X 12	**12 X 12**
8 X 15	**12 X 15**
8 X 16	**12 X 16**
10 X 10	**12 X 24**
10 X 12	**15 X 15**

Size in feet

Any other size available on request

35 pds per square feet
170 kilos per square metre

All the blasting mats of less than 120 feet are manufactured with new steel cable of 5/8 FC (breaking load 25,000 lbs)

BLASTING

The Super Heavy Duty blasting mat reassures the blaster and his environment.

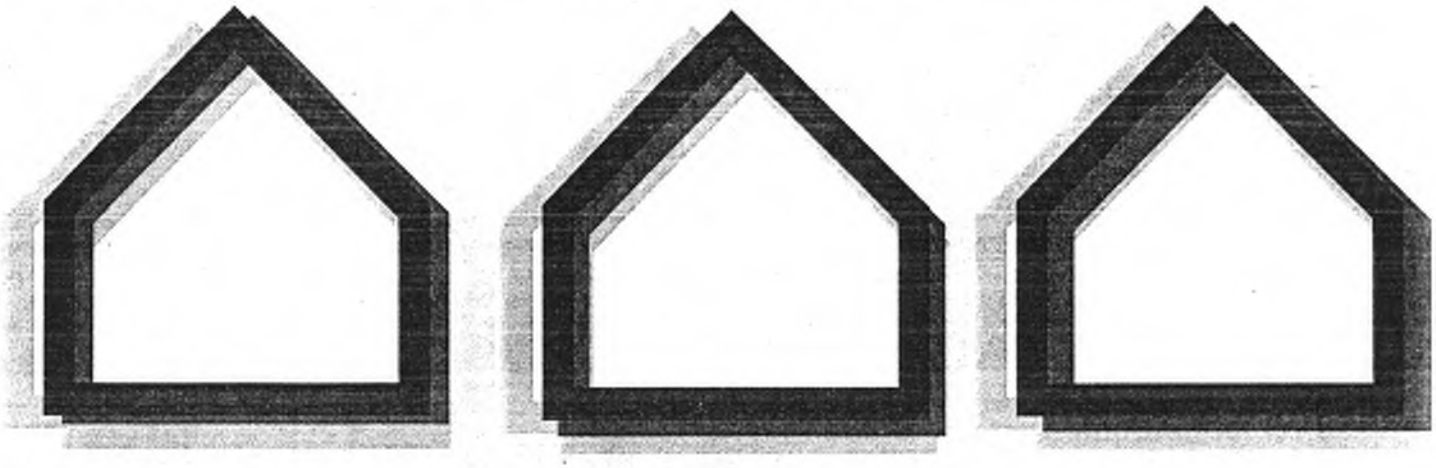
Custom-made

Our equipment lets us produce custom-made blasting mats to your specifications in sizes ranges from 4 x 4 ft. (1.20 x 1.20m) to 16 x 30 ft. (4.88 x 9.14 m). Only Dynamat can offer you blasting mats this big. Another Dynamat advantage!

Our blasting mats

BLASTING MATS			
Dimensions	**Weight**	**Number that fit into a 53-ft. trailer**	
		Canada ON/QC	USA
8 ft. X 16 ft. (2.43m x 4.87m)	4 736 lbs. (2 148 kg.)	18	9
10 ft. X 15 ft. (3.00m x 4.50m)	5 550 lbs. (2 517 kg.)	15	8
12 ft. X 24 ft. (3.65m x 7.30m)	10 650 lbs. (4 830.7 kg.)	8	4

Natural and Human-Induced



Vibrations in Homes

by David E. Siskind

Equivalent vibration velocities based on measurements of house wall responses and/or strains (various sources, in/sec):

From USBM fatigue study test-house in Indiana (RI 8896, Stagg, et all., 1984)

Slamming of front door	0.15 - 1.9
Jumping on the floor & walking	0.10 - 0.50
Humidity change inside (10 pct)	1.0 - 2.4
Temperature change inside (Δ10°F)	1.0 - 3.2
Wind	0.6 - 2.6

From five homes in Penna (Fang, 1976)

Temp. and humidity over 7 days	1.75 - 3.1
Auto traffic	0.04 - 0.20
Pushing on the wall	0.025-0.36

From UK studies at Leeds University (White, et al., 1993)

Outside temperature changes (Δ18°F)	>0.34
Pushing on wall near doorway	0.6 - 1.2
Pushing on wall next to window	2.4
Heel drop and jumping	0.15 - 0.9

From ISEE paper by Simms, et al., 1994

Closing door	0.3 - 0.45

From Sutherland, et al., 1968

Wind (50 mph)	1.1 - 6.7

From ISEE paper by Siskind, et al., 1996

Temperature outside (Δ10°F)	0.5 - 1.7

From Dowding, 1996

Temperature and humidity	0.75 - 2.6

References

Dowding, C. H., 1996. Construction Vibrations. Prentice Hall, ~10 pp.

Fang, H. Y., 1976. Field Studies of Structural Response to Blasting Vibrations and Environmental Effects. Lehigh University.

Simms, D. R., 1994. "A Good Neighbors Policy", the Evolution of O & G Industries, Inc.'s Public Relations Policy Working with Local Towns. Proc. 12th Annual Conf. on Explosives and Blasting Techniques. Society of Explosives Engineers. Austin, TX. pp 467-478

Siskind, D. E., M. S. Stagg, W. E. Pierce and S. V. Crum, 1996. Low-Frequency Blast Vibrations at a High Water Table Site. Proc. 12th Annual Symp on Explosives and Blasting Research. Society of Explosives Engineers. Orlando, FL. pp 21-31

Stagg, M. S., D. E. Siskind, M. G. Stevens and C. H. Dowding, 1984. Effects of Repeated Blasting on a Wood Frame House. U. S. Bureau of Mines RI 8896, 82 pp.

Sutherland, L. C., 1968. Sonic and Vibration Environments for Ground Facilities... A Design Manual. Report for NASA, Contract NAS8-11217, 633 pp.

Thoenen, J. R. and S. L. Windes, 1942. Seismic Effects of Quarry Blasting. U.S. Bureau of Mines Bulletin 442. 83 pp.

White, T., R. Farnfield and M. Kelly, 1993a. The Effect of Low Level Blast Vibrations and the Environment on a Domestic Building. Proc. 9th Annual Symp. on Explosives and Blasting Research, Society of Explosives Engineers, San Diego, CA. pp 71-81

White, T., R. Farnfield and M. Kelly, 1993b. The Effects of Surface Mine Blasting on Buildings. Proc. 4th International Symp. On Rock Fragmentation by Blasting (Fragblast 4), Vienna, Austria, pp 105-111

Safety Data Sheet

SECTION 1 – IDENTIFICATION

Name, Address, and Telephone of the Responsible Party

Dyno Nobel Inc.
2795 East Cottonwood Parkway, Suite 500
Salt Lake City, Utah 84121
Phone: 801-364-4800 Fax 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com www.dynonobel.com

SDS #: 1063
Date: 03/18/2015
Supersedes: 12/15/2011

Product Identifier
Product Form: Mixture
Product Name: Packaged Emulsion Explosives

Trade Name(s):
Synonyms:
BLASTEX®
BLASTEX® PLUS
BLASTEX® TX

Other Means of Identification
Product Class: Emulsion Explosives, Packaged

Intended Use of the Product:
Industrial blasting applications

Emergency Telephone Number
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

SECTION 2 – HAZARD(S) IDENTIFICATION

Classification of the Substance or Mixture

Classification (GHS-US)
Expl. 1.5 H205

Label Elements
GHS-US Labeling
Hazard Pictograms (GHS-US) :

GHS07

Signal Word (GHS-US) : Danger
Hazard Statements (GHS-US) : H205 – May mass explode in fire
Precautionary Statements (GHS-US) : P210 - Keep away from heat, hot surfaces, open flames, sparks. - No smoking
P264 - Wash exposed areas. thoroughly after handling
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P373 - DO NOT fight fire when fire reaches explosives
P370+P380 - In case of fire: Evacuate area
P372 - Explosion risk in case of fire
P401 – Store as defined in the Explosives Act of Canada and the provisions of the Bureau of Alcohol, Tobacco and Firearms regulations contained in 27 CFR part 555.

P501 - Dispose of contents/container according to local, regional, national, and international regulations

Other Hazards

Hazards Not Otherwise Classified (HNOC): Not available
Other Hazards: None

SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Name	Product identifier	% (w/w)	Ingredient Classification (GHS-US)
Ammonium nitrate	(CAS No) 6484-52-2	65 - 85	Ox. Sol. 3, H272 Eye Irrit. 2A, H319
Sodium nitrate	(CAS No) 7631-99-4	0.1 – 10	Ox. Sol. 3, H272 Acute Tox. 4 (Oral), H302 Eye Irrit. 2A, H319
Aluminum	(CAS No) 7429-90-5	0.1 - 3	Comb. Dust, H232 Flam. Sol. 1, H228 Water-react. 2, H261
Mineral Oil	(CAS No) 64742-54-7	0 – 2	Asp. Tox. 1, H304
Wax (paraffin)	(CAS No) 8002-72-2	0.0 – 2.2	Not Classified

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).
Full text of H-phrases: see section 16

SECTION 4 - FIRST AID MEASURES

Description of First Aid Measures

This is a packaged product that will not result in exposure to the contents under normal conditions of use. In the event of contact, administer first aid appropriate for symptoms present.

General: Never give anything by mouth to an unconscious person. If exposed or concerned, seek medical advice and attention.

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Obtain medical attention if breathing difficulty persists.

Skin Contact: Remove contaminated clothing. Gently wash with plenty of soap and water followed by rinsing with water for at least 15 minutes. Wash contaminated clothing before reuse.

Eye Contact: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention if irritation develops or persists.

Ingestion: Rinse mouth. Do not induce vomiting. Immediately call a POISON CENTER or doctor/physician.

Most Important Symptoms and Effects Both Acute and Delayed

General: Avoid ingestion, contact with eyes or skin.

Inhalation: May cause respiratory irritation.

Skin Contact: May cause skin irritation.

Eye Contact: May cause serious eye irritation.

Ingestion: Seek medical attention.

Chronic Symptoms: None expected under normal conditions of use.

Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention.

SECTION 5 - FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media: DO NOT ATTEMPT TO FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Evacuate

all personnel to a predetermined safe location, no less than 2,500 feet in all directions.
Unsuitable Extinguishing Media: DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS
Special Hazards Arising From the Substance or Mixture
Fire Hazard: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.
Explosion Hazard: This product is an explosive with mass detonation hazard. Heating may cause an explosion.
Reactivity: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in a large quantity.

Advice for Firefighters
Firefighting Instructions: DO NOT ATTEMPT TO FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions. Guard against re-entry.
Protection During Firefighting: See above
Hazardous Combustion Products: Nitrogen Oxides (NO_X), Carbon Monoxide (CO). Ammonia.
Reference to Other Sections: Refer to section 9 for flammability properties.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures
General Measures: Avoid all contact with skin, eyes, or clothing. Keep away from heat/sparks/open flames/hot surfaces. No smoking. Eliminate every possible source of ignition.
For Non-Emergency Personnel
Protective Equipment: Use appropriate personal protection equipment (PPE).
Emergency Procedures: Evacuate unnecessary personnel.
For Emergency Personnel
Protective Equipment: Use appropriate personal protection equipment (PPE).
Emergency Procedures: Eliminate ignition sources. Ventilate area.

Environmental Precautions
Prevent entry to sewers and public waters.

Methods and Material for Containment and Cleaning Up
Methods for Cleaning Up: Protect from all ignition sources. If no fire danger is present, and product is undamaged and/or uncontaminated, pick up or sweep up and repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements.
Reference to Other Sections
See heading 8, Exposure Controls and Personal Protection. Concerning disposal elimination after cleaning, see section 13.

SECTION 7 - HANDLING AND STORAGE

Precautions for Safe Handling
This is a packaged product that will not result in exposure to the contents under normal conditions of use.
Additional Hazards When Processed: This product is an explosive and should only be used under the supervision of trained and licensed personnel. Use accepted safe industry practices when handling and using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.
Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures. Wash hands and other exposed areas with mild soap and water before eating, drinking, or smoking and again when leaving work. Do not eat, drink or smoke when using this product.
Conditions for Safe Storage, Including Any Incompatibilities
Technical Measures: Store as defined in the Explosives Act of Canada and the provisions of the Bureau of Alcohol, Tobacco and Firearms regulations contained in 27 CFR Part 555.
Storage Conditions: Store in cool, dry, well-ventialated location. Store in compliance with Federal, State and local regulations. Keep away from heat, flame, ignition sources and strong shock. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials, combustibles, and sources of

heat. Isolate from incompatibles.
Incompatible Materials: Corrosives (strong acids and strong bases or alkalis)
Specific End Use(s) For industrial blasting applications.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters

Occupational Exposure Limits

Ingredients:	Product identifier:	ACGIH TLV-TWA	OSHA PEL-TWA
Ammonium nitrate	(CAS No) 6484-52-2	None	None
Sodium nitrate	(CAS No) 7631-99-4	None	None
Aluminum	(CAS No) 7429-90-5	10 mg/m^3 (dust)	15 mg/m^3 (total)
Mineral Oil	(CAS No) 64742-54-7	5 mg/m^3 (mist)	5 mg/m^3 (mist)
Wax (paraffin)	(CAS No) 8002-72-2	2-10 mg/m^3 (wax fume)	None

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

Exposure Controls
Appropriate Engineering Controls: Ensure adequate ventilation, especially in confined areas. Ensure all national/local regulations are observed.

