Surface Mining Products, Services and Reference Guide

DYNO
Dyno Nobel

Groundbreaking Performance

Contents

Why do companies come to Dyno Nobel for groundbreaking solutions?

Dyno Nobel is a global leader in commercial explosives and blast design. One of our core strengths is our understanding of the processes and challenges that impact on the mining industry. We leverage our decades of industry experience to meet and exceed customer expectations.

We can draw upon our global resources to provide our customers with fully tailored solutions that can make a positive difference to your project.

Our team work with mining companies to solve highly complex problems and they can help you too. Dyno Nobel has the people, the resources and the experience to deliver Groundbreaking Performance®.

Dyno Nobel is a business of Incitec Pivot Limited (IPL), an S&P/ASX Top 50 company listed on the Australian Securities Exchange (ASX). Dyno Nobel Asia Pacific provides a full range of industrial explosives, related products and services to customers in Australia, Indonesia, Papua New Guinea, Turkey, Latin America, the United States and Canada.

Consulting services

DynoConsult®, the specialist consulting division of Dyno Nobel, aims to improve customer performance. Its resources include a team of experienced professionals with local and international experience in open cut mining processes.

DynoConsult is a high-technology group that can plan and implement an onsite review and importantly, recommend process improvements.

Its focus is on outcomes that make a fundamental and positive difference, adding value where it counts the most – your bottom line.

As a DynoConsult client, you benefit from partnering with a group that invests in its people and has the resources and the vision to deliver results.

The DynoConsult team offers specialised technical solutions across mining segments to optimise your mine processes. These include:

Minimising Ore Dilution. By monitoring and modeling the ore body movements during a blast, DynoConsult has developed techniques to significantly minimise dilution.

Limits Blasting and Final Wall Control. DynoConsult has a range of tools and models to measure and predict blast damage. These are used to implement the most effective blasting techniques to minimise blast damage for different rock masses.

Optimising Fragmentation for Mine to Mill™ Application. DynoConsult offers Mine to Mill blasting solutions which quantify the leverage that blast results have on different downstream processes and then recommends improvements to help optimise the overall performance of the mine.

Drill and Blast Auditing and Improvement Projects. DynoConsult has a suite of audit tools to account for the differing nature of drill and blast operations across our industry. An integral part of this work is the auditing of drill and blast practices, to provide a baseline from which to measure improvement and assess progress against KPIs set as part of the project.

Coal Loss and Damage. DynoConsult has the experience and expertise to analyse the mechanisms of coal loss and coal fines generated from overburden blasting.

Tailored training courses

Dyno Nobel backs up its innovative product offering with world class support for our customers.

To reinforce safe practices and upskill technical proficiency, Dyno Nobel offers a full range of training courses including the widely respected Optimal Blasting Techniques for Surface Mining. Surface Mining Courses are specifically customised for coal mining applications and metalliferous mining applications.

Research & Technology

New ideas in design and development and cutting-edge technology are what you should expect from a global leader in explosives and blasting services. The combined experience and expertise of the teams within Dyno Nobel's Research & Technology Centres will ensure we continue to provide technology-based solutions for the mining industry.

Customer Relations

Our Customer Relations team are trained to undertake and oversee order placement and process invoices.

For your convenience, orders can be placed by phone, fax or email.

Telephone Toll Free: **1800 251 872**

Facsimile: **+61 7 3026 3999**

E-mail: **dnap.customer.relations@ap.dynonobel.com**

BULK EXPLOSIVES®

We are well known for our invention of dynamite. We followed this with the introduction of bulk slurry explosive and then packaged and bulk emulsions.

Dyno Nobel manufactures and has access to ammonium nitrate at strategic locations throughout the Asia Pacific region, ensuring we can meet your product needs.

ANFO (Bulk)

Description

ANFO is a nominal 94:6 (%wt) blend of porous ammonium nitrate prill (Detaprill®) and fuel oil. It is a dry, free flowing bulk explosive; formulated to ensure the appropriate oxygen balance providing optimal energy and sensitivity.

Application

ANFO has a wide variety of applications in dry hole blasting conditions. It is one of the most cost efficient blasting agents available for use in small, medium or large diameter applications. When pneumatically loaded, ANFO may also be used effectively in underground development and tunnelling applications.

Features and Benefits

ANFO provides excellent heave energy compared with explosives that contain a high emulsion content. The low bulk density of ANFO provides excellent charge distribution throughout the blasthole.

Priming Requirements

It is recommended that ANFO should be primed with a cast booster for all hole diameters. Depending on the application, ANFO may be primed with a suitable diameter detonator sensitive cartridge explosive (Powermite® Pro). For specific priming requirements, please consult your Dyno Nobel representative. Additional boosters should be used when the column height exceeds 10 metres or where there is risk of column disruption.

Maximum Hole Depth

ANFO can be detonated successfully in depths up to 75m.

Sleep Time

Under normal conditions in dry and stemmed blastholes, ANFO may be slept for periods up to six (6) weeks. The sleep time may be limited to the recommended sleep time of the initiating system. The presence of water will dramatically reduce the sleep time. For applications where unusual or specific conditions exist please consult your local Dyno Nobel representative for advice.

Water Resistance

ANFO has zero water resistance.

Reactive Ground Conditions

ANFO is not designed for use in reactive (pyritic) ground conditions. For applications in reactive ground conditions please consult your Dyno Nobel representative.

Ground Temperature

ANFO is suitable for use in ground with a temperature range of 0°C to a maximum of 55°C. For applications in ground with temperatures outside this range, consult your Dyno Nobel representative.

Shelf Life

ANFO has a maximum shelf life of six (6) months dependent on temperature and humidity conditions. Storage in a high humidity and high temperature environment will accelerate product breakdown and should be avoided. Signs of ANFO degradation are hardening or caking which can lead to difficulty in loading and as a result, may lead to poor blasting performance.

Packaging

ANFO is available in bulk, through specialised delivery systems.

Properties	Poured	Blow Loaded
Density (g/cm^3) [1]	0.82	0.95
Min Diameter (mm)	75	25
Energy (MJ/kg) [2]	3.7	3.7
Typical VoD (m/sec) [3]	2500 – 4500	2000 – 4000
RWS [4]	100	100
RBS [5]	100	116
Recommended Max Sleep Time [6]	6 Weeks	

1 Values are indicative average densities only, determined under laboratory conditions by Dyno Nobel technical personnel at Dyno Nobel. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – PRODET. Other programs may give different values.
3 These results represent a range of Velocities of Detonation (VoDs) collected from numerous Dyno Nobel blast sites through the Asia Pacific region over a period of time. The VoD actually recorded in use is dependant upon many factors, including: the initiation system used, the product density, blasthole diameter and ground confinement.
4 Relative Weight Strength (RWS) and Relative Bulk Strength (RBS) are determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
5 RBS is dependant on the final density of the product at the time of loading.
6 The Recommended Maximum Sleep Time (RMST) in ideal conditions (dry, stemmed, non reactive ground), is up to 6 weeks. The presence of water will dramatically reduce the sleep time. For more information or for applications where unusual or specific conditions exist, please contact your Dyno Nobel representative.

Detaprill®

Properties	
Bulk Density Loose Poured (g/cm^3)	0.72 – 0.78
Ammonium Nitrate (%wt)	99.0
Fuel Oil Retention (%wt)	>6.00
Moisture Content (%wt)	<0.20
Prill pH (10% solution)	5.0 ± 0.5
Mean Prill Diameter (mm)	1.80 – 2.20
Prills smaller than 1 mm (%)	1 ± 1

Description

Detaprill is a porous prilled form of ammonium nitrate. The prills are uniform in size and readily absorb fuel oil, ensuring effective mixing with other blasting agent ingredients. An anticaking agent is used to coat each prill to maintain free flowing characteristics and avoid agglomeration.

Application

Detaprill ammonium nitrate prills are mixed with liquid hydrocarbons (usually fuel oil) to form a blasting agent called ANFO. To obtain optimal detonation performance with ANFO, it is necessary that the fuel oil be uniformly mixed with the prills.

Features and Benefits

Detaprill ammonium nitrate prill is not a Class 1 Dangerous Good (explosive), reducing storage, handling and transportation risks. The free flowing characteristics of Detaprill ammonium nitrate prill allow for optimal bulk handling of this product.

Priming Requirements

Priming requirements are application, diameter and rock type dependent. Please consult your local Dyno Nobel representative for priming requirements best suited to your application.

Water Resistance

Detaprill nitrate prills have zero water resistance.

Reactive Ground Conditions

Detaprill nitrate prills are not designed for use in reactive (pyritic) ground conditions. For applications in reactive ground conditions please consult your local Dyno Nobel representative.

Ground Temperature

Detaprill nitrate prills are suitable for use in ground with a temperature range of 0°C to a maximum of 55°C. For applications in ground with temperatures outside this range, consult your Dyno Nobel representative.

Packaging

Detaprill nitrate prills are available in bulk, through specialised delivery systems.

BlastLite®

Description

BlastLite bulk explosive is a dry, free flowing product comprised of porous ammonium nitrate prill (Detaprill®) and brown fibrous bulking agent. It is delivered as an augered product from a specifically designed bulk delivery truck.

Application

BlastLite bulk explosive is used as an ANFO replacement in soft to medium strength rock masses. BlastLite bulk explosive can only be used in dry or dewatered blastholes in non-reactive ground.

Features and Benefits

BlastLite bulk explosive has both a lower density and lower bulk strength than ANFO. The lower density allows reduced powder factors to be employed and the lower bulk strength allows improved explosive distribution to be achieved. BlastLite bulk explosive is useful where heave energy is preferable to shock energy. BlastLite bulk explosive has a lower Velocity of Detonation (VoD) than ANFO in similar blasthole diameters.

Priming Requirements

BlastLite bulk explosive is booster sensitive and a minimum HDP 400 (400g) primer is recommended. Smaller booster types may reduce the performance of the explosive. Additional boosters should be used when the column height exceeds 10 to 15 metres or where there is risk of column disruption. For specific priming requirements please contact your Dyno Nobel representative.

Sleep Time

Under normal conditions in dry, stemmed blastholes, BlastLite bulk explosive may be slept for a period up to two (2) weeks. The sleep time may be limited to the recommended sleep time of the initiating system. For applications where unusual or specific conditions exist please contact your Dyno Nobel representative.

Water Resistance

BlastLite bulk explosive has zero water resistance.

Reactive Ground Conditions

BlastLite bulk explosive is not designed for use in reactive (pyritic) ground conditions. For applications in reactive ground conditions please consult your Dyno Nobel representative.

Ground Temperature

BlastLite bulk explosive is suitable for use in ground with a temperature range of 0°C to a maximum of 55°C. For applications in ground with temperatures outside this range, consult your Dyno Nobel representative.