Personal Protective Equipment: Gloves. Protective goggles. Protective clothing.
Materials for Protective Clothing: protective clothing.
Hand Protection: Protect against incidental skin contact.
Eye Protection: Chemical goggles or safety glasses.
Skin and Body Protection: Wear suitable protective clothing.
Respiratory Protection: Use a NIOSH-approved respirator or self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limits.
Environmental Exposure Controls: Do not allow the product to be released into the environment.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Information on Basic Physical and Chemical Properties

Physical State	:	Solid
Appearance	:	White or pink opaque semi-solid, which will appear gray if product contains aluminum. Typically paper or plastic chub packaging.
Odor	:	Faint petroleum odor
Odor Threshold	:	Not available
pH	:	Not applicable
Evaporation Rate	:	< 1
Melting Point	:	Not applicable
Freezing Point	:	Not applicable
Boiling Point	:	Not applicable
Flash Point	:	Not applicable

Auto-ignition Temperature	:	Not available
Decomposition Temperature	:	Ammonium nitrate: 210 °C (410 °F)
Flammability (solid, gas)	:	Not applicable
Lower Flammable Limit	:	Not applicable
Upper Flammable Limit	:	Not applicable
Vapor Pressure	:	Not applicable
Relative Vapor Density at 20 °C	:	Not applicable
Relative Density	:	Not applicable
Density	:	1.20 - 1.30 g/cc
Specific Gravity	:	Not applicable
Solubility	:	Partially soluble in water
Partition coefficient: n-octanol/water	:	Not available
Viscosity	:	Not available
Explosive properties	:	Explosive; mass explosion hazard
Explosion Data – Sensitivity to Mechanical Impact	:	Not sensitive
Explosion Data – Sensitivity to Static Discharge	:	Not sensitive

SECTION 10 - STABILITY AND REACTIVITY

Reactivity: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in a large quantity.
Chemical Stability: Stable under normal temperature and pressure.
Possibility of Hazardous Reactions: Hazardous polymerization will not occur.
Conditions to Avoid: Keep away from heat, flame, ignition sources and strong shock.
Incompatible Materials: Corrosives (strong acids and strong bases or alkalis).
Hazardous Decomposition Products: Nitrogen Oxides (NO_X), Carbon Monoxide (CO), Ammonia

SECTION 11 - TOXICOLOGICAL INFORMATION

Information on Toxicological Effects - Product
Acute Toxicity: Not classified
LD50 and LC50 Data: Not available
Skin Corrosion/Irritation: Not classified
Serious Eye Damage/Irritation: May cause eye irritation.
Respiratory or Skin Sensitization: Not classified
Germ Cell Mutagenicity: Not classified
Teratogenicity: Not classified
Carcinogenicity: Not classified
Specific Target Organ Toxicity (Repeated Exposure): Not classified
Reproductive Toxicity: Not classified
Specific Target Organ Toxicity (Single Exposure): Not classified
Aspiration Hazard: Not classified
Symptoms/Injuries After Inhalation: May cause respiratory irritation.
Symptoms/Injuries After Skin Contact: May cause skin irritation.
Symptoms/Injuries After Eye Contact: Causes eye irritation.
Symptoms/Injuries After Ingestion: If ingested, seek medical attention.

Information on Toxicological Effects - Ingredient(s)
LD50 and LC50 Data:

Sodium nitrate (7631-99-4)

LD50 Oral Rat	> 2000 mg/kg
Ammonium nitrate (6484-52-2)	
LD50 Oral Rat	2217 mg/kg
LC50 Inhalation Rat	> 88.8 mg/l/4h

SECTION 12: ECOLOGICAL INFORMATION

Toxicity Not classified

Sodium nitrate (7631-99-4)	
LC50 Fish 1	2000 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [static])
LC 50 Fish 2	994.4 - 1107 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [static])

Persistence and Degradability

Sodium nitrate (7631-99-4)	
Persistence and Degradability	**Readily biodegradable in water.**

Bioaccumulative Potential

Sodium nitrate (7631-99-4)	
Bioaccumulative Potential	Not expected to bioaccumulate.
Ammonium nitrate (6484-52-2)	
BCF fish 1	No bioaccumulation expected.

Mobility in Soil Not available

Other Adverse Effects

Other Information: Avoid release to the environment.

Toxicity Not classified

SECTION 13 – DISPOSAL CONSIDERATIONS

Waste Disposal Recommendations: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

Additional Information: None

SECTION 14 - TRANSPORT INFORMATION

14.1 In Accordance with DOT

Proper Shipping Name : EXPLOSIVE, BLASTING, TYPE E or Agent blasting, Type E

Hazard Class : 1.5D

Identification Number : UN0332

Label Codes : 1.5D

Packing Group : II

ERG Number : 140

14.2 In Accordance with IMDG

Proper Shipping Name : EXPLOSIVE, BLASTING, TYPE E (AGENT, BLASTING, TYPE E)

Hazard Class : 1.5D

Identification Number : UN0332

Label Codes : 1.5D
EmS-No. (Fire) : F-B
EmS-No. (Spillage) : S-Y

14.3 In Accordance with IATA
Proper Shipping Name : AGENT, BLASTING TYPE E
Identification Number : UN0332
Hazard Class : 1
Label Codes : 1.5D

ERG Code (IATA) : 1L

14.4 In Accordance with TDG
Proper Shipping Name : EXPLOSIVE, BLASTING, TYPE E
Packing Group : II
Hazard Class : 1.5D
Identification Number : UN0332
Label Codes : 1.5D

SECTION 15 - REGULATORY INFORMATION

US Federal Regulations

Packaged Emulsion Explosives

Bureau of Alcohol Tobacco & Firearms (BATF)
Department of Transportation (DOT)
Mine Safety & Health Administration (MSHA)

Canadian Regulations

Packaged Emulsions

WHMIS Classification	**Note: Explosives are not regulated under WHMIS. They are subject to the regulations of the Explosives Act of Canada.**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all of the information required by CPR.

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Revision date : 03/18/2015
Other Information : This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200.

GHS Full Text Phrases:

Expl. 1.5	Explosive Category 1.5
H205	May mass explode in fire

Party Responsible for the Preparation of This Document
Dyno Nobel Inc.
2795 East Cottonwood Parkway, Suite 500
Salt Lake City, Utah 84121
Phone: 801-364-4800

Disclaimer

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Dyno Nobel SDS

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 22.05.2015 Revision: 22.05.2015

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

· **1.1 Product identifier**

· **Trade name: CAST BOOSTERS**

· **Article number:**
No other identifiers
1108

· **Other product identifiers:**
DYNO® CORD SENSITIVE BOOSTERS - CS35, CS45, CS90, CS135
TROJAN® SPARTAN®
TROJAN® SPARTAN® Slider
TROJAN® Stinger
TROJAN® NB
TROJAN® NB UNIVERSAL
TROJAN® Twinplex
TROJAN® SPARTAN® SR
TROJAN® SPARTAN® Cone
TROJAN® Ringprime
TROJAN® SPARTAN® CSU

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture**
Explosive product.
Commercial blasting applications

· **1.3 Details of the supplier of the Safety Data Sheet**

· **Manufacturer/Supplier:**
Dyno Nobel Inc.
2795 East Cottonwood Parkway, Suite 500
Salt Lake City, Utah 84121
Phone: 801-364-4800
Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com

· **1.4 Emergency telephone number:**
CHEMTREC
1-800-424-9300 (US/Canada)
+01 703-527-3887 (International)

SECTION 2: Hazards identification

· **2.1 Classification of the substance or mixture**

· **Classification according to Regulation (EC) No 1272/2008**
Classifications listed also are applicable to the OSHA GHS Hazard Communication Standard (29CFR1910.1200).


exploding bomb

(Contd. on page 2)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 22.05.2015 Revision: 22.05.2015

Trade name: CAST BOOSTERS

(Contd. of page 1)

Expl. 1.1 H201 Explosive; mass explosion hazard.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**

E; Explosive

R2: Risk of explosion by shock, friction, fire or other sources of ignition.

· **Information concerning particular hazards for human and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

· **Classification system:**
The classification is according to the latest editions of the EU-lists, and extended by company and literature data.
The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

· **Additional information:**
There are no other hazards not otherwise classified that have been identified.
0 percent of the mixture consists of component(s) of unknown toxicity

· **2.2 Label elements**

· **Labelling according to Regulation (EC) No 1272/2008**
The product is additionally classified and labelled according to the Globally Harmonized System within the United States (GHS).
The product is classified and labelled according to the CLP regulation.

· **Hazard pictograms**

GHS01

· **Signal word** Danger

· **Hazard-determining components of labelling:**
pentaerythritol tetranitrate (PETN)
octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
perhydro-1,3,5-trinitro-1,3,5-triazine (RDX)
2,4,6-trinitrotoluene (TNT)
aluminium powder (pyrophoric)

· **Hazard statements**
H201 Explosive; mass explosion hazard.

· **Precautionary statements**

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P250	Do not subject to grinding/shock/friction.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P373	DO NOT fight fire when fire reaches explosives.
P370+P380	In case of fire: Evacuate area.
P372	Explosion risk in case of fire.
P401	Store in accordance with local/regional/national/international regulations.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

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· **Hazard description:**
· **WHMIS-symbols:** Explosive products are not classified under WHMIS.
· **NFPA ratings (scale 0 - 4)** Not available.

· **HMIS-ratings (scale 0 - 4)** Not available

· **HMIS Long Term Health Hazard Substances**
None of the ingredients are listed.

· **2.3 Other hazards**
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Explosive Product Notice**
PREVENTION OF ACCIDENTS IN THE USE OF EXPLOSIVES - The prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The explosives user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

WARNING - All explosives are dangerous and must be carefully handled and used following approved safety procedures either by or under the direction of competent, experienced persons in accordance with all applicable federal, state, and local laws, regulations, or ordinances. If you have any questions or doubts as to how to use any explosive product, DO NOT USE IT before consulting with your supervisor, or the manufacturer, if you do not have a supervisor. If your supervisor has any questions or doubts, he should consult the manufacturer before use.

SECTION 3: Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**	
CAS: 78-11-5 EINECS: 201-084-3 Index number: 603-035-00-5	pentaerythritol tetranitrate (PETN) E R3 Unst. Expl., H200
CAS: 118-96-7 EINECS: 204-289-6 Index number: 609-008-00-4	2,4,6-trinitrotoluene (TNT) T R23/24/25; E R2; N R51/53 R33 Expl. 1.1, H201 Acute Tox. 3, H301; Acute Tox. 3, H311; Acute Tox. 3, H331 STOT RE 2, H373 Aquatic Chronic 2, H411
CAS: 7429-90-5	aluminum metal F R15 Water-react. 1, H260

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CAS: 121-82-4 EINECS: 204-500-1	perhydro-1,3,5-trinitro-1,3,5-triazine (RDX) T R25; E R2 Expl. 1.1, H201 Acute Tox. 3, H301
CAS: 2691-41-0 EINECS: 220-260-0	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) T R24; Xn R22; E R2 Expl. 1.1, H201 Acute Tox. 3, H301; Acute Tox. 3, H311

· **Additional information:**
For the wording of the listed risk phrases refer to section 16.
For the listed ingredients, the identity and exact percentages are being withheld as a trade secret.

SECTION 4: First aid measures

· **4.1 Description of first aid measures**
· **General information:** No special measures required.
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Generally the product does not irritate the skin.
Wash with soap and water.
If skin irritation is experienced, consult a doctor.
· **After eye contact:**
Remove contact lenses if worn.
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:** Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed** Blast injury if mishandled.
· **Hazards** Danger of blast or crush-type injuries.
· **4.3 Indication of any immediate medical attention and special treatment needed**
Product may produce physical injury if mishandled. Treatment of these injuries should be based on the blast and compression effects.

SECTION 5: Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:** DO NOT fight fire when fire reaches explosives.
· **For safety reasons unsuitable extinguishing agents:** None.
· **5.2 Special hazards arising from the substance or mixture**
DO NOT ATTEMPT TO FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions. Can explode or detonate under fire conditions. Burning material may produce toxic vapors. It is recommended that users of explosives material be familiar with the Institute of Makers of Explosives Safety Library publications.
Explosive; mass explosion hazard.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.

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· **Additional information**
Eliminate all ignition sources if safe to do so.
Flammability Classification: (defined by 29 CFR 1910.1200) Explosive. Can explode under fire conditions. Individual devices will randomly explode. Mass explosion of multiple devices is possible under certain conditions. Burning material may produce toxic and irritating vapors. In unusual cases, shrapnel may be thrown from exploding devices under containment. See 2012 Emergency response Guidebook for further information.

SECTION 6: Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Evacuate area.
Wear protective clothing.
Ensure adequate ventilation
Keep away from ignition sources.
Protect from heat.
Isolate area and prevent access.
· **6.2 Environmental precautions:** No special measures required.
· **6.3 Methods and material for containment and cleaning up:**
Pick up mechanically.
Send for recovery or disposal in suitable receptacles.
Dispose unusable material as waste according to item 13.
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

SECTION 7: Handling and storage

· **7.1 Precautions for safe handling**
Open and handle receptacle with care.
Handle with care. Avoid jolting, friction and impact.
Use only in well ventilated areas.
Do not subject to grinding/shock/friction.
· **Information about fire - and explosion protection:**
Keep ignition sources away - Do not smoke.
Protect from heat.
Prevent impact and friction.
Emergency cooling must be available in case of nearby fire.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:**
Store in a cool location.
Avoid storage near extreme heat, ignition sources or open flame.
· **Information about storage in one common storage facility:**
Store away from foodstuffs.

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Store away from oxidising agents.

· **Further information about storage conditions:**
Store under lock and key and with access restricted to technical experts or their assistants only.
Keep away from heat.

· **7.3 Specific end use(s)** No further relevant information available.

SECTION 8: Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**

· **Ingredients with limit values that require monitoring at the workplace:**	
118-96-7 2,4,6-trinitrotoluene (TNT)	
PEL (USA)	Long-term value: 1,5 mg/m³ Skin
REL (USA)	Long-term value: 0,5 mg/m³ Skin
TLV (USA)	Long-term value: 0,1 mg/m³ Skin; BEI-M
EL (Canada)	Long-term value: 0,1 mg/m³ Skin
EV (Canada)	Short-term value: 0,2 mg/m³, 0,02 ppm Long-term value: 0,1 mg/m³, 0,01 ppm Skin
7429-90-5 aluminum metal	
PEL (USA)	Long-term value: 15*; 15** mg/m³ *Total dust; ** Respirable fraction
REL (USA)	Long-term value: 10* 5** mg/m³ as Al*Total dust**Respirable/pyro powd./welding f.
TLV (USA)	Long-term value: 1* mg/m³ as Al; *as respirable fraction
EL (Canada)	Long-term value: 1,0 mg/m³ respirable, as Al
EV (Canada)	Long-term value: 5 mg/m³ aluminium-containing (as aluminium)
121-82-4 perhydro-1,3,5-trinitro-1,3,5-triazine (RDX)	
REL (USA)	Short-term value: 3 mg/m³ Long-term value: 1,5 mg/m³ Skin
TLV (USA)	Long-term value: 0,5 mg/m³ Skin

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EL (Canada)	Long-term value: 0,5 mg/m³ Skin
EV (Canada)	Long-term value: 0,5 mg/m³ Skin

· **DNELs** No further relevant information available.
· **PNECs** No further relevant information available.

· **Ingredients with biological limit values:**	
118-96-7 2,4,6-trinitrotoluene (TNT)	
BEI (USA)	1,5 % of hemoglobin Medium: blood Time: during or end of shift Parameter: Methemoglobin (background, nonspecific, semi-quantitative)

· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures are to be adhered to when handling chemicals.
Keep ignition sources away - Do not smoke.
Keep away from foodstuffs, beverages and feed.
Wash hands before breaks and at the end of work.
· **Respiratory protection:**
Not required under normal conditions of use.
Respiratory protection may be required after product use.
· **Protection of hands:**
Wear gloves for the protection against mechanical hazards according to NIOSH or EN 388.
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**
Face protection

Safety glasses

· **Body protection:** Impervious protective clothing
· **Limitation and supervision of exposure into the environment**
No further relevant information available.