Packaging

BlastLite bulk explosive is available in bulk, through specialised delivery systems.

Properties	
Density (g/cm^3) [1]	0.53 – 0.59
Recommended Minimum Diameter (mm)	165
Energy (MJ/kg) [2]	3.2
Water Resistance [3]	Nil
Recommended Maximum Sleep Time [4]	2 weeks
RWS [5]	87
RBS [5]	59

Hole Diameter (mm)	Density (g/cm^3)	Booster	VoD (m/sec)
200	0.56	HDP 400	2100 [6]
203	0.56	HDP 400	2700 – 3200 [7]
211	0.56	HDP 400	2800 – 3400 [7]

1 In hole density is dependent on hole depth and loading rate.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.
3 Water resistance is determined using laboratory testing methods.
4 Under normal conditions in dry, stemmed, non-reactive (pyritic) blastholes, BlastLite bulk explosive may be slept for a period of up to two (2) weeks. The sleep time may be limited to the recommended sleep time of the initiating system. For applications where unusual or specific conditions exist please consult your local Dyno Nobel representative.
5 Relative Weight Strength (RWS) and Relative Bulk Strength (RBS) determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO and a density of 0.56g/cm^3 for BlastLite bulk explosive.
6 VoD recorded using a continuous VoD method, in unconfined conditions. VoD for non-ideal explosives is a function of borehole diameter, product density and confinement conditions. These figures are indicative only and represent the unconfined conditions used in the test. Typically the product will shoot at higher VoDs as the borehole diameter and confinement increase.
7 VoD recorded using a continuous VoD method, on a customer site. The VoD recorded is indicative of the conditions at that site, and will vary due to variations in confinement from site to site.

TITAN® BlastLite®

Description

TITAN BlastLite blends are comprised of blends of ANFO manufactured using porous ammonium nitrate prill (Detaprill®), TITAN emulsion and brown fibrous bulking agent. The low density products are for use in dry or dewatered holes, and are delivered as augered products from a specifically designed bulk delivery truck.

Application

TITAN BlastLite blends are used as a Heavy ANFO replacement in soft to medium strength rock masses. TITAN BlastLite blends may be used only in dry or dewatered blastholes in non-reactive ground.

Features and Benefits

TITAN BlastLite blends are useful where heave energy is preferable to shock energy. The lower emulsion component in TITAN BlastLite 30 provides a lower relative bulk strength than ANFO, optimising blasting in soft rock. TITAN BlastLite blends have a lower Velocity of Detonation (VoD) than ANFO in similar blasthole diameters.

Priming Requirements

TITAN BlastLite blends are booster sensitive and a minimum 400g cast booster is recommended. Smaller booster types may reduce the performance of the explosive. Additional boosters should be used when the column height exceeds 10 metres, or where there is risk of column disruption. For specific priming requirements please contact your Dyno Nobel representative.

Sleep Time

Under normal conditions in dry, stemmed blastholes, TITAN BlastLite blends may be slept for a period of up to two (2) weeks. The sleep time may be limited to the recommended sleep time of the initiating system. For applications where unusual or specific conditions exist please consult your local Dyno Nobel representative.

Water Resistance

TITAN BlastLite blends have zero water resistance.

Reactive Ground Conditions

TITAN BlastLite blends are not designed for use in reactive (pyritic) ground conditions. For applications in reactive ground conditions please consult your local Dyno Nobel representative.

Ground Temperature

TITAN BlastLite blends are suitable for use in ground with a temperature of 0°C to a maximum of 55°C.

Confined Conditions

TITAN BlastLite is a high heave, low VoD product suitable for softer material including porous strata. Where a shot is fired under confined conditions, slow venting of post detonation gases may occur.

Packaging

TITAN BlastLite is available in bulk, through specialised delivery systems.

Properties	Titan BlastLite 30	Titan BlastLite 55
Density (g/cm^3) [1]	0.85	1.15
Rec. Min. Diameter (mm)	152	152
Energy (MJ/kg) [2]	3.06	2.80
Water Resistance [3]	Nil	Nil
Rec. Sleep Time [4]	2 weeks	2 weeks
RWS [5]	83.0	76.0
RBS [5]	86.0	106.6
Typical VoD (m/sec) [6]	3500 – 3650	3500 – 4000

1 In hole density is dependent on hole depth and loading rate.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.
3 Water Resistance determined using laboratory testing methods.
4 Under normal conditions in dry, stemmed, non-reactive (pyritic) blastholes, TITAN BlastLite may be slept for a period of up to two (2) weeks. The sleep time may be limited to the recommended sleep time of the initiating system. For applications where unusual or specific conditions exist please consult your local Dyno Nobel representative.
5 Relative Weight Strength (RWS) and Relative Bulk Strength (RBS) are determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO and a density of 0.56g/cm^3 for TITAN BlastLite.
6 VoD recorded using a continuous VoD method, on a customer site. The VoD recorded is indicative of the conditions at that site, and will vary due to variations in confinement from site to site.

TITAN® 2000 Matrix Blend Series

Description

TITAN® 2000 matrix has been specially formulated for use in medium to large diameter open cut mining applications. TITAN 2000 matrix may be blended with ANFO to make heavy ANFO or gas sensitised blends.

TITAN 2000 Heavy ANFO (HANFO) Blends contain TITAN 2000 emulsion and ANFO manufactured from porous ammonium nitrate prill (Detaprill®). The blends are not waterproof and provide only low to average water resistance and are suitable for use in dry and dewatered blastholes.

TITAN 2000 Gassed Blends are emulsion rich, water resistant mixtures of TITAN 2000 emulsion and ANFO manufactured from porous ammonium nitrate prill. Gassed blends are pumped from a Mobile Processing Unit (MPU) through a loading hose to the bottom of wet blastholes. Augering of selected gassed blends into dewatered blastholes may be available. Contact your Dyno Nobel representative for more information.

Features and Benefits

The addition of ANFO to TITAN 2000 matrix provides the ability to vary the bulk strength and gas volume generated during detonation, which means you can match performance to desired blast requirements.

As the emulsion content of the blend increases, the water resistance of the product increases significantly.

Priming Requirements

TITAN 2000 matrix blends are booster sensitive and should be primed with a minimum 400g cast booster. Additional 400g boosters must be used when the column height exceeds 10 metres or where there is risk of column disruption. Contact your Dyno Nobel representative if you intend using detonating cord down lines.

Maximum Hole Depth

TITAN 2000 HANFO blends may be detonated at depths of up to 70m. TITAN 2050 may be used unsensitised at depths of up to 13m. TITAN 2050G sensitisation to 1.10g/cm^3 may be used at depths up to 60m. TITAN 2060G and higher emulsion content blends maximum hole depths are determined by the level of sensitisation. Refer to the TITAN Matrix Blend Gassing Tables for more details.

Sleep Time

TITAN 2000 matrix blends have a maximum sleep time of 14 days under ideal conditions. Further recommendations for sleep time and product selection in non ideal conditions are outlined in the Product Selection Guide.

Sensitisation

TITAN 2000 matrix blends containing 60% or more emulsion must be sensitised as the product is delivered to the blasthole. Incorrectly sensitised gassed blends may lead to poor explosive performance and the formation of excessive post blast fume (NOx).

TITAN 2050 and 2050G blends: The majority of sensitisation in the blend is provided by the porosity of the ammonium nitrate prill. Although sensitisation is not necessary for depths up to 13m, gassing to an open cup density of 1.20g/cm^3 is recommended to increase the Velocity of Detonation (VoD). For depths from 13m to 60m the recommended open cup density is 1.10g/cm^3. Over-sensitisation may lead to product collapse and

Properties					
TITAN Blend	**2030**	**2040**	**2050**	**2050G**	**2070G**
Emulsion %	30	40	50	50	70
Density (avg g/cm^3) [1]	1.10	1.25	1.31	1.15	1.15
Min Diameter (mm)	102	127	203	102	102
Energy (MJ/kg) [2]	3.3	3.2	3.1	3.1	2.8
Relative Weight Strength (RWS) [3]	90	87	84	84	77
Relative Bulk Strength (RBS) [3]	121	132	128	118	108
Typical Velocity of Detonation (VoD) (m/sec) [4]	2500 – 5000		2800 – 5800		3500 – 5800
CO_2 Emissions (tCO_2e/t) [5]	0.167	0.162	0.156	0.156	0.145

1 In hole density is dependant on hole depth.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.
3 RWS and RBS determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
4 VoD recorded using a continuous VoD method, in unconfined conditions. VoD for non-ideal explosives is a function of blasthole diameter, product density and confinement conditions. These figures are indicative only and represent the unconfined conditions used in the test. Typically the product will shoot at higher VoDs as the blasthole diameter and confinement increase.
5 CO_2 emissions calculated as tonnes of CO_2 equivalent per tonne of explosive. As per National Greenhouse Accounts; July 2012; Department of Climate Change and Energy Efficiency

formation of NOx. For depths exceeding 60m contact your Dyno Nobel representative.

Reactive Ground Conditions

TITAN 2000 matrix blends are not suitable for use in conditions where reactive sulphides are present without appropriate compatibility testing. Contact your Dyno Nobel representative for more information.

Loading

TITAN 2000 HANFO blends must not be loaded into blastholes where static water is present. Augering Heavy ANFO blends into water will cause damage to the explosive product, which may lead to the formation of NOx after detonation.

Product Selection Guide

Under ideal conditions TITAN 2000 matrix blends may be slept for a maximum of 14 days. In non ideal conditions, sleep times should be reduced. The sleep times in the table below are recommendations to assist with minimisation of post blast fume. The Recommended Maximum Sleep Time (RMST) is a guide for when the product is used in best case conditions, however, it is likely to be less in practice. Where site specific factors exist that make post blast fume a manageable risk, sleep times may be increased up to a maximum of 14 days, following a site specific risk assessment and the application of appropriate controls. Risk assessment should be conducted on a blast by blast basis.

Emulsion Content % w/w			10	20	30	40	50	60	70	80	90	100
Blasthole Condition	Dry [1]	Use	YES									
		RMST	14	14	14	14	14	14	14	14	14	14
	Dewatered [2]	Use	NO			YES						
		RMST	–	–	–	5	8	12	12	12	12	12
	Wet [3]	Use	NO					YES				
		RMST	–	–	–	–	–	8	12	12	12	12
	Dynamic [4]	Use	NO						YES			
		RMST	–	–	–	–	–	–	5	8	8	8
Sensitisation Required			NO				Note [5]	YES [6]				
Delivery Method [7]			A	A	A	A	A/P	A/P	A/P	A/P	A/P	A/P

1 A Dry hole is defined as a blasthole containing no water including no wet walls.
2 A dewatered hole is defined as not recharging with water.
3 A wet hole is defined as a blasthole containing static water or has a recharge rate of <1m in 30 minutes.
4 Dynamic water is defined as a recharge rate of >1m in 30 minutes. If the level of dynamic water is such that product damage is suspected or observed, the suggested RMST should be reduced.
5 This product has reduced sensitivity and is recommended for hole depths less than 13m. Sensitisation is required for use in holes deeper than 13m. Please consult your Dyno Nobel representative to check which delivery options are available at your location.
6 The TITAN Matrix Blend Gassing Table should be used to determine the appropriate open cup density for the hole depth.
7 A = Auger, P = Pump.