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· **Risk management measures**
Organizational measures should be in place for all activities involving this product.

SECTION 9: Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Solid material
Colour:	According to product specification
· **Odour:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	80 °C (176 °F) (trinitrotoluene)
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Explosive; mass explosion hazard.
· **Auto/Self-ignition temperature:**	Not determined.
· **Decomposition temperature:**	Not determined.
· **Self-igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Risk of explosion by shock, friction, fire or other sources of ignition.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure:**	Not applicable.
· **Density at 20 °C (68 °F):**	1,55 - 1,65 g/cm³ (12,935 - 13,769 lbs/gal)
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with water:**	Variable, dependent upon product composition and packaging.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **9.2 Other information**	No further relevant information available.

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SECTION 10: Stability and reactivity

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used and stored according to specifications.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
· **10.3 Possibility of hazardous reactions**
Danger of explosion.
Toxic fumes may be released if heated above the decomposition point.
· **10.4 Conditions to avoid** Keep ignition sources away - Do not smoke.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Nitrogen oxides
Hydrocarbons

SECTION 11: Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity:**
· **LD/LC50 values relevant for classification:** None.
· **Primary irritant effect:**
· **on the skin:**
Not a skin irritant in unused form. Vapors/particles from used product are possibly irritating to skin.
· **on the eye:**
Not an eye irritant in unused form. Vapors/particles from used product are possibly irritating to eyes.
· **Sensitisation:** No sensitising effects known.
· **Subacute to chronic toxicity:** No further relevant information available.
· **Acute effects (acute toxicity, irritation and corrosivity):** Danger of blast or crush-type injuries.
· **Repeated dose toxicity:** No further relevant information available.

SECTION 12: Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** Toxic for aquatic organisms
· **12.2 Persistence and degradability** No further relevant information available.
· **12.3 Bioaccumulative potential** No further relevant information available.
· **12.4 Mobility in soil** No further relevant information available.
· **Ecotoxical effects:**
· **Remark:** Toxic for fish
· **Additional ecological information:**
· **General notes:**
Water hazard class 3 (German Regulation) (Self-assessment): extremely hazardous for water
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.

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Also poisonous for fish and plankton in water bodies.
Toxic for aquatic organisms
Due to available data on eliminability/decomposition and bioaccumulation potential prolonged term damage of the environment can not be excluded.

· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Must not be disposed together with household garbage. Do not allow product to reach sewage system.
Damaged materials pose a danger to anyone in the immediate area; consult experts for disposal of damaged products.
The user of this material has the responsibility to dispose of unused material, residues and containers in compliance with all relevant local, state and federal laws and regulations regarding treatment, storage and disposal for hazardous and nonhazardous wastes. Residual materials should be treated as hazardous.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to official regulations.

SECTION 14: Transport information

· **14.1 UN-Number**
· **DOT, ADR, IMDG** UN0042
· **IATA** FORBIDDEN
· **14.2 UN proper shipping name**
· **DOT, IMDG** Boosters, without detonator
· **ADR** 0042, BOOSTERS, WITHOUT DETONATOR
· **IATA** FORBIDDEN
· **14.3 Transport hazard class(es)**

· **DOT, ADR, IMDG**

· **Class** 1.1
· **Label** 1.1D

· **IATA**
· **Class** FORBIDDEN
· **14.4 Packing group**
· **DOT, ADR, IMDG** II
· **IATA** FORBIDDEN

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· **14.5 Environmental hazards:**
· **Marine pollutant:** No
· **Special marking (IATA):** Prohibited from Transport in Passenger Aircraft.
· **14.6 Special precautions for user** Not applicable.
· **EMS Number:** F-B,S-X
· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.

· **Transport/Additional information:**

· **ADR**
· **Limited quantities (LQ)** 0
· **Excepted quantities (EQ)** Code: E0
Not permitted as Excepted Quantity
· **Tunnel restriction code** 1

· **IMDG**
· **Limited quantities (LQ)** 0
· **Excepted quantities (EQ)** Code: E0
Not permitted as Excepted Quantity

· **IATA** FORBIDDEN.
· **UN "Model Regulation":** UN0042, BOOSTERS, WITHOUT DETONATOR, 1.1D, II

SECTION 15: Regulatory information

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**
None of the ingredients are listed.

· **Section 313 (Specific toxic chemical listings):**

7429-90-5	aluminum metal

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**

118-96-7	2,4,6-trinitrotoluene (TNT)

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients are listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients are listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients are listed.

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· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**		
118-96-7	2,4,6-trinitrotoluene (TNT)	C
121-82-4	perhydro-1,3,5-trinitro-1,3,5-triazine (RDX)	C
2691-41-0	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	D

· **IARC (International Agency for Research on Cancer)**		
118-96-7	2,4,6-trinitrotoluene (TNT)	3

· **TLV (Threshold Limit Value established by ACGIH)**		
7429-90-5	aluminum metal	A4
121-82-4	perhydro-1,3,5-trinitro-1,3,5-triazine (RDX)	A4

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

None of the ingredients are listed.

· **Canada**

· **Canadian Domestic Substances List (DSL)**

All ingredients are listed.

· **Canadian Ingredient Disclosure list (limit 0.1%)**

None of the ingredients are listed.

· **Canadian Ingredient Disclosure list (limit 1%)**	
118-96-7	2,4,6-trinitrotoluene (TNT)
7429-90-5	aluminum metal

· **Other regulations, limitations and prohibitive regulations**
This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

· **Substances of very high concern (SVHC) according to REACH, Article 57**

None of the ingredients are listed.

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

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· **Relevant phrases**

H200	Unstable explosives.
H201	Explosive; mass explosion hazard.
H260	In contact with water releases flammable gases which may ignite spontaneously.
H301	Toxic if swallowed.
H311	Toxic in contact with skin.
H331	Toxic if inhaled.
H373	May cause damage to organs through prolonged or repeated exposure.
H411	Toxic to aquatic life with long lasting effects.

R15	Contact with water liberates extremely flammable gases.
R2	Risk of explosion by shock, friction, fire or other sources of ignition.
R22	Harmful if swallowed.
R23/24/25	Toxic by inhalation, in contact with skin and if swallowed.
R24	Toxic in contact with skin.
R25	Toxic if swallowed.
R3	Extreme risk of explosion by shock, friction, fire or other sources of ignition.
R33	Danger of cumulative effects.
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
DNEL: Derived No-Effect Level (REACH)
PNEC: Predicted No-Effect Concentration (REACH)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
Expl. 1.1: Explosives, Division 1.1
Unst. Expl.: Explosives, Unstable explosives
Water-react. 1: Substances and Mixtures which, in contact with water, emit flammable gases, Hazard Category 1

Acute Tox. 3: Acute toxicity, Hazard Category 3
STOT RE 2: Specific target organ toxicity - Repeated exposure, Hazard Category 2
Aquatic Chronic 2: Hazardous to the aquatic environment - Chronic Hazard, Category 2

· **Sources**

SDS Prepared by:
ChemTel Inc.
1305 North Florida Avenue
Tampa, Florida USA 33602-2902
Toll Free North America 1-888-255-3924 Intl. +01 813-248-0573
Website: www.chemtelinc.com

Material Safety Data Sheet

Dyno Nobel Inc.
2795 East Cottonwood Parkway, Suite 500
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Phone: 801-364-4800 Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1322
Date 08/29/12

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SECTION I - PRODUCT IDENTIFICATION

Trade Name(s): NONEL® EZ DET® CPZ
NONEL® EZTL™ CPZ

Product Class: NONEL® Non-electric Delay Detonators

Product Appearance & Odor: Aluminum cylindrical shell with varying length and diameter of attached colored plastic tubing. The detonator may be enclosed in a plastic housing, and an assembly may contain two detonators. Odorless.

DOT Hazard Shipping Description: UN0361 Detonator assemblies, non-electric 1.4B II

NFPA Hazard Classification: Not Applicable (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

		Occupational Exposure Limits	
Ingredients	**CAS#**	**OSHA PEL-TWA**	**ACGIH TLV-TWA**
Pentaerythritol Tetranitrate (PETN)	78-11-5	None[1]	None[2]
Lead Azide	13424-46-9	0.05 mg (Pb)/m^3	0.05 mg (Pb)/m^3
Lead	7439-92-1	0.05 mg (Pb)/m^3	0.05 mg (Pb)/m^3
Silicon	7440-21-3	15 mg / m^3 (total dust) 5 mg / m^3 (respirable fraction)	10 mg / m^3
Red Lead (Lead tetroxide)	1314-41-6	0.05 mg (Pb)/m^3	0.05 mg (Pb)/m^3
Titanium dioxide	13463-67-7	15 mg/m^3	10 mg/m^3
Silica (crystalline)	61790-53-2	See Note Below	0.05 mg/m^3 (resp frac)
Aluminum	7429-90-5	15 mg/m^3 (total dust) 5 mg/m^3 (respirable fraction)	5 mg/m^3
Antimony	7440-36-0	0.5 mg/m^3	0.5 mg/m^3
Cyclotetramethylene Tetranitramine (HMX)	2691-41-0	None[1]	None[2]
Diazodinitrophenol	4682035	No value established	No value established

[1] Use limit for particulates not otherwise regulated (PNOR): Total dust, 15 mg/m^3 ; respirable fraction, 5 mg/m^3 .
[2] Use limit for particulates not otherwise classified (PNOC): Inhalable particulate, 10 mg/m^3 ; respirable part., 3 mg/m^3 .
Note: The OSHA PEL for crystalline silica is calculated as follows:
Quartz, respirable: 10 mg/m^3 [e] / % SiO_2 + 2 Quartz, total dust: 30 mg/m^3 / % SiO_2 + 2

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable
Vapor Density: Not Applicable
Percent Volatile by Volume: Not Applicable
Evaporation Rate (Butyl Acetate = 1): Not Applicable

Vapor Pressure: Not Applicable
Density: Not Applicable
Solubility in Water: Not Applicable

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not Applicable **Flammable Limits:** Not Applicable
Extinguishing Media: (See Special Fire Fighting Procedures section.)
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe, distant location. Allow fire to burn unless it can be fought remotely or with fixed extinguishing systems (sprinklers).
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

This is a packaged product that will not result in exposure to the explosive material under normal conditions of use. Exposure concerns are primarily with post-detonation reaction products, particularly heavy metal compounds.

Eyes: No exposure to chemical hazards anticipated with normal handling procedures. Particulates in the eye may cause irritation, redness, swelling, itching, pain and tearing.
Skin: No exposure to chemical hazards anticipated with normal handling procedures. Exposure to post-detonation reaction products may cause irritation.
Ingestion: No exposure to chemical hazards anticipated with normal handling procedures. Post-detonation reaction product residue is toxic by ingestion. Symptoms may include gastroenteritis with abdominal pain, nausea, vomiting and diarrhea. See systemic effects below.

Inhalation: Not a likely route of exposure. See systemic effects below.
Systemic or Other Effects: None anticipated with normal handling procedures. Repeated inhalation or ingestion of post-detonation reaction products may lead to systemic effects such as respiratory tract irritation, ringing of the ears, dizziness, elevated blood pressure, blurred vision and tremors. Heavy metal (lead) poisoning can occur.
Carcinogenicity: ACGIH classifies Lead as a “Suspected Human Carcinogen. NTP, OSHA, and IARC consider components contained in this detonator carcinogenic.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: Not applicable.
Special Considerations: None

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact.
Conditions to Avoid: Keep away from heat, flame, ignition sources, impact, friction, electrostatic discharge and strong shock. Do not attempt to disassemble.
Materials to Avoid (Incompatibility): Corrosives (acids and bases or alkalis).
Hazardous Decomposition Products: Carbon Monoxide (CO), Nitrous Oxides (NO_X), Lead (Pb), Antimony (Sb) and various oxides and complex oxides of metals.
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate all personnel to a safe distant area and allow to burn or fight fire remotely. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. If loose explosive powder is spilled, such as from a broken detonator, only properly qualified and authorized personnel should be involved with handling and clean-up activities. Spilled explosive powder is extremely sensitive to initiation and may detonate. Follow applicable Federal, State, and local spill reporting requirements.

Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: None required for normal handling. Provide enhanced ventilation after use if in underground mines or other enclosed areas.

Respiratory Protection: None required for normal handling.

Protective Clothing: Cotton gloves are recommended.

Eye Protection: Safety glasses are recommended.

Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State, and local regulations. Only properly qualified and authorized personnel should handle and use explosives. Keep away from heat, flame, ignition sources, impact, friction, electrostatic discharge and strong shock.

Precautions to be taken during use: Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death. Avoid breathing the fumes or gases from detonation of explosives. Detonation in confined or unventilated areas may result in exposure to hazardous fumes or oxygen deficiency.

Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

These products contain the following substances that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Chemical Name	CAS Number	Max. lbs/1000 units
Lead	7439-92-1	36.0
	(Use Toxic Chemical Category Code)	
Lead Compounds	N420	2.0

Range* of Section 313 Chemicals in each product

Product	lb Pb per 1000 detonators	lb Pb compounds per 1000 detonators
NONEL® EZ DET® CPZ	22 - 36	2.0
NONEL® EZTL™ CPZ	5 - 15	0.5 – 0.7

*** The exact quantity and weight percent of Section 313 Chemicals in each delay period and tubing length for each product is available upon request.**

Disclaimer

Safety Data Sheet

SECTION 1 – IDENTIFICATION

Name, Address, and Telephone of the Responsible Party

Date: 08/24/2015

Supersedes: 09/2005

Independent Explosives, Inc
88 Gold Ledge Ave,
Auburn, NH 03032

Phone: (860) 243-0137 Toll Free: (888) 658-3966

Product Identifier
Product Form: Mixture
Product Name: 1966 Emulsion Blend

Other Means of Identification
Product Class: Emulsion
Trade Names:
1966 Emulsion Blend

Intended Use of the Product
Industrial applications

Emergency Telephone Numbers: DAY Only: 888-658-3966
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

SECTION 2 – HAZARD(S) IDENTIFICATION

Classification of the Substance or Mixture
Classification (GHS-US)

Expl. 1.5	H205
Eye Irrit. 2A	H319
Carc. 2	H351
STOT RE 2	H373

Label Elements
GHS-US Labeling
Hazard Pictograms (GHS-US) :

GHS07 GHS08

Signal Word (GHS-US) : Danger
Hazard Statements (GHS-US) : H205 - May mass explode in fire.
H319 - Causes serious eye irritation.
H351 – Contains materials suspected of causing cancer.
H373 - May cause damage to organs through prolonged or repeated exposure.