TITAN® 3000 Matrix Blend Series

Description

TITAN® 3000 matrix is specialised explosive precursor providing superior energy and sensitivity for small to medium diameter open cut hard rock mining applications.

TITAN 3000 Heavy ANFO (HANFO) Blends contain TITAN 3000 emulsion and ANFO manufactured from porous ammonium nitrate prill (Detaprill®). The blends are not waterproof and provide only low to average water resistance, that are suitable for use in dry and dewatered blastholes.

TITAN 3000 Gassed Blends are emulsion rich, water resistant mixtures of TITAN 3000 emulsion and ANFO manufactured from porous ammonium nitrate prill. Gassed blends are pumped from a Mobile Processing Unit (MPU) through a loading hose to the bottom of wet blastholes. Augering of selected gassed blends into dewatered blastholes may be available. Contact your Dyno Nobel representative for more information.

Features and Benefits

TITAN 3000 matrix may be used blended with ANFO as heavy ANFO, gas sensitised blends or as a gas sensitised without ANFO as a straight emulsion matrix.

The addition of ANFO provides the ability to vary the bulk strength and gas volume generated during detonation, which means you can match performance to desired blast requirements.

As the emulsion content of the blend increases, the water resistance of the product increases significantly.

Priming Requirements

TITAN 3000 matrix blends are booster sensitive and require a minimum 400g cast booster when used in blastholes with diameters of 102mm or greater. For diameters less than 102mm, 150g cast boosters are recommended. Additional boosters are recommended when the column height exceeds 10 meters or where there is risk of column disruption. Please consult your Dyno Nobel representative if you intend using detonating cord down lines.

Maximum Hole Depth

TITAN 3000 Heavy ANFO blends may be detonated at depths of up to 70m. TITAN 3050 may be used unsensitised at depths of up to 11m. TITAN 3050G sensitisation to 1.10g/cm^3 may be used at depths up to 60m. TITAN 3060G and higher emulsion content blends maximum hole depths are determined by the level of sensitisation. Refer to the TITAN Matrix Blend Gassing Tables for more details.

Sleep Time

TITAN 3000 matrix blends have a maximum sleep time of 14 days under ideal conditions. Further recommendations for sleep time and product selection in non ideal conditions are outlined in the Product Selection Guide.

Sensitisation

TITAN 3000 matrix blends containing 60% or more emulsion must be sensitised as the product is delivered to the blasthole. Incorrectly sensitised gassed blends may lead to poor explosive performance and the formation of excessive post blast fume (NOx).

TITAN 3050 and 3050G blends: The majority of sensitisation in the blend is provided by the porosity of the ammonium nitrate prill. Although sensitisation is not necessary for depths up to 11m, gassing to an open cup density of 1.20g/cm^3 is recommended to increase the Velocity of Detonation (VoD). For depths from 11m to 60m the recommended open cup density is 1.10g/cm^3. Over-

Properties						
TITAN Blend	3030	3040	3050	3050G	3070G	3000G
Emulsion %	30	40	50	50	70	100
Density (avg g/cm^3) [1]	1.05	1.25	1.32	1.10	1.15	1.15
Min Diameter (mm)	102	127	152	76	76	76
Energy (MJ/kg) [2]	3.4	3.3	3.2	3.2	3.0	2.7
Relative Weight Strength (RWS) [3]	92	89	86	86	81	73
Relative Bulk Strength (RBS) [3]	118	136	139	116	114	102
Typical VoD (m/sec) [4]	2500 – 5600		2800 – 5800		3500 – 5800	
CO_2 Emissions (tCO_2e/t) [5]	0.17	0.17	0.16	0.16	0.15	0.14

1 In hole density is dependant on hole depth.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.
3 RWS and RBS determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
4 VoD recorded using a continuous VoD method, in unconfined conditions. VoD for non-ideal explosives is a function of blasthole diameter, product density and confinement conditions. These figures are indicative only and represent the unconfined conditions used in the test. Typically the product will shoot at higher VoDs as the blasthole diameter and confinement increase.
5 CO_2 emissions calculated as tonnes of CO_2 equivalent per tonne of explosive. As per National Greenhouse Accounts; July 2012; Department of Climate Change and Energy Efficiency.

sensitisation may lead to product collapse and formation of NOx. For depths exceeding 60m contact your Dyno Nobel representative.

Reactive Ground Conditions

TITAN 3000 matrix blends are not suitable for use in conditions where reactive sulphides are present without appropriate compatibility testing. Contact your Dyno Nobel representative for more information.

Loading

TITAN 3000 Heavy ANFO blends must not be loaded into blastholes where static water is present. Augering Heavy ANFO blends into water will cause damage to the explosive product, which may lead to the formation of NOx after detonation.

TITAN 3000 gassed blends may be delivered via auger into dry and dewatered blastholes or pumped through a loading hose to the bottom of wet blastholes.

Product Selection Guide

Under ideal conditions TITAN 3000 matrix blends may be slept for a maximum of 14 days. In non ideal conditions, sleep times should be reduced. The sleep times in the table below are recommendations which may assist in reducing the risk of post blast fume. The Recommended Maximum Sleep Time (RMST) is a guide for when the product is used in best case conditions, however, it is likely to be less in practice. Where site specific factors exist that make post blast fume a manageable risk; sleep times may be increased by up to a maximum of 14 days following a site specific risk assessment, and the application of appropriate controls. Risk assessments should be conducted on a blast by blast basis.

Emulsion Content % w/w			10	20	30	40	50	60	70	80	90	100
Blasthole Condition	Dry [1]	Use	YES									
		RMST	14	14	14	14	14	14	14	14	14	14
	Dewatered [2]	Use	NO			YES						
		RMST	–	–	–	5	8	12	12	12	12	12
	Wet [3]	Use	NO					YES				
		RMST	–	–	–	–	–	8	12	12	12	12
	Dynamic [4]	Use	NO						YES			
		RMST	–	–	–	–	–	–	5	8	8	8
Sensitisation Required			NO				Note [5]	YES [6]				
Delivery Method [7]			A	A	A	A	A/P	A/P	A/P	A/P	A/P	A/P

1 A Dry hole is defined as a blasthole containing no water including no wet walls.
2 A dewatered hole is defined as not recharging with water.
3 A wet hole is defined as a blasthole containing static water or has a recharge rate of <1m in 30 minutes.
4 Dynamic water is defined as a recharge rate of >1m in 30 minutes. If the level of dynamic water is such that product damage is suspected or observed, the suggested RMST should be reduced.
5 This product has reduced sensitivity and is recommended for hole depths up to 11m. Sensitisation is required for use in holes deeper than 13m. Please consult your Dyno Nobel representative to check which delivery options are available at your location.
6 The TITAN Matrix Blend Gassing Tables should be used to determine the appropriate open cup density for the hole depth.
7 A = Auger delivery into dry and/or dewatered blastholes, P = Pump through loading hose to the bottom of wet blastholes.

TITAN® 5000 Matrix Blend Series

Description

The TITAN® 5000 emulsion series has been specifically formulated with an inhibitor for use in reactive (pyritic) ground conditions and should be used in accordance with procedures that are developed on a site basis and in consultation with Dyno Nobel and regulatory authorities.

TITAN 5000 Heavy ANFO (HANFO) Blends contain TITAN 5000 emulsion and ANFO manufactured from porous ammonium nitrate prill (Detaprill®) and are designed for use in dry or dewatered blastholes of medium to large diameter in reactive ground. Use of blends with less than 40% (w/w) emulsion component are not recommended for use in reactive ground conditions.

TITAN 5000 Gassed Blends are emulsion rich, water resistant mixtures of TITAN 5000 emulsion and ANFO manufactured from porous ammonium nitrate prill and are for use in dry, dewatered or wet blastholes of medium to large diameter in reactive ground.

Features and Benefits

Titan 5000 Matrix blends are suitable for use in reactive ground conditions and conditions where elevated ground temperatures are encountered.

When used in accordance with the AEISG Code of Practice: Elevated Temperature and Reactive Ground and site procedures, TITAN 5000 may be used to minimise risks associated with blasting in elevated ground temperatures and reactive ground conditions.

As the emulsion content of the blend increases, the water resistance of the product also increases.

Priming Requirements

TITAN 5000 matrix blends are booster sensitive and should be primed with a minimum 400g cast booster. Additional 400g boosters must be used when the column height exceeds 10 metres or where there is risk of column disruption. Contact your Dyno Nobel representative if you intend using detonating cord down lines.

Maximum Hole Depth

TITAN 5000 Heavy ANFO blends may be detonated at depths of up to 70m. TITAN 5050 may be used unsensitised at depths of up to 11m. TITAN 5050G sensitised to 1.10g/cm^3 may be used at depths up to 60m. TITAN 5060G and higher emulsion content blends maximum hole depths are determined by the level of sensitisation. Refer to the TITAN Matrix Blend Gassing Tables for more details. For depths exceeding 60m contact your Dyno Nobel representative.

Sleep Time

Refer to *Reactive Ground Conditions* and *Non Reactive Ground Conditions* (next page).

Sensitisation

TITAN 5000 matrix blends containing 60% or more emulsion must be sensitised as the product is delivered to the blasthole. Incorrectly sensitised gassed blends may lead to poor explosive performance and the formation of excessive post blast fume (NOx).

Properties						
TITAN Blend	5030	5040	5050	5050G	5070G	5000G
Emulsion %	30	40	50	50	70	100
Density (avg g/cm^3) [1]	1.05	1.21	1.31	1.15	1.15	1.15
Min Diameter (mm)	102	127	203	102	102	102
Energy (MJ/kg) [2]	3.3	3.2	3.1	3.1	2.8	2.5
Relative Weight Strength (RWS) [3]	92	86	84	84	78	68
Relative Bulk Strength (RBS) [3]	120	129	134	123	109	95
Typical VoD (m/sec) [4]	2500 – 5600		2800 – 5800		3500 – 5800	
CO_2 Emissions (tCO_2e/t) [5]	0.17	0.17	0.17	0.17	0.16	0.16

1 In hole density is dependent on hole depth.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.
3 RWS and RBS determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
4 VoD recorded using a continuous VoD method, in unconfined conditions. VoD for non-ideal explosives is a function of blasthole diameter, product density and confinement conditions. These figures are indicative only and represent the unconfined conditions used in the test. Typically the product will shoot at higher VoDs as the blasthole diameter and confinement increase.
5 CO_2 emissions calculated as tonnes of CO_2 equivalent per tonne of explosive. As per National Greenhouse Accounts; July 2012; Department of Climate Change and Energy Efficiency.