Precautionary Statements (GHS-US) : P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, open flames, sparks. - No

smoking.
P220 - Keep/Store away from combustible materials.
P221 - Take any precaution to avoid mixing with combustible materials.
P240 - Ground/bond container and receiving equipment. Consult manufacturer for detailed guidance on appropriate grounding/bonding.
P260 - Do not breathe dust, mist, vapors.
P264 - Wash hands, forearms and exposed areas thoroughly after handling.
P273 - Avoid release to the environment.
P280 - Wear eye protection, protective clothing, protective gloves.
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308+P313 - If exposed or concerned: Get medical advice/attention.
P314 - Get medical advice/attention if you feel unwell.
P337+P313 - If eye irritation persists: Get medical advice/attention.
P370+P378 - In case of fire: Do NOT attempt to fight fire.
P370+P380 - In case of fire: Evacuate area.
P372 - Explosion risk in case of fire.
P373 - DO NOT fight fire when fire reaches explosives.
P401 - Store as defined in the Explosives Act of Canada and the provisions of the Bureau of Alcohol, Tobacco and Firearms regulations contained in 27 CFR Part 555..
P405 - Store locked up.
P501 - Dispose of contents/container in accordance with local, regional, national, territorial, provincial, and international regulations.

SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Name	Product identifier	% (w/w)	Ingredient Classification (GHS-US)
Ammonium nitrate	(CAS No) 6484-52-2	65 - 90	Ox. Sol. 3, H272 Eye Irrit. 2A, H319
Fuel oil / mineral oil blend	(CAS No) 68476-30-2	3 - 9	Flam. Liq. 3, H226 Acute Tox. 4 (Inhalation:dust,mist), H332 Skin Irrit. 2, H315 Carc. 2, H351 STOT RE 2, H373 Asp. Tox. 1, H304 Aquatic Acute 3, H402 Aquatic Chronic 2, H411
Aluminum	(CAS No) 7429-90-5	0.1 - 10	Comb. Dust Flam. Sol. 1, H228 Water-react. 2, H261
Polymeric Surfactant	NA	0.5 – 2	Not available

More than one of the ranges of concentration prescribed by Controlled Products Regulations has been used where necessary, due to varying composition.
Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION 4 - FIRST AID MEASURES

Description of First Aid Measures

General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Obtain medical attention if breathing difficulty persists.

Skin Contact: Remove contaminated clothing and wash before reuse. Gently wash with plenty of soap and water.

Eye Contact: Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention if irritation develops or persists.

Ingestion: Rinse mouth. Do not induce vomiting. Immediately call a POISON CENTER or doctor/physician.

Most Important Symptoms and Effects Both Acute and Delayed

General: May cause serious eye irritation. Contains material suspected of causing cancer. May cause damage to organs through prolonged or repeated exposure.

Inhalation: May cause respiratory irritation.

Skin Contact: May cause skin irritation.

Eye Contact: May cause serious eye irritation.

Ingestion: Ingestion is likely to be harmful or have adverse effects.

Chronic Symptoms: Contains material suspected of causing cancer. May cause damage to organs through prolonged or repeated exposure.

Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention. If ingested, causes methemoglobenemia – emergency response should treat appropriately, such as by intravenous administration of methylene blue.

SECTION 5 - FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media: DO NOT FIGHT FIRES INVOLVING EXPLOSIVES.

Unsuitable Extinguishing Media: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.

Special Hazards Arising From the Substance or Mixture

Fire Hazard: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

Explosion Hazard: Explosion risk in case of fire. This product is an explosive with mass detonation hazard. Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries.

Reactivity: Stable under normal conditions. May explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities.

Advice for Firefighters

Firefighting Instructions: DO NOT ATTEMPT TO FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions. Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

Hazardous Combustion Products: Carbon Monoxide (CO) and Nitrogen Oxides (NOx)

Reference to Other Sections: Refer to section 9 for flammability properties.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Avoid all contact with skin, eyes, or clothing. Avoid breathing (vapor, mist, dust).

For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protection equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel.

For Emergency Personnel

Protective Equipment: Use appropriate personal protection equipment (PPE).

Emergency Procedures: Stop release if safe to do so. Eliminate ignition sources. Ventilate area.

Environmental Precautions
Prevent entry to sewers and public waters.

Methods and Material for Containment and Cleaning Up
For Containment: Contain any spills with dikes to prevent migration and entry into sewers or streams. Do not use combustible absorbents and do not mix with other materials.
Methods for Cleaning Up: Collect spillage for possible reuse. Clean up spills immediately and dispose of waste in accordance with appropriate Federal, State and local regulations.
Reference to Other Sections
See heading 8, Exposure Controls and Personal Protection

SECTION 7 - HANDLING AND STORAGE

Precautions for Safe Handling
General: It is recommended that users of explosives material be familiar with the Institute of Makers of Explosives Safety Library publications. Comply with the safety library publication No. 4 "Warnings and Instructions" as adopted by the Institute of Makers of Explosives.
Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures. Wash hands and forearms thoroughly after handling. Do not eat, drink or smoke when using this product.
Conditions for Safe Storage, Including Any Incompatibilities
Technical Measures: Contact manufacturer for appropriate grounding/bonding guidance. Comply with applicable regulations.
Storage Conditions: Store as defined in the Explosives Act of Canada and the provisions of the Bureau of Alcohol, Tobacco and Firearms regulations contained in 27 CFR Part 555. Store in a dry, cool and well-ventilated place. Keep/Store away from direct sunlight, extremely high or low temperatures, heat sources, ignition sources. Keep container closed when not in use. Store locked up.
Incompatible Materials: Strong acids. Strong bases. Strong oxidizers. Zinc. Copper and its alloys. Organic materials. Combustible materials.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters
For substances listed in section 3 that are not listed here, there are no established exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), NIOSH (REL), or OSHA (PEL).

Fuels, diesel, no. 2 (68476-30-2)

USA ACGIH	ACGIH TWA (mg/m³)	100 mg/m³ (inhalable fraction and vapor, as total hydrocarbons) 8 h (skin)
USA ACGIH	ACGIH chemical category	Skin - potential significant contribution to overall exposure by the cutaneous route, Confirmed Animal Carcinogen with Unknown Relevance to Humans

Exposure Controls
Appropriate Engineering Controls: Ventilation System: Indoors: A system of local and / or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, Industrial Ventilation, A Manual of Recommended Practices, most recent edition, for details. Use explosion-proof equipment. / Outdoors: Work upwind.
Personal Protective Equipment: Personal Respirators (NIOSH Approved): A respirator is not needed under normal and intended conditions of use. If the exposure limit is exceeded and engineering controls are not feasible, use a mask with an organic vapor cartridge or positive pressure air supplied (SCBA) unit. Breathing air quality must meet the requirements

of the OSHA respiratory protection standard (29CFR1910.134).

Skin Protection: Gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure - Neoprene, PVC.

Eye Protection: Use chemical safety goggles and / or a full face shield where splashing is possible.

Hygiene Measures: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Information on Basic Physical and Chemical Properties

Physical State	:	Solid
Appearance	:	White to tan colored thick cream. If aluminim is present, gray metal particles will be visible. If ammonium nitrate prill is present, white to tan colored granules will be visible.
Odor	:	Slight odor of fuel oil
Odor Threshold	:	Not available
pH	:	Not available
Evaporation Rate	:	Not available
Melting Point	:	Not available
Freezing Point	:	Not available
Boiling Point	:	Not available
Flash Point	:	165 °F (74 °C) (PMCC)
Auto-ignition Temperature	:	Not available
Decomposition Temperature	:	Not available
Flammability (solid, gas)	:	Not available
Lower Flammable Limit	:	Not available
Upper Flammable Limit	:	Not available
Vapor Pressure	:	Not available
Relative Vapor Density at 20 °C	:	Not available
Density	:	Not available
Specific Gravity	:	1.20 – 1.30
Solubility	:	Not available
Partition Coefficient: N-Octanol/Water	:	Not available
Viscosity	:	Not available
Explosive properties	:	Explosive; fire, blast or projection hazard
Explosion Data – Sensitivity to Mechanical Impact	:	Not expected to present an explosion hazard due to mechanical impact.
Explosion Data – Sensitivity to Static Discharge	:	Not expected to present an explosion hazard due to static discharge.

SECTION 10 - STABILITY AND REACTIVITY

Reactivity: May cause or intensify fire; oxidizer. May accelerate the burning of other combustible materials. Contact with organic material or combustible material may cause an explosive situation.
Chemical Stability: Stable under recommended handling and storage conditions (see section 7). May explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities.
Possibility of Hazardous Reactions: Hazardous polymerization will not occur.
Conditions to Avoid: Avoid temperatures above (212°F (100°C).
Incompatible Materials: Avoid all contamination, especially peroxides and chlorates. Alkaline contamination may liberate ammonia fumes.
Hazardous Decomposition Products: Gaseous nitrogen oxides and carbon oxides: Toxic decomposition products including carbon monoxide (CO) may migrate to off blast-site areas.

SECTION 11 - TOXICOLOGICAL INFORMATION

Information on Toxicological Effects - Product
Acute Toxicity: Not classified
LD50 and LC50 Data: Not available
Skin Corrosion/Irritation: Not classified
Serious Eye Damage/Irritation: Causes serious eye irritation.
Respiratory or Skin Sensitization: Not classified
Germ Cell Mutagenicity: Not classified
Teratogenicity: Not classified
Carcinogenicity: Contains an ingredient suspected of causing cancer.
Specific Target Organ Toxicity (Repeated Exposure): May cause damage to organs through prolonged or repeated exposure.
Reproductive Toxicity: Not classified
Specific Target Organ Toxicity (Single Exposure): Not classified
Aspiration Hazard: Not classified
Symptoms/Injuries After Inhalation: May cause respiratory irritation.
Symptoms/Injuries After Skin Contact: May cause skin irritation.
Symptoms/Injuries After Eye Contact: May cause serious eye irritation.
Symptoms/Injuries After Ingestion: Ingestion is likely to be harmful or have adverse effects. Overexposure to this material may result in methemoglobinemia. Methemoglobinemia decreases the blood's ability to carry oxygen and results in symptoms such as dizziness, drowsiness, headache, shortness of breath, blue skin and lips, rapid heart rate, unconsciousness, and possibly death.
Chronic Symptoms: Contains an ingredient suspected of causing cancer. May cause damage to organs through prolonged or repeated exposure.
Information on Toxicological Effects - Ingredient(s)
LD50 and LC50 Data:

Fuels, diesel, no. 2 (68476-30-2)	
LD50 Oral Rat	18.7 - 24.9 ml/kg
LD50 Dermal Rabbit	> 4300 mg/kg
ATE US (dust, mist)	3.60 mg/l/4h
Ammonium nitrate (6484-52-2)	
LD50 Oral Rat	2217 mg/kg
LC50 Inhalation Rat	> 88.8 mg/l/4h

Safety Data Sheet

SECTION 12: ECOLOGICAL INFORMATION

Toxicity

Ecology - General: This material is hazardous to the aquatic environment. Keep out of sewers and waterways.

Ecology - Water: Harmful to aquatic life with long lasting effects.

Fuels, diesel, no. 2 (68476-30-2)	
LC50 Fish 1	57 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])

Persistence and Degradability Not available

Bioaccumulative Potential

Ammonium nitrate (6484-52-2)	
BCF fish 1	(no bioaccumulation expected)
Log Pow	-3.1 (at 25 °C)

Mobility in Soil Not available

Other Adverse Effects

Other Information: Avoid release to the environment.

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Treatment Methods: Uncontaminated and contaminated material may be placed in large diameter boreholes and detonated so that the explosive energy is utilized as originally intended. Dispose of under direct supervision of a qualified person according to local, state and federal regulations. Call Maine Drilling & Blasting Safety and Compliance Department for recommendations and assistance.

Additional Considerations: This material may become a hazardous waste under certain conditions and must be collected, labeled and disposed of per state and federal hazardous waste regulations.

SECTION 14 - TRANSPORT INFORMATION

In Accordance with DOT

Proper Shipping Name : EXPLOSIVE, BLASTING, TYPE E (AGENT, BLASTING, TYPE E)
Hazard Class : 1.5D
Identification Number : NA0332
Label Codes : 1.5D

Packing Group : II
ERG Number : 140

In Accordance with IMDG

Proper Shipping Name : EXPLOSIVE, BLASTING, TYPE E (AGENT, BLASTING, TYPE E)
Hazard Class : 1
Identification Number : UN0332
Label Codes : 1.5D
EmS-No. (Fire) : F-B
EmS-No. (Spillage) : S-Y

In Accordance with IATA

Proper Shipping Name : AGENT, BLASTING TYPE E
Identification Number : UN0332
Hazard Class : 1
Label Codes : 1.5D

ERG Code (IATA) : 1L

In Accordance with TDG

Safety Data Sheet

Proper Shipping Name	: EXPLOSIVE, BLASTING, TYPE E	
Packing Group	: II	
Hazard Class	: 1.5D	
Identification Number	: UN0332	
Label Codes	: 1.5D	

SECTION 15 - REGULATORY INFORMATION	
US Federal Regulations	
MDB Blend 1966	
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Delayed (chronic) health hazard Sudden release of pressure hazard Fire hazard
Fuels, diesel, no. 2 (68476-30-2)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Ammonium nitrate (6484-52-2)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Aluminum (7429-90-5)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings)	
SARA Section 313 - Emission Reporting	

US State Regulations
Fuels, diesel, no. 2 (68476-30-2)
U.S. - New Hampshire - Regulated Toxic Air Pollutants - Ambient Air Levels (AALs) - 24-Hour U.S. - New Hampshire - Regulated Toxic Air Pollutants - Ambient Air Levels (AALs) - Annual U.S. - New Jersey - Discharge Prevention - List of Hazardous Substances U.S. - New Jersey - Environmental Hazardous Substances List RTK - U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - California - Safer Consumer Products - Initial List of Candidate Chemicals and Chemical Groups U.S. - Texas - Effects Screening Levels - Long Term U.S. - Texas - Effects Screening Levels - Short Term
Aluminum (7429-90-5)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List
Ammonium nitrate (6484-52-2)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List

Canadian Regulations 1966 Emulsion Blend	
WHMIS Classication	**Note: Explosives are not regulated under WHMIS. They are subject to the regulations of the Explosives Act of Canada.**
Fuels, diesel, no. 2 (68476-30-2)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class B Division 3 - Combustible Liquid Class D Division 2 Subdivision A - Very toxic material causing other toxic effects Class D Division 2 Subdivision B - Toxic material causing other toxic effects Class D Division 1 Subdivision B - Toxic material causing immediate and serious toxic effects
Ammonium nitrate (6484-52-2)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class C - Oxidizing Material Class D Division 2 Subdivision B - Toxic material causing other toxic effects
Aluminum (7429-90-5)	
Listed on the Canadian DSL (Domestic Substances List) inventory. Listed on the Canadian Ingredient Disclosure List	
WHMIS Classification	Class B Division 6 - Reactive Flammable Material

Safety Data Sheet

	Class B Division 4 - Flammable Solid

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Revision Date : 08/24/2015

Other Information : This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200.