TITAN 5050 and 5050G blends: The majority of sensitisation in the blend is provided by the porosity of the ammonium nitrate prill. Although sensitisation is not necessary for depths up to 11m, gassing to an open cup density of 1.20g/cm^3 is recommended to increase the Velocity of Detonation (VoD). For depths from 11m to 60m the recommended open cup density is 1.10g/cm^3. Over-sensitisation may lead to product collapse and formation of NOx. For depths exceeding 60m contact your Dyno Nobel representative.

Reactive Ground Conditions

In reactive (pyritic) ground conditions and/or in ground with temperatures greater than 55°C please consult your local Dyno Nobel representative to undertake the appropriate test work to determine the maximum sleep time available at the maximum ground temperature. In reactive ground, the maximum sleep time will be established by conducting reactive ground testing at specific blasthole temperatures observed on site. The maximum available sleep time will be the lesser time determined by reactive ground testing and the recommended times for the observed blasthole conditions (see table below).

Non Reactive Ground Conditions

Under ideal conditions in non reactive ground with temperatures less than 55°C, TITAN 5000 matrix blends may be slept for a maximum of 14 days. In non ideal conditions, sleep times should be reduced. The sleep times in the table below are recommended as a maximum sleep time which may assist in reducing the risk of post blast fume. The Recommended Maximum Sleep Time (RMST) is a guide for when the product is used in best case conditions, however, it is likely to be less in practice. Where site specific factors exist that make post blast fume a manageable risk; sleep times may be increased up to a maximum of 14 days following a site specific risk assessment and the application of appropriate controls. Risk assessments should be conducted on a blast by blast basis.

Ground Temperature

Refer to *Reactive Ground Conditions* and *Non Reactive Ground Conditions* (this page).

Loading

TITAN 5000 Heavy ANFO blends may be delivered into dry and dewatered blastholes via auger. Heavy ANFO blends must not be loaded into blastholes where static water is present. Augering Heavy ANFO blends into water will cause damage to the explosive product, which may lead to the formation of NOx after detonation.

TITAN 5000 gassed blends may be delivered via auger into dry and dewatered blastholes or pumped through a loading hose to the bottom of wet blastholes.

Emulsion Content % w/w			10	20	30	40	50	60	70	80	90	100
Blasthole Condition	Dry [1]	Use	YES									
		RMST	14	14	14	14	14	14	14	14	14	14
	Dewatered [2]	Use	NO			YES						
		RMST	–	–	–	5	8	12	12	12	12	12
	Wet [3]	Use	NO					YES				
		RMST	–	–	–	–	–	8	12	12	12	12
	Dynamic [4]	Use	NO						YES			
		RMST	–	–	–	–	–	–	5	8	8	8
Sensitisation Required			NO				Note [5]	YES [6]				
Delivery Method [7]			A	A	A	A	A/P	A/P	A/P	A/P	A/P	A/P

1 A Dry hole is defined as a blasthole containing no water including no wet walls.
2 A dewatered hole is defined as not recharging with water.
3 A wet hole is defined as a blasthole containing static water or has a recharge rate of <1m in 30 minutes.
4 Dynamic water is defined as a recharge rate of >1m in 30 minutes. If the level of dynamic water is such that product damage is suspected or observed, the suggested RMST should be reduced.
5 This product has reduced sensitivity but may be use in hole depths up to 11m without chemical sensitisation. In holes deeper than 11m sensitisation is required for optimum performance. Please consult your Dyno Nobel representative to check which delivery options are available at your location.
6 The TITAN Matrix Blend Gassing Tables should be used to determine the appropriate open cup density for the hole depth.
7 A = Auger delivery into dry and/or dewatered blastholes, P = Pump through loading hose to the bottom of wet blastholes.

TITAN® 9000 Matrix Blend Series

Description

TITAN® 9000 matrix is a high performance emulsion specially formulated for use in areas where fume generation is predicted and fume minimisation is essential.

TITAN 9000 Heavy ANFO (HANFO) Blends containing up to 50% w/w TITAN 9000 emulsion are delivered via auger from a Mobile Processing Unit (MPU). HANFO blends are suitable for use in dry blastholes. Use of HANFO blends containing less than 40% emulsion in dewatered blastholes is not recommended.

TITAN 9000 Gassed Blends contain 50% w/w or more TITAN 9000 emulsion and are chemically sensitised while loaded into the blasthole. Emulsion rich blends are generally pumped from an MPU through a loading hose to the bottom of wet blastholes or gassed augered into dry or dewatered blastholes.

Featured Benefits

TITAN 9000 matrix is specially formulated to optimise detonation when blasting in challenging conditions.

As the emulsion content of the blend increases, the water resistance of the product increases significantly.

Priming Requirements

TITAN 9000 matrix blends are booster sensitive and require a minimum 400g cast booster when used in blastholes with diameters of 102mm or greater. For diameters less than 102mm, 150g cast boosters are recommended. Additional boosters are recommended when the column height exceeds 10 metres or where there is risk of column disruption. Please consult your Dyno Nobel representative if you intend using detonating cord down lines.