Party Responsible for the Preparation of This Document

Independent Explosives, Inc
88 Gold Ledge Ave,
Auburn, NH 03032

Phone: (860) 243-0137 Toll Free: (888) 658-3966

Disclaimer

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1966 Emulsion Blend
Technical Data Sheet

1966 Emulsion Blend is based on the Nelson Brothers PowerNel 1500 or similar Sensitized Bulk Emulsion. For purposes of this document the PowerNel 1500 was used to develop the information below:

PowerNel® 1500 Specification

PowerNel 1500 is an ammonium nitrate / hydrocarbon emulsion blasting agent in the form of a water-in-oil emulsion explosive. PowerNel 1500 can be used in packaged or bulk form, and it is often used in combination with low cost ANFO in various proportions to meet individual blasting needs. PowerNel 1500 is sensitized to insure effective performance when used under demanding conditions.

PowerNel® 1500 is manufactured to the following specifications:

PowerNel® 1500

Parameter	Specification
Density *g/cc*	1.25 maximum[1]
lb/gal	10.43 maximum[1]
Absolute Weight Strength *cal/g*	645[2]
Absolute Bulk Strength *cal/cc*	806
Relative Bulk Strength *(% ANFO)*	109
Velocity of Detonation[3] *ft/sec*	19,000 – 20,000
Shelf Life (minimum, matrix only)	1 year

The Sensitized Bulk Emulsion is blended to an approximate 80% Emulsion / 20% Ammonium Nitrate ratio for delivery to the job site. Additional ratios may be blended on site by "Quad" blend trucks and include 70/30 and 50/50 ratios.

BLEND	***Sensitized Emulsion***	***80/20***	***70/30****	***50/50****
DENSITY[4] g/cc	**1.25**	**1.27**	**1.29**	**1.34**
Relative Bulk Strength	**109**	**121**	**126**	**135**
Velocity of Detonation ft/sec	**19,000-20,000[3]**	**19,000[5]**	**18,700[5]**	**16,100[5]**
Water Resistance	**Excellent**	**Excellent**	**Excellent**	**Excellent**
Minimum Diameter**	**3"**	**3 ½"**	**5"**	**6"**
Minimum Booster***	**¾ lb**	**¾ lb**	**1 lb**	**2 lb**

*These blends (70/30 & 50/50) are produced on site from a "Quad" truck.

** Recommended minimum diameters

***Recommended minimum priming requirements

All data provided by Nelson Bros. laboratory:

[1] *At normal ambient temperature (approx 75 F)*
[2] *From TIGERWIN Program Code, version 4*
[3] *Measured velocities in 6.75 inch diameter borehole, 100% emulsion*
[4] *Typical values, may vary with ANFO density*
[5] *Typical, averaged values in 6.75 inch borehole*

BLASTEX®

Technical Information

PACKAGED EXPLOSIVES

Small & Large Diameter Cast Booster Sensitive Emulsion

Product Description

BLASTEX is a booster sensitive, water resistant, packaged emulsion explosive designed to satisfy a majority of medium diameter explosive applications for quarry and construction blasting. It is a cost effective alternative to most detonator sensitive, water resistant, packaged emulsion explosives. BLASTEX is available in two grades with increasing energy level for each.

Application Recommendations

- Package diameter and type affect product density. Use cartridge count to determine actual explosive charge weight.
- Ensure continuous column loading. For column lengths in excess of 6 m (20 ft) or whenever column separation is suspected, multiple priming is recommended.
- Emulsion explosives are susceptible to "dynamic shock" and may detonate at low order or fail completely when applied in very wet conditions, where explosive charges or decks are closely spaced and/or where geological conditions promote this effect. Consult your Dyno Nobel representative for alternate product recommendations when these conditions exist.
- **ALWAYS** use a cast booster as a primer for BLASTEX to ensure maximum performance.
- **ALWAYS** use a 340 g (12 oz) or larger cast booster at internal product temperatures higher than -18º C (0º F). At internal product temperatures below -18º C (0º F) and higher than -34º C (-30º F) use a 454 g (16 oz) or larger cast booster.
- **NEVER** use BLASTEX at internal product temperatures below -34º C (-30º F). At internal product temperatures below -34º C (-30º F), adequate product warm-up time must be allowed after loading into boreholes and before initiation.
- Use with detonating cord is not recommended.

Properties

SDS #1063

		BLASTEX	BLASTEX PLUS
Density	(g/cc) Avg	1.26	1.26
Energy[a]	(cal/g)	740	800
	(cal/cc)	930	1,010
Relative Weight Strength[a]		0.84	0.91
Relative Bulk Strength[a,b]		1.29	1.40
Velocity[c]	(m/s)	5,000	4,900
	(ft/s)	16,400	16,100
Detonation Pressure[c]	(Kbars)	79	76
Gas Volume[a]	(moles/kg)	44	39
Fume Class		IME1 & NRCan[d]	IME1
Shelf Life Maximum		1 year (from date of production)	
Maximum Water Depth		45 m (150 ft)	
Water Resistance		Excellent	

[a] All Dyno Nobel Inc. energy and gas volume values are calculated using PRODET™ the computer code developed by Dyno Nobel Inc. for its exclusive use. Other computer codes may give different values.

[b] ANFO = 1.00 @ 0.82 g/cc

[c] Unconfined @ 75 mm (3 in) diameter

[d] Approved by Natural Resources Canada as Fume Class 1 in:
*valeron chub 50 mm (2 in) diameter and greater
*shot bag 125 mm (5 in) diameter and greater

Hazardous Shipping Description

Explosive, Blasting, Type E, 1.5D, UN 0332 II

See Product Disclaimer on page 2

BLASTEX®

Technical Information

Transportation, Storage and Handling

- BLASTEX and BLASTEX PLUS must be transported, stored, handled and used in conformity with all applicable federal, state, provincial and local laws and regulations.
- Packaged emulsions have a shelf life of one (1) year when stored at temperatures between -18º C and 38º C (0º F and 100º F). Explosive inventory should be rotated. Avoid using new materials before the old. For recommended good practices in transporting, storing, handling and using this product, see the booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case ad the Safety Library Publications of the Institute of Makers of Explosives.

Packaging Details

- Package diameter and type affect product density. Use cartridge count to determine actual explosive charge weight.
- All weights are approximate.
- BLASTEX and BLASTEX PLUS are available in a wide variety of sizes. Custom sizes are subject to surcharge and may require longer than usual lead times.
- Check with your Dyno Nobel representative should you have any questions.

Packaging—Chub

Diameter x Length		Blastex	Blastex Plus	Case Quantity	Case Weight		Net Explosive Weight / Chub	
mm	in				kg	lbs	kg	lbs
50 x 400	2 x 16	■	■	18	18.0	40	1.00	2.20
57 x 400	2¼ x 16	■	■	14	17.7	39	1.26	2.78
65 x 400	2½ x 16	■	■	12	18.1	40	1.51	3.33
70 x 400	2¾ x 16	■	■	9	17.3	38	1.92	4.23
75 x 400	3 x 16	■	■	8	18.2	40	2.27	5.00
89 x 400	3½ x 16	■	■	6	16.7	37	2.77	6.11

Packaging—Shot Bag

Bag Diameter		Bag Weight		Tote Bag Quantity
mm	in	kg	lbs	
125	5	11.3	25	40

Tote Bag Dimensions

84 x 84 x 94 cm 33 x 33 x 37 in

Case Dimensions

44 x 35 x 20 cm 17.25 x 13.875 x 7.875 in

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NONEL® EZ DET®CPZ 1.4B

Technical Information

Nonelectric Blast Initiation System
Perchlorate Free

Product Description

NONEL® nonelectric delay detonator EZ DET® 1.4B units consist of a length of orange shock tube with a surface detonator attached to one end and a Standard (#8) in-hole detonator on the other. The surface detonator is inside a color-coded plastic EZ™ Connector block to facilitate easy connections to shock tube leads. This block can hold up to 6 shock tube leads. Easy-to-read, color-coded delay tags display the delay number and nominal firing time prominently.

NONEL EZ DET units can be easily connected to one another to satisfy basic blast design requirements in construction, mining, and quarry operations. They can also be used in combination with NONEL MS, NONEL EZTL™ and/or NONEL TD detonators to satisfy complex blast design requirements and minimize inventory of initiation system components.

Application Recommendations

For detailed application recommendations, **ALWAYS** request a copy of Dyno Nobel's *Product Manual: NONEL® and PRIMACORD®* from your Dyno Nobel representative.

- **ALWAYS** select a NONEL EZ DET unit having more than enough tubing length to extend from the planned primer location in the borehole to the collar of the next hole.

Properties

MSDS #1122

Net Explosive Content per 100 units 0.0810 kg / 0.1782 lbs

Nominal Time (msec)	Delay Code	Connector Block Color
17/350	DBZ	Yellow
25/350	ABZ	Red
25/375	AEZ	Red

Hazardous Shipping Description

Detonator assemblies nonelectric, 1.4B, UN 0361 PG II

NONEL® EZ DET® CPZ 1.4B

Technical Information

Application Recommendations (continued)

- **ALWAYS** protect the plastic EZ Connector block and all shock tube leads from impact or damage during the loading and stemming operations. Use care when placing blasting mats and cover material on top of the blasting circuit. The EZ Connector block contains a detonator and is subject to detonation caused by abuse such as impact. Shock tube which has been cut, ruptured or damaged may cause misfires.
- **ALWAYS** be sure that the shock tube(s) are securely inserted, one at a time, into the EZ Connector block. The head of the EZ Connector block should rise to accept the shock tube and return to a closed position with an audible click.
- **ALWAYS** ensure that individual shock tubes remain aligned side by side in the connector channel and do not cross one over the another on insertion.
- **NEVER** use NONEL EZ DET units with detonating cord. The low strength surface detonator will not initiate detonating cord and may cause misfires.
- **NEVER** attempt to disassemble the delay detonator from the plastic EZ Connector block or use the detonator without the connector.
- **NEVER** place more than 6 shock tube leads into the plastic EZ Connector block. Misfires may result.
- **NEVER** pull, stretch, kink or put tension on shock tube such that the tube could break.
- **NEVER** splice NONEL EZ DET shock tube together to extend between holes.
- **NEVER** connect NONEL EZ DET units together until all holes have been primed, loaded and stemmed and the blast site has been cleared.

Transportation, Storage and Handling

- NONEL EZ DET must be transported, stored, handled and used in conformity with all federal, state, provincial and local laws and regulations.
- For maximum shelf life (3 years), NONEL EZ DET must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old. For recommended good practices in transporting, storing, handling and using this product, see the booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case and the Safety Library Publications of the Institute of Makers of Explosives

Packaging

Length		Product Code	Case Type	Quantity per Case
m	ft			
4.5	16	DX---616	D*	60
7	24	DX---623	D*	60
9	30	DX---629	D*	40
12	40	DX---641	D*	30
18	60	DX---660	DC	50
24	80	DX---680	DC	40
30	100	DX---6M0	DC	30

* Always shipped with 2 cases strapped together. Case dimension width will double.

- Length rounded to nearest one-half meter.
- Case weight varies by length & delay; see case label for exact weight.
- Replace "---" in Product Code with delay desired.

Case Dimensions

Detpak Case (DC)	48 x 45 x 26 cm	18¾ x 17¾ x 10¼ in
Detpak (D)	44 x 22 x 25 cm	17 ½ x 8 ¾ x 10 in

NONEL® EZTL™ CPZ

Technical Information

Nonelectric Trunkline Delay Detonators Perchlorate Free

Product Description

NONEL® nonelectric delay detonator EZTL™ units consist of a length of yellow shock tube, with a surface detonator attached to one end and the other end sealed. The detonator is housed in a plastic EZ Connector block which facilitates easy connection to shock tube. A white J-hook is affixed near the sealed end. Easy-to-read, color-coded delay tags display the delay number and nominal firing time prominently.

EZTL detonators are designed for use with NONEL MS and EZ DET® units to provide effective and accurate surface timing between blastholes and/or rows of blastholes in surface and underground blasting designs.

Application Recommendations

For detailed application recommendations, **ALWAYS** request a copy of Dyno Nobel's *Product Manual: NONEL® and PRIMACORD®* from your Dyno Nobel representative.

- **ALWAYS** be sure that the shock tube(s) are securely inserted, one at a time, into the plastic EZ connector. The head of the connector block should rise to accept the tube, and return to a closed position with an audible click.
- **ALWAYS** ensure that the individual shock tubes remain aligned side by side in the EZ connector channel and do not cross over one another during insertion.
- **ALWAYS** protect the plastic EZ connector and all shock tube leads from impact or

Properties

MSDS #1122

Net Explosive Content per 100 units 0.0240 kg
0.0529 lbs

Delay Time (msec)	Delay Code	Connector Block Color
17	17Z	Yellow
25	25Z	Red
33	33Z	Green

Hazardous Shipping Description
Detonator assemblies nonelectric,
1.4B, UN 0361 PG II

See Product Disclaimer on page 2.

NONEL® EZTL™ CPZ

Technical Information

Application Recommendations (continued)

damage. Use care when placing blasting mats and cover material on top of the blasting circuit. The EZ connector contains a detonator and is subject to detonation caused by abuse such as impact. Shock tube which has been cut, ruptured or damaged may cause misfires.

- **NEVER** use NONEL EZTL detonators with detonating cord. The low strength surface detonator will not initiate detonating cord.
- **NEVER** attempt to disassemble the delay detonator from the EZ connector block or use the detonator without the connector.
- **NEVER** place more than 6 shock tube leads into an EZ connector block. Misfires may result.
- **NEVER** tie-in NONEL EZTL units until all holes have been primed, loaded, stemmed and the blast site has been cleared**.**

Transportation, Storage and Handling

- NONEL EZTL must be transported, stored, handled and used in conformity with all federal, state, provincial and local laws and regulations.
- For maximum shelf life (3 years), NONEL EZTL must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old. For recommended good practices in transporting, storing, handling and using this product, see the booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case and the Safety Library Publications of the Institute of Makers of Explosives.

Packaging

Length		Product Code	Case Type	Quantity per	
m	ft			Case*	Inner Carton
3.5	12	DY---812ME	D	90	30
6	20	DY---820ME	D	60	20
9	30	DY---830ME	D	45	15
12	40	DY---840ME	D	30	10

* Always shipped with 2 cases strapped together. Case dimension width will double.

- Length rounded to nearest one-half meter.
- Case weight varies by length & delay; see case label for exact weight.
- Replace "---" in Product Code with delay desired.

Case Dimensions

Detpak (D)	44 x 22 x 25 cm	17½ x 8¾ x 10 in

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NONEL® Lead Line

Technical Information

Nonelectric Shock Tube

Product Description

NONEL LEAD LINE is NONEL shock tube spooled at the factory in 763 meter (2,500 foot) lengths for easy application and deployment. NONEL LEAD LINE shock tube is a small diameter, three-layer plastic tube coated on the innermost wall with a reactive explosive compound. When initiated, NONEL shock tube propagates a low energy signal, similar to a dust explosion, at approximately 2000 m/sec (6,500 ft/sec) along the tube's length with minimal disturbance to the outside of the tube. The signal is transmitted from one NONEL shock tube to another through field-assembled splices.

NONEL LEAD LINE provides maximum flexibility to the blaster in choosing a position of safety from which to initiate nonelectric blast rounds in either underground or surface applications. NONEL LEAD LINE is the only NONEL product that can be cut and spliced into a NONEL detonator product to construct a custom length nonelectric starter assembly.

Application Recommendations

- **ALWAYS s**plice NONEL LEAD LINE to NONEL EZTL™ nonelectric trunkline delay detonators, NONEL EZ DET® nonelectric blast initiation system, NONEL TD or NONEL Starter detonators to make-up the nonelectric starter assembly when using

Properties

MSDS #1124

Net Explosive Content per 100 units 0.0044 kg
0.0097 lbs

Length		Spools / Case
m	ft	
762	2500	2

- **Length rounded to nearest one-half meter.**
- **See case label for exact case weight.**

Hazardous Shipping Description
Articles, Explosives, N.O.S. (HMX, Aluminum), 1.4S, UN 0349, PG II

See Product Disclaimer on page 2.

NONEL® Lead Line

Technical Information

Application Recommendations (continued)

NONEL LEAD LINE as the primary initiator for NONEL blast rounds.

- **ALWAYS** trim at least 3 m [10 ft] of tubing before inserting into a nonelectric shock tube starting device or whenever dirt and/or moisture may have compromised the open tube ends before making a splice connection.
- **ALWAYS** replace the plastic tube closure over the open end of any NONEL LEAD LINE that remains on the spool and is intended to be used to make up another nonelectric starter assembly.
- **ALWAYS** make the final hook-up of the nonelectric starter assembly to the blast round only after all equipment and non-essential personnel are clear of the blast area.
- **ALWAYS** unspool NONEL LEAD LINE by hand if the starter assembly has been spliced to it and is attached to the blast round.
- **ALWAYS** keep any NONEL LEAD LINE tube ends sealed and free from dirt and moisture since dirt or moisture in the shock tube may cause a misfire.
- **NEVER** use NONEL LEAD LINE for in-hole use. NONEL LEAD LINE is for use outside the borehole only.
- **NEVER** attempt to knot different lengths of shock tube together. Shock tube will not initiate itself through knot connections. It must be spliced.
- **NEVER** remove the plastic tube closure from the NONEL LEAD LINE shock tube until just before splicing.
- **NEVER** attach the starter assembly to the blast round until after the LEAD LINE deployment is complete whenever NONEL LEAD LINE is to be unspooled by any method other than by hand,

Application Recommendations (continued)

- **NEVER** run over NONEL LEAD LINE with equipment. This may damage the shock tube and may cause a misfire. **ALWAYS** replace the NONEL LEAD LINE if it is damaged.
- When making a nonelectric starter assembly using NONEL LEAD LINE, **ALWAYS** remove the plastic tube closure and save for later use. Splice two freshly-cut ends of NONEL shock tube together (one from the NONEL LEAD LINE and the other from the NONEL detonator) by inserting them into opposite ends of the plastic connector sleeve and pushing them toward one another until they are both at least ½ cm (¼ in) in the splice.

Transportation, Storage and Handling

- NONEL LEAD LINE must be transported, stored, handled and used in conformity with all federal, state, provincial and local laws and regulations.
- For maximum shelf life (3 years), NONEL LEAD LINE must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old. For recommended good practices in transporting, storing, handling and using this product, see the booklet “Prevention of Accidents in the Use of Explosive Materials” packed inside each case and the Safety Library Publications of the Institute of Makers of Explosives.

Case Dimensions

51 x 25 x 28 cm 20 x 9 ⅞ x 10 ⅞ in

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TROJAN SPARTAN®

Technical Information

BOOSTERS • CORDS

Cast Booster

Product Description

TROJAN SPARTAN cast boosters are detonator sensitive, high density, high energy molecular explosives avaliable in various sizes designed to optimize initiation of all booster sensitive explosives. All TROJAN SPARTAN boosters are manufactured with an internal through-tunnel and detonator well for easy application with either electric, electronic or nonelectric detonators or 10.6 g/m (50 gr/ft) minimum strength detonating cord.

TROJAN SPARTAN boosters are formulated from the highest quality PETN and other high explosive materials ensuring reliability, consistency and durability in all blasting environments. The fluorescent green container and clear printing makes the TROJAN SPARTAN booster more visible on the blast site (as well as in low light situations) and reduces the possibility of misplaced charges. The redesigned Caplock™ holds the detonator in place more securely and makes it more difficult for the detonator to be pulled out of the capwell position while it is being lowered into the borehole.

Application Recommendations

- **NEVER** force the detonator into the through-tunnel, the detonator-well or otherwise attempt to clear these areas if obstructed. If the through-tunnel or detonator-well does not accommodate the detonator, do not use the booster. Notify your Dyno Nobel representative.

Properties

MSDS #1108

Density	(g/cc) Avg	1.65
Velocity	(m/sec)	7,550
	(ft/s)	24,800
Detonation Pressure (Kbars)		235
Water Resistance		6 months with no loss of sensitivity
Shelf Life Maximum		5 years (from date of production)
Maximum Usage Temperature		66°C (150°F)

All Dyno Nobel Inc. energy and gas volume values except Velocity and Detonation Pressure are calculated using PRODET™ the computer code developed by Dyno Nobel Inc. for its exclusive use. Other computer codes may give different values.

Velocity and Detonation Pressure are the result of empirical methods during May 2009.

Hazardous Shipping Description

UN 0042 Boosters, 1.1D PG II

TROJAN® SPARTAN®

Technical Information

Application Recommendations (continued)

- **ALWAYS** use detonating cord with a coreload of 10.6 g/m (50 gr/ft) or higher when initiating the TROJAN SPARTAN booster with detonating cord.
- Minimum detonator is No. 8 strength for temperatures above -40º C (-40º F). A high strength detonator is recommended for temperatures below -40º C (-40º F).
- Extremely low temperatures do not affect the performance of cast boosters with commercial detonators. Low temperatures do affect detonators and detonating cord. Be certain your initiation system is suitable for your application in extremely low temperatures. Cast boosters are more susceptible to breakage during handling in extremely cold temperatures.

Transportation, Storage and Handling

- Dyno Nobel cast boosters must be transported, stored, handled and used in conformity with all federal, state, provincial and local laws and regulations.
- For maximum shelf life (5 years), Dyno Nobel cast boosters must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old.

Packaging

Unit Weight		Unit Dimensions				Case Quantity	Gross Weight/ Case	
		Length		Diameter				
g	oz	cm	in	cm	in		kg	lbs
90*	3.2	11.9	4.7	2.7	1.1	150	14.0	30.8
150	5.5	11.9	4.7	3.6	1.4	95	16.7	36.7
200	7	11.7	4.6	4.1	1.6	72	16.5	36.4
350	12	11.9	4.7	5.0	2.0	49	17.9	39.5
400	14	11.9	4.7	5.5	2.2	40	17.6	38.8
450	16	11.9	4.7	5.8	2.3	36	17.8	39.2
900*	32	12.9	5.1	7.9	3.1	18	17.8	39.2

* The Caplock feature is not available on these boosters because the shells are made of cardboard instead of plastic.

Note: All weights and dimensions are approximate.

Case Dimensions

42 x 33 x 14 cm 16 ½ x 13 x 5 ½ in

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 28.07.2015 Revision: 28.07.2015

SECTION 1: Identification of the substance/mixture and of the company/ undertaking

· **1.1 Product identifier**

· **Trade name: DYNOSPLIT® RiGHT, DYNOSPLIT® EX**

· **Article number:** 1157

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture**
Explosive product.
Commercial blasting applications

· **1.3 Details of the supplier of the Safety Data Sheet**

· **Manufacturer/Supplier:**
Dyno Nobel Inc.
2795 East Cottonwood Parkway, Suite 500
Salt Lake City, Utah 84121
Phone: 801-364-4800
Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com

· **1.4 Emergency telephone number:**
CHEMTREC
1-800-424-9300 (US/Canada)
+01 703-527-3887 (International)

SECTION 2: Hazards identification

· **2.1 Classification of the substance or mixture**

· **Classification according to Regulation (EC) No 1272/2008**
Classifications listed are applicable to the OSHA GHS Hazard Communication Standard (29CFR1910.1200).
Hazard Statement H412 is not applicable to the OSHA US regulations.


exploding bomb

Expl. 1.1 H201 Explosive; mass explosion hazard.

· **Additional information:**
There are no other hazards not otherwise classified that have been identified.
0 % of the mixture consists of component(s) of unknown toxicity.

· **2.2 Label elements**

· **Labelling according to Regulation (EC) No 1272/2008**
The product is additionally classified and labelled according to the Globally Harmonized System within the United States (GHS).
The product is classified and labelled according to the CLP regulation.

(Cont'd. on page 2)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 28.07.2015 Revision: 28.07.2015

Trade name: DYNOSPLIT® RiGHT, DYNOSPLIT® EX

(Cont'd. from page 1)

· **Hazard pictograms**

GHS01

· **Signal word** Danger
· **Hazard statements**
The following Hazard Statements are applicable only to the EU regulations and not the US GHS regulation: H412.
H201 Explosive; mass explosion hazard.
· **Precautionary statements**

P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P230	Keep wetted.
P250	Do not subject to grinding/shock/friction.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P240	Ground/bond container and receiving equipment.
P373	DO NOT fight fire when fire reaches explosives.
P370+P380	In case of fire: Evacuate area.
P372	Explosion risk in case of fire.
P401	Store in accordance with local/regional/national/international regulations.
P501	Dispose of contents/container in accordance with local/regional/national/international regulations.

· **NFPA ratings (scale 0 - 4)** Not available.
· **HMIS-ratings (scale 0 - 4)** Not available
· **2.3 Other hazards**
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Explosive Product Notice**
PREVENTION OF ACCIDENTS IN THE USE OF EXPLOSIVES - The prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The explosives user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

WARNING - All explosives are dangerous and must be carefully handled and used following approved safety procedures either by or under the direction of competent, experienced persons in accordance with all applicable federal, state, and local laws, regulations, or ordinances. If you have any questions or doubts as to how to use any explosive product, DO NOT USE IT before consulting with your supervisor, or the manufacturer, if you do not have a supervisor. If your supervisor has any questions or doubts, he should consult the manufacturer before use.

(Cont'd. on page 3)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 28.07.2015 Revision: 28.07.2015

Trade name: DYNOSPLIT® RiGHT, DYNOSPLIT® EX

(Cont'd. from page 2)

SECTION 3: Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**		
CAS: 6484-52-2 EINECS: 229-347-8	ammonium nitrate	Ox. Sol. 3, H272 Eye Irrit. 2, H319
CAS: 7631-99-4 EINECS: 231-554-3	sodium nitrate	Ox. Sol. 2, H272 Eye Irrit. 2, H319
CAS: 78-11-5 EINECS: 201-084-3 Index number: 603-035-00-5	pentaerythritol tetranitrate (PETN)	Unst. Expl., H200

· **Additional information:**
For the listed ingredient(s), the identity and exact percentages are being withheld as a trade secret.
For the wording of the listed Hazard Statements refer to section 16.

SECTION 4: First aid measures

· **4.1 Description of first aid measures**
· **General information:**
This is a packaged product that will not result in exposure to the contents under normal conditions of use.
In the event of exposure, administer first aid appropriate for symptoms present.
Immediately remove any clothing soiled by the product.
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
· **After inhalation:**
Unlikely route of exposure.
Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Wash with soap and water.
If skin irritation is experienced, consult a doctor.
· **After eye contact:**
Remove contact lenses if worn.
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed** Blast injury if mishandled.
· **Hazards** Danger of blast or crush-type injuries.
· **4.3 Indication of any immediate medical attention and special treatment needed**
Product may produce physical injury if mishandled. Treatment of these injuries should be based on the blast and compression effects.

(Cont'd. on page 4)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 28.07.2015 Revision: 28.07.2015

Trade name: DYNOSPLIT® RiGHT, DYNOSPLIT® EX

(Cont'd. from page 3)

SECTION 5: Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:** DO NOT fight fire when fire reaches explosives.
· **For safety reasons unsuitable extinguishing agents:** None.
· **5.2 Special hazards arising from the substance or mixture**
DO NOT ATTEMPT TO FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions. Can explode or detonate under fire conditions. Burning material may produce toxic vapors. It is recommended that users of explosives material be familiar with the Institute of Makers of Explosives Safety Library publications.
May mass explode in fire.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information**
Eliminate all ignition sources if safe to do so.
Flammability Classification: (defined by 29 CFR 1910.1200) Explosive. Can explode under fire conditions. Individual devices will randomly explode. Mass explosion of multiple devices is possible under certain conditions. Burning material may produce toxic and irritating vapors. In unusual cases, shrapnel may be thrown from exploding devices under containment. See 2012 Emergency response Guidebook for further information.

SECTION 6: Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Remove persons from danger area.
Ensure adequate ventilation
Wear protective clothing.
Protect from heat.
Evacuate area.
Isolate area and prevent access.
· **6.2 Environmental precautions:** No special measures required.
· **6.3 Methods and material for containment and cleaning up:**
Pick up mechanically.
Send for recovery or disposal in suitable receptacles.
Dispose unusable material as waste according to item 13.
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

SECTION 7: Handling and storage

· **7.1 Precautions for safe handling**
Handle with care. Avoid jolting, friction and impact.

(Cont'd. on page 5)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and OSHA GHS

Printing date 28.07.2015 Revision: 28.07.2015

Trade name: DYNOSPLIT® RiGHT, DYNOSPLIT® EX

(Cont'd. from page 4)

Use only in well ventilated areas.
Do not subject to grinding/shock/friction.
Keep from heat and sources of ignition.