Hole Depth

TITAN 9000 HANFO blends may be detonated at depths of up to 70m. TITAN 9050 may be used unsensitised at depths up to 11m; TITAN 9050G should be sensitised to an open cup density of 1.10 g/cm^3 for depths up to 60m. Hole depth for TITAN 9000 gassed blends with 60% emulsion content or more are determined by the level of sensitisation. Refer to TITAN Matrix Blend Gassing Table for more details. For hole depths exceeding 60m please contact your Dyno Nobel representative.

Sensitisation

TITAN 9000 blends containing more than 50% w/w emulsion must be sensitised as the product is delivered to the blasthole. TITAN 9050 blends must be sensitised when used at depths greater than 11m. Incorrectly sensitised gassed blends may lead to the formation of excessive post blast fume (NOx).

TITAN 9050 Blends: The majority of sensitisation in the blend is provided by the porosity of the ammonium nitrate prill, so the required level of added chemical sensitisation is relatively low. Although sensitisation is not necessary

Properties						
TITAN Blend	9030	9040	9050	9050G	9070G	9000G
Emulsion %	30	40	50	50	70	100
Density (avg g/cm^3) [1]	1.10	1.25	1.32	1.10	1.15	1.15
Min Diameter (mm)	102	127	200	102	76	76
Energy (MJ/kg) [2]	3.4	3.3	3.2	3.2	3.0	2.7
Gas Volume (Litres/kg) [2]	974	978	982	982	989	1001
Relative Weight Strength (RWS) [3]	92	89	86	86	81	73
Relative Bulk Strength (RBS) [3]	123	136	139	116	114	102
Typical VoD (m/sec) [4]	4000 – 5600					
CO_2 Emissions (tCO_2e/t) [5]	0.17	0.17	0.16	0.16	0.15	0.14

1 For gassed products this is the nominal open cup density. Use of the Dyno Nobel gassing table is required to determine the appropriate open cup density needed to achieve a toe density below the critical density for the hole depth.

2 All Dyno Nobel energy and gas values are calculated using a proprietary Dyno Nobel thermodynamic code – PRODET. Other programs may give different values.

3 The values stated are typical of those recorded for the product in various hole diameters, densities and ground types, and may not be achievable under all circumstances. The Velocity of Detonation (VoD) actually recorded in use is dependent upon many factors, including: the initiation system used, the product density, blasthole diameter and ground confinement.

4 For calculation of RWS and RBS; ANFO – density 0.82g/cm^3 and an energy of 3.7MJ/kg was used.

5 CO_2 Emissions calculated as tonne of CO_2 equivalents per tonne of explosive. As per National Greenhouse Accounts; July 2012; Department of Climate Change and Energy Efficiency

for depths up to 11m, an open cup density of 1.20g/cm^3 is recommended to optimise detonation characteristics. For depths from 11m to 60m the recommended open cup density is 1.10g/cm^3.

Over-sensitisation may lead to product collapse and formation of NOx.

Sleep Time

TITAN 9000 matrix blends have a maximum sleep time of 14 days in dry hole conditions. Further recommendation for sleep time and product selection in non ideal conditions are outlined in the Product Selection Guide.

Reactive Ground Conditions

TITAN 9000 matrix blends are not suitable for use in conditions where reactive sulphides are present.

Product Selection Guide Table

Under ideal conditions TITAN 9000 matrix blends may be slept for a maximum of 14 days. In non ideal conditions, sleep times should be reduced. The sleep times in the table below are recommendations to assist with minimisation of post blast fume. The Recommended Maximum Sleep Time (RMST) is a guide for when the product is used in best case conditions however it is likely to be less in practice. Where site specific factors exist that make post blast fume a manageable risk; sleep times may be increased up to a maximum of 14 days following a site specific risk assessment and the application of appropriate controls. Risk assessment should be conducted on a blast by blast basis.

Emulsion Content % w/w			10	20	30	40	50	60	70	80	90	100
Blasthole Condition	Dry [1]	Use	YES									
		RMST	14	14	14	14	14	14	14	14	14	14
	Dewatered [2]	Use	NO			YES						
		RMST	–	–	–	5	8	12	12	12	12	12
	Wet [3]	Use	NO					YES				
		RMST	–	–	–	–	–	8	12	12	12	12
	Dynamic [4]	Use	NO						YES			
		RMST	–	–	–	–	–	–	5	8	8	8
Sensitisation Required			NO				Note [5]	YES [6]				
Delivery Method [7]			A	A	A	A	A/P	A/P	A/P	A/P	A/P	A/P

1 A Dry hole is defined as a blasthole containing no water including no wet walls.
2 A dewatered hole is defined as having wet toe and walls, and is not recharging with water.
3 A wet hole is defined as a blasthole containing static water.
4 Dynamic water is defined as a recharge rate of >1m in 30 minutes. If the level of dynamic water is such that product damage is suspected or observed, the suggested RMST should be reduced.
5 This product, without sensitisation is recommended for hole depths less than 11m. Sensitisation is required for use in holes deeper than 11m. Please consult your Dyno Nobel representative to check which delivery options are available at your location.
6 The Dyno Nobel Gassing Table should be used to determine the appropriate open cup density for the hole depth.
7 A = Auger delivery into dry and/or dewatered blastholes, P = Pump through loading hose to the bottom of wet blastholes.

TITAN® 9000xero