· **Information about fire - and explosion protection:**
Protect from heat.
Emergency cooling must be available in case of nearby fire.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:**
Store in a cool location.
Avoid storage near extreme heat, ignition sources or open flame.
· **Information about storage in one common storage facility:** Store away from foodstuffs.
· **Further information about storage conditions:**
Store under lock and key and with access restricted to technical experts or their assistants only.
Keep away from heat.
· **7.3 Specific end use(s)** No further relevant information available.

SECTION 8: Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see section 7.

· **8.1 Control parameters**
· **Ingredients with limit values that require monitoring at the workplace:**
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· **DNELs** No further relevant information available.
· **PNECs** No further relevant information available.
· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures are to be adhered to when handling chemicals.
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.
· **Respiratory protection:**
Not required under normal conditions of use.
Respiratory protection may be required after product use.
· **Protection of hands:**
Wear gloves for the protection against mechanical hazards according to NIOSH or EN 388.
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

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(Cont'd. from page 5)

· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**

Safety glasses

Face protection
· **Body protection:** Impervious protective clothing
· **Limitation and supervision of exposure into the environment**
No further relevant information available.
· **Risk management measures**
Organizational measures should be in place for all activities involving this product.

SECTION 9: Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Solid material
Colour:	According to product specification
· **Odour:**	Characteristic
· **Odour threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition**	
Melting point/Melting range:	Not Determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Explosive; mass explosion hazard.
· **Auto/Self-ignition temperature:**	Not determined.
· **Decomposition temperature:**	Not determined.
· **Self-igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Heating may cause an explosion.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure:**	Not applicable.
· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.

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Trade name: DYNOSPLIT® RiGHT, DYNOSPLIT® EX

(Cont'd. from page 6)

· **Evaporation rate** Not applicable.

· **Solubility in / Miscibility with water:** Variable, dependent upon product composition and packaging.

· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**
Dynamic: Not applicable.
Kinematic: Not applicable.

· **9.2 Other information** No further relevant information available.

SECTION 10: Stability and reactivity

· **10.1 Reactivity** No further relevant information available.
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
· **10.3 Possibility of hazardous reactions**
May mass explode in fire.
Toxic fumes may be released if heated above the decomposition point.
Acts as an oxidising agent on organic materials such as wood, paper and fats.
· **10.4 Conditions to avoid** No further relevant information available.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Hydrocarbons
Nitrogen oxides

SECTION 11: Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity**

· **LD/LC50 values relevant for classification:**		
6484-52-2 ammonium nitrate		
Oral	LD50	2217 mg/kg (rat)
7631-99-4 sodium nitrate		
Oral	LD50	3236 mg/kg (rat)

· **Primary irritant effect:**
· **Skin corrosion/irritation** Based on available data, the classification criteria are not met.
· **Serious eye damage/irritation**
Based on available data, the classification criteria are not met.
· **Respiratory or skin sensitisation** Based on available data, the classification criteria are not met.
· **Subacute to chronic toxicity:** No further relevant information available.
· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction):**
· **Germ cell mutagenicity**
Based on available data, the classification criteria are not met.
· **Carcinogenicity**
Based on available data, the classification criteria are not met.

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· **Reproductive toxicity**
Based on available data, the classification criteria are not met.
· **STOT-single exposure**
Based on available data, the classification criteria are not met.
· **STOT-repeated exposure**
Based on available data, the classification criteria are not met.
· **Aspiration hazard**
Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **12.2 Persistence and degradability** No further relevant information available.
· **12.3 Bioaccumulative potential** No further relevant information available.
· **12.4 Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Must not be disposed together with household garbage. Do not allow product to reach sewage system.
Damaged materials pose a danger to anyone in the immediate area; consult experts for disposal of damaged products.
The user of this material has the responsibility to dispose of unused material, residues and containers in compliance with all relevant local, state and federal laws and regulations regarding treatment, storage and disposal for hazardous and nonhazardous wastes. Residual materials should be treated as hazardous.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to local official regulations.

SECTION 14: Transport information

· **14.1 UN-Number**
· **DOT, ADR, IMDG** UN0241
· **IATA** FORBIDDEN
· **14.2 UN proper shipping name**
· **DOT** Explosive, Blasting, Type E
· **ADR** 0241 EXPLOSIVE, BLASTING, TYPE E
· **IMDG** EXPLOSIVE, BLASTING, TYPE E
· **IATA** FORBIDDEN

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· **14.3 Transport hazard class(es)**

· **DOT, IMDG**

· **Class**	1.1
· **Label**	1.1D

· **ADR**

· **Class**	1.1 (-)
· **Label**	1.1D

· **IATA**	
· **Class**	FORBIDDEN
· **14.4 Packing group**	
· **DOT, ADR, IMDG**	II
· **IATA**	FORBIDDEN
· **14.5 Environmental hazards:**	
· **Marine pollutant:**	No
· **Special marking (IATA):**	FORBIDDEN BY AIR.
· **14.6 Special precautions for user**	Not applicable.
· **Danger code (Kemler):**	-
· **EMS Number:**	F-B,S-X
· **14.7 Transport in bulk according to Annex II of Marpol and the IBC Code**	Not applicable.

· **Transport/Additional information:**

· **ADR**	
· **Limited quantities (LQ)**	0
· **Excepted quantities (EQ)**	Code: E0 Not permitted as Excepted Quantity

· **IMDG**	
· **Limited quantities (LQ)**	0
· **Excepted quantities (EQ)**	Code: E0 Not permitted as Excepted Quantity

· **IATA**	FORBIDDEN.
· **UN "Model Regulation":**	UN0241, EXPLOSIVE, BLASTING, TYPE E, 1.1D, II

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SECTION 15: Regulatory information

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**
None of the ingredients are listed.

· **Section 313 (Specific toxic chemical listings):**

6484-52-2	ammonium nitrate

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients are listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients are listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients are listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients are listed.

· **IARC (International Agency for Research on Cancer)**
None of the ingredients are listed.

· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients are listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients are listed.

· **Canada**
· **Canadian Domestic Substances List (DSL)**
Some components are listed on the NDSL.
All ingredients are listed.

· **Canadian Ingredient Disclosure list (limit 0.1%)**
None of the ingredients are listed.

· **Canadian Ingredient Disclosure list (limit 1%)**

7631-99-4	sodium nitrate

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· **Directive 2012/18/EU**

· **Named dangerous substances - ANNEX I**
None of the ingredients are listed.

· **Other regulations, limitations and prohibitive regulations**
This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

· **Substances of very high concern (SVHC) according to REACH, Article 57**
None of the ingredients are listed.

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

Disclaimer
Dyno Nobel Inc. and its subsidiaries disclaim any warranties with respect to this product, the safety or suitability thereof, the information contained herein, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR OTHER WARRANTY. The information contained herein is provided for reference purposes only and is intended only for persons having relevant technical skills. Because conditions and manner of use are outside of our control, the user is responsible for determining the conditions of safe use of the product. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product or information. Under no circumstances shall either Dyno Nobel Inc. or any of its subsidiaries be liable for special, consequential or incidental damages or for anticipated loss of profits.

· **Relevant phrases**
H200 Unstable explosives.
H272 May intensify fire; oxidiser.
H319 Causes serious eye irritation.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
DNEL: Derived No-Effect Level (REACH)
PNEC: Predicted No-Effect Concentration (REACH)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
SVHC: Substances of Very High Concern
vPvB: very Persistent and very Bioaccumulative
Expl. 1.1: Explosives, Division 1.1

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Unst. Expl.: Explosives, Unstable explosives
Ox. Sol. 2: Oxidising Solids, Hazard Category 2
Ox. Sol. 3: Oxidising Solids, Hazard Category 3
Eye Irrit. 2: Serious eye damage/eye irritation, Hazard Category 2

· **Sources**

SDS Prepared by:
ChemTel Inc.
1305 North Florida Avenue
Tampa, Florida USA 33602-2902
Toll Free North America 1-888-255-3924 Intl. +01 813-248-0573
Website: www.chemtelinc.com

DYNOMAX™ PRO

Extra Gelatin Nitroglycerin Dynamite

Technical Information

Product Description

DYNOMAX PRO is desensitized extra gelatin dynamite designed to satisfy the majority of explosive application requirements. DYNOMAX PRO is formulated to consistently deliver high detonation velocity and excellent water resistance while reducing cartridge to cartridge gap sensitivity and hole-to-hole propagation problems. DYNOMAX PRO is recommended for bottom loading and as the main explosive charge where high density and energy is required. DYNOMAX PRO is recommended for use as booster, bottom load or floor control solution.

Application Recommendations

- DYNOMAX PRO is an excellent primer for Dynomix (ANFO), Dynomix WR (WR ANFO) or other detonator sensitive packaged product and can be used as a secondary primer in hard seams or at the top of the explosive column.
- Minimum diameter is 32 mm (1¼ in).
- Minimum detonator is No. 8 strength.
- DYNOMAX PRO has been formulated to reduce susceptibility to sympathetic detonation when applied in very wet conditions where boreholes are closely spaced and/or where geological conditions promote this effect. Consult your Dyno Nobel representative for product recommendations where these conditions exist.
- Storage at elevated temperatures and/or high humidity for 12-18 months can reduce the performance of DYNOMAX PRO depending on the diameter. Consult your Dyno Nobel representative for specific recommendations.

Properties

SDS #1019

Density	(g/cc) Avg	1.45
Energy[a]	(cal/g)	1,055
	(cal/cc)	1,510
Relative Weight Strength[a]		1.20
Relative Bulk Strength[a,b]		2.10
Velocity[c]	(m/s)	5,275
	(ft/s)	17,300
Detonation Pressure[c]	(Kbars)	101
Gas Volume[a]	(moles/kg)	32
Water Resistance		Excellent
Fume Class[d]		IME1

[a] All Dyno Nobel Inc. energy and gas volume values are calculated using PRODET™ the computer code developed by Dyno Nobel Inc. for its exclusive use. Other computer codes may give different values.
[b] ANFO = 1.00 @ 0.82 g/cc
[c] Unconfined @ 50 mm (2 in) diameter.
[d] IME Fume Class 1 in convolute paper shell only. Not Fume Class 1 in paper tube shell. Natural Resources Canada Fume Class approvals pending.

Hazardous Shipping Description

Explosive, Blasting, Type A 1.1D UN 0081 II

See Product Disclaimer on page 2

DYNOMAX™ PRO

Technical Information

Transportation, Storage and Handling

- For maximum shelf-life, DYNOMAX PRO dynamite must be stored in cool, dry and well-ventilated magazines. Explosive inventory should always be rotated by using the oldest materials first. For recommended good practices in transporting, storing, handling and using this product, see the booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case and the Safety Library Publications of the Institute of Makers of Explosives.
- DYNOMAX PRO must be transported, stored, handled and used in conformity with all applicable federal, state, provincial and local laws and regulations.

Packaging

Diameter x Length		Qty / Case	Case Type	Nominal Case Weight	
mm	in			kg	lbs
32 x 200	1 1/4 x 8	88	DA	20	44
32 x 400	1 1/4 x 16	44	DA	20	44
40 x 200	1 1/2 x 8	60	DA	20	44
50 x 200	2 x 8	34	DB	20	43
50 x 400[a]	2 x 16[a]	17	DB	20	43
65 x 400[a]	2 1/2 x 16[a]	10	DB	19	41
75 x 200	3 x 8[a]	16	DE	20	44
75 x 400[a]	3 x 16[a]	8	DE	20	44

[a] Avaliable in spiral tube shell with tapered end. • Note: All weights are approximate.

**Available upon request. Check with your Dyno Nobel representative should you have any questions.

- Product density is 1.40 g/cc for package diameters less than 50mm (2 in). Use cartridge count to determine actual explosive charge weight.
- DYNOMAX PRO is available in a wide variety of sizes. Custom sizes are subject to surcharge and may require longer than usual lead times.

Case Dimensions

DA	17¾ x 13⅜ x 6⅜ in	34 x 34 x 17 cm
DB	17⅞ x 13⅜ x 5⅞ in	45 x 34 x 15 cm
DE	17⅝ x 13 5/16 x 6¾ in	45 x 34 x 17 cm

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SAFETY LIBRARY PUBLICATION

October 2011

SAFETY IN THE TRANSPORTATION, STORAGE, HANDLING AND USE OF EXPLOSIVE MATERIALS

MISFIRES

Every precaution must be taken to prevent misfires. Experience has shown that if proper procedures are followed the probability of misfires occurring is reduced to an absolute minimum. Detection of misfires during the post-blast inspection is paramount since history shows that many serious accidents involve misfired explosives of which workers are unaware. When a misfire occurs, it is sometimes difficult to detect the presence of the unexploded materials. If a misfire is suspected, do not give the "all-clear" signal and immediately barricade the area and notify managerial level personnel as soon as possible and by the end of the shift. This identified misfired area should be barricaded from unauthorized entry until the misfire is successfully resolved. For this reason, never drill into or near a borehole that has previously been loaded with explosive materials. Accidents could occur if misfired explosive material is impacted by a drill steel or bit.

Because misfires occur under so many varied conditions, and are caused by so many different factors, it is impossible to offer detailed instructions to cover every situation. Moreover, due to the potential hazards involved, ***misfires should only be handled by persons who are thoroughly trained and experienced in the properties of explosive materials and their use in blasting operations.***

A. Prevention Plan

A thorough investigation should always be made of all misfire incidents so the cause can be determined and corrective action can be taken to prevent recurrence. Some of the more frequent causes of misfires are:

1. inadequate or improperly made primers;
2. use of nonwater-resistant explosive materials in wet work;
3. improper loading practices;
4. physical damage to leg wires of electric or electronic detonators, shock tube leads, detonating cord, or primers;
5. failure to light fuse or to connect the delay detonators into the blasting circuit;

6. failure or improper initiation system connection;

7. insufficient or excessive electric current;

8. damage to the fuse powder train;

9. improper programming of electronic delay detonators;

10. dead pressing or other damage caused by the detonation of nearby charges;

11. lost or dropped downlines from the collar of the borehole during the loading or stemming process;

12. inadequate or improper inert decking material; and

13. improper delay timing between decked charges or boreholes.

Occasionally, the primer will detonate, but not initiate a portion of the explosive materials in the borehole. These failures should be handled in the same manner as failures of the entire charge. Partial failures are usually caused by:

1. cutoff holes or sections of holes;

2. improper or inadequate priming;

3. deteriorated explosive materials;

4. improper loading or drill cuttings between cartridges or unplanned separation of explosive column;

5. effect of water or moisture on the explosive materials; and

6. dead pressing or other damage caused by the detonation of nearby charges.

Minimizing cutoffs in the borehole may be accomplished by properly priming the explosive materials throughout the borehole, by properly delaying the blast, using multiple or "insurance" primers, and by designing the round with due consideration to burdens and spacing and all visible seams and partings.

B. Waiting Period

If a misfire is known to occur involving the use of cap and fuse, the blast area should be kept clear for at least 30 minutes. If electric or nonelectric (shock tube) detonators, or detonating cord systems are involved in a misfire, the waiting period should be at least 15 minutes. If electronic detonators are involved in a misfire, wait a minimum of 30 minutes before reentering the blast area, unless the manufacturer recommends additional time. Entry to the blast area should be restricted during the waiting period. If electric initiation has been used, the lead-in-line should be disconnected from the blasting machine, the lines shunted and the blasting machine secured. If shock tube initiation has been used, the lead-in-line should be disconnected from the blasting machine and the blasting machine secured.

C. Misfire Resolution Procedures

After the appropriate waiting period, the blaster-in-charge (BIC) and an *absolute minimum* number of authorized, competent, and experienced personnel required to assess the situation may enter the blast area. The BIC should develop a plan for resolving the misfire and communicate that plan to essential personnel before work begins. Figure 3 shows the basic elements of a logic flow diagram for a typical misfire resolution procedure.

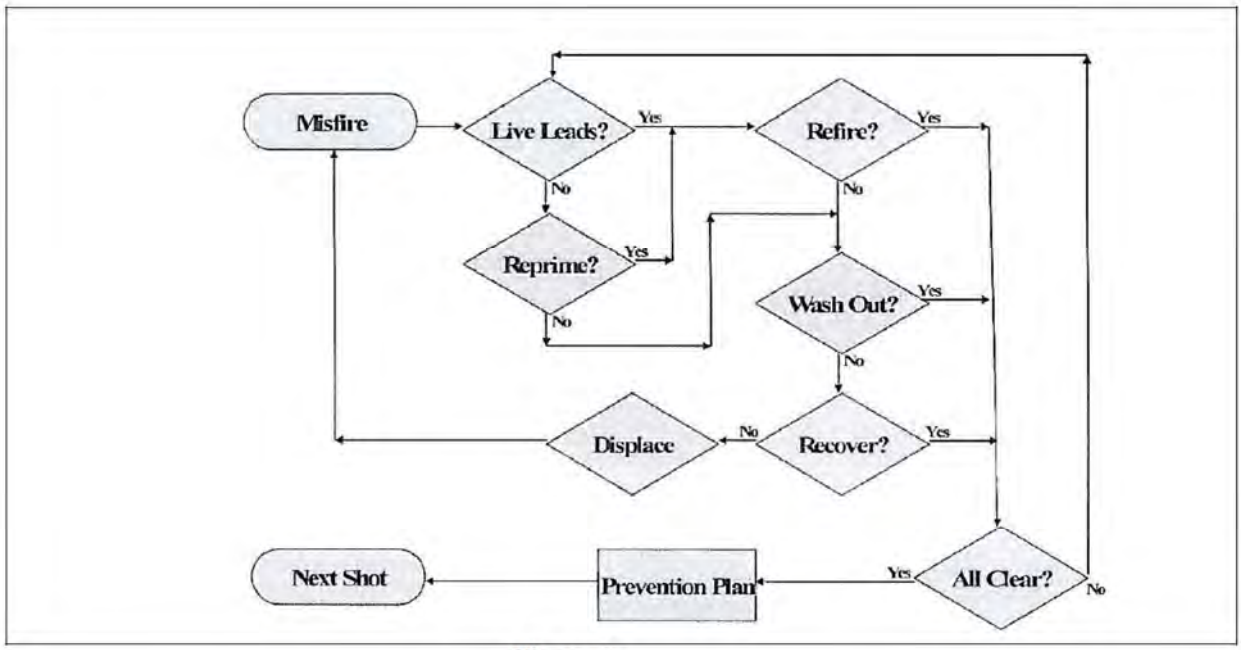

Figure 3
Misfire Resolution Protocol

1. Refiring

   The safest and surest way to dispose of any misfired explosive material is by detonation (providing there is sufficient burden or cover to contain the blast). The BIC should, before taking any action, make an evaluation to determine the amount and location of the unfired explosive material and the condition of the ground surrounding the misfires.

   If the blast was fired electrically, a check should be made of all apparently unfired circuits. Electric detonator circuits should be checked for continuity by use of a blasting galvanometer, blasting ohmmeter, blaster's ohmmeter or blaster's multimeter. Electronic detonator circuits should be checked for continuity with equipment recommended by the manufacturer of the electronic system. Misfires attributable to malfunctions of the electrical circuit may be reconnected and fired if the holes have sufficient burden. When entire holes or groups of holes have failed to fire, the problem may have been failure of the initiation system to deliver energy to that portion of the pattern. In this case, the primers may still be functional and the holes can be refired.

   When detonating cord or nonelectric detonators are involved in misfires, it is virtually impossible to test for circuit continuity. However, the blaster can check any lines coming out of the hole and, if they appear to be intact, reconnect them and try to detonate the misfired holes.

   Due to the varying and unique designs of electronic detonator systems, misfires must be handled according to the specific manufacturer's recommended procedures.

Often only a portion of the blast will fire and crater or otherwise disturb the area around the collar of the blastholes. In this situation, an examination should be made to locate and mark the individual blastholes. If there are detonator leg wires, leads, or detonating cord downlines in the holes they should be checked to determine the feasibility of refiring the holes.

Probably one of the greatest hazards associated with the handling of misfires is the possibility of excessive flyrock when refiring the charge. This is especially true when only a portion of the blast has fired, reducing the burdens and shattering the ground surrounding the misfired holes. A thorough evaluation should be made of the area containing misfired holes before any action is taken to refire the holes. Sometimes it may be necessary to eliminate certain holes to prevent excessive flyrock, or to cover the area with rock screenings, sand, and/or mats to contain the blast. In all instances of refiring misfired charges, the possibility of excessive flyrock is an important consideration and personnel and equipment must be moved beyond the normal blast area or provide proper shelter.

2. Repriming

In blastholes where the leg wires are discontinuous, or leads or detonating cord are cut off in the hole, there may still be explosive materials in the hole, which can be reprimed and fired. If the powder column is visible, it may be possible to place a fresh primer on top of the column. When stemming is still in the blasthole, it can be removed by vacuuming, blowing it out with air, or washing it out with water. Care should be taken to ensure that the introduction of electrically powered equipment into the blast site does not present a hazard. Normally, the use of air to blow out stemming in large diameter holes is impractical due to the large volume of air required. A jet of water introduced into the hole through a rubber or plastic hose will often work in large diameter holes, especially where drill cuttings have been used for stemming. Air or water will work equally well for small diameter holes. When blowing stemming out of blastholes, dirt, stone chips and mud will be ejected from the hole with great velocity and personnel should take proper precautions. When misfires involve electric detonators, special precautions must be implemented to prevent premature detonation from an extraneous electrical charge such as static generated by moving particles. These precautions may prevent certain stemming removal procedures.

When attempting to remove stemming from a misfired blasthole, only plastic or rubber hoses or wooden tamping poles should be used. Exercise care so that explosive materials are not vacuumed. Ferrous metal tools, pipes or rods should not be used. Never allow a drill to set up over a misfired hole to drill or blow out the stemming or the explosive charge.

In holes where the stemming has been removed and the powder column is accessible, a new primer should be placed in the hole and the hole refired. Because the explosive material to be primed may have gotten wet in the process of removing the stemming, the new primer should be of high strength to assure initiation of the misfired explosive material.

The sound of the new primer firing is not a dependable indication that the entire charge of misfired explosive material has detonated. The primer may have caused some of the charge to burn, creating a "hangfire" which could eventually detonate from a build up of heat and pressure. It is recommended that no one return to the blast area for at least one hour following the firing of a reprimed misfired charge.

3. Hangfires
In addition to the specific risk of explosives burning following the repriming of a misfired blasthole, misfires of any kind always create the possibility that some of the misfired explosive material may start to burn. This burning explosive, which is commonly called a "hangfire", could eventually result in an explosion, especially if the burning explosive is confined in the blasthole. Burning explosives generally result from an interruption in the explosive column caused by drill cuttings or loose material in the blasthole creating separations, a shifting or squeezing of the blasthole due to rock movement, or by other factors which slow down or interrupt the steady state velocity of the explosive charge. Whenever a misfire occurs the area should always be checked for signs of explosives burning near or in the blastholes. In the event of a burning charge, personnel should leave the area and entrance to the site should be restricted until all evidence of burning has ceased.

Another possible cause of burning explosive materials is "arcing" of long-period delay electric detonators when using an AC or DC power line. "Arcing" can be eliminated by using capacitor discharge type blasting machines or time limiting switch on the powerline.

4. Washing Out
Where conditions do not permit the refiring of a misfired charge, it is often possible to wash the charge out of the hole. Consideration must be given to the environmental impact and compliance of such an activity.

5. Recovering
When misfired holes cannot be refired, or the explosive materials cannot be readily recovered or washed out of the holes, consideration must be given to recovering the misfired charge from the ground. A written procedure for this type of recovery should exist for the operation. This procedure should consider the following elements:

a. Nonmetallic Tools. When attempting to remove the explosive charge from a misfired blasthole, only plastic, rubber, or wooden tools and tamping poles should be used. Ferrous metal tools, pipes or rods should not be used.
b. Experienced Persons. Designate an experienced person as the ground spotter knowledgeable of the location, loading, and properties of the misfired explosives. The ground spotter or his designated responsible representative should be present and direct all operations during the search and movement of any materials suspected of containing misfired explosives. Any equipment operator involved should be informed of the potential hazards of the operation and shown items for which he should be watchful.
c. Protect Operator. A barricade should be provided to give protection to the operator of equipment used for the recovery. A barricade could be constructed of high velocity impact resistant plastic, such as Lexan® plastic, or other material sufficient to protect the operator from flying materials (such as rock fragments) resulting from the accidental detonation of misfired explosives.
d. Protect Ground Spotter. Either a protective shelter should be available, or the movement of the equipment should occur in a manner so that the ground spotter is barricaded from any potential flying materials such as rock fragments resulting from any accidental detonation of misfired explosives.
e. Communication. The equipment operator and the ground spotter should have a constant method of communication such as a dedicated two-way radio system.
f. Discovery. Any person involved in the procedure should halt the operation immediately whenever any remnants of misfired explosives are observed. When any explosive material is discovered, the ground spotter should control procedures to safely remove the

hazard. This may include continuation of physical recovery, procedures to safely detonate the explosives in place, or other procedures.

g. Digging. Movement of any material that may contain misfired explosives should only be performed in the immediate presence and direction of a ground spotter. Digging should be approached from a direction that reduces the probability of contact with multiple misfired charges.

h. Primer and Downline Protection. When digging approaches the location of a suspected misfired primer or downline, extra care should be taken to ensure that forces capable of initiating the primer or downline are not delivered to the primer or downline. The excavation elevation should be changed (either elevated or lowered) to prevent the probability of impact of the equipment digging edge with the misfired primer assembly.

i. Material Inspection. Material suspected of containing misfired explosives should be spread out in a thin pile for further examination. Whenever any misfired explosives are observed, they should be carefully removed for safe disposal. When this material is sent for further processing such as crushing or milling, the processing personnel should be notified. As the material is being unloaded for processing, the material should be visually checked again from a safe location for the presence of explosives.

j. Material Handling. Transport equipment for the material should be oriented in a manner to protect the operator from any potential flying materials such as rock fragments resulting from accidental detonation of misfired explosives. The operators of equipment used for transport of mucked material should remain inside the equipment.

6. Displacing

As a last resort, drilling and blasting holes adjacent to the misfired hole(s) and displacing the unfired explosive materials may be considered. Extreme care should be exercised since intersection of the misfired charge with the drill may cause detonation. When possible, drilling should be conducted remotely, protecting the drill operator from the forces of such a detonation. Unfired explosives remaining in misfired blastholes may be initiated or ignited by the detonation of adjacent blastholes. For this reason no misfired blastholes should be left near a blast with the intention of firing the misfired holes later.

CAUTION: This method can be extremely hazardous and should be attempted only by experienced, qualified persons.

7. Disposal of Misfired Explosives

Misfires should be disposed of as promptly as possible to eliminate the potential hazard of any misfired holes being accidentally initiated. All recovered explosive material to be disposed of should be taken to a separate storage magazine and managed in accordance with applicable laws and regulations pertaining to waste disposal. In some locations, misfires must be reported to regulatory agencies that will prescribe procedures for proper handling.

THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC SAFETY
Office of the State Fire Marshal

CMR 13: EXPLOSIVES COURSE HANDOUT

Understanding and Regulating Explosives Using the Amended Regulation

(Effective March 1, 1996)

Material Stiffness Ratio

Stiffness ratio provides insight into the potential for unwanted adverse effects

- Bench height (L) =
- Burden (B) =

L / B = Material Stiffness Ratio (L/B)

STIFFNESS RATION TABLE				
Stiffness Ratio	1	2	2	4
Fragmentation	Poor	Fair	Good	Excellent
Air Blast	Severe	Fair	Good	Excellent
	Severe	Fair	Good	Excellent
Ground Vibration	Severe	Fair	Good	Excellent
Comments	Severe backbreak & toe problems. Do not shoot *REDESIGN*	Redesign if possible	Good control and fragmentation	No increased benefit by increasing stiffness ratio above 4

Note:: Round off L/B and compare with Stiffness Ratio Table

SPG_r determined by chart

Rock Type	Specific Gravity	ton/yd ^{3} (Cu Yd)
Basalt	2.8 - 3.0	2.57
Diabase	2.6 - 3.0	2.36
Diorite	2.8 - 3.0	2.50
Dolomite	2.8 - 2.9	2.43
Gneiss	2.6 - 2.9	2.43
Granite	2.6 - 2.9	2.30
Hematite	4.5 - 5.3	4.12
Limestone	2.4 - 2.9	2.23
Marble	2.1 - 2.9	2.09
Micaschist	2.5 - 2.9	2.30
Quartzite	2.0 - 2.8	2.16
Sandstone	2.0 - 2.8	2.03
Shale	2.4 - 2.8	2.16
Slate	2.5 - 2.8	2.23
Trap Rock	2.6 - 3.0	2.36

SPG_c is provided on the Explosive Material Manufacturers Safety Data Sheet

Burden Estimated from Specific Gravity (Density Ratio)

Specific Gravity of explosive (SPG_c) =

Specific Gravity of rock (SPG_r) =

Diameter of Explosive (D_c) =

SPG_c / SPG_r = Density Ratio (DR)

Note: Using the Density Ratio / Burden Estimate Table Find DR in row 1. Find D_c in column 1. Where both vertical column 1 and horizontal row 1 intersect the approximate Burden is read in feet.

Diameter of Explosive	DENSITY RATIO / BURDEN ESTIMATE TABLE Density Ration (DR)						
	0.20	0.30	0.40	0.50	0.60	0.70	0.80

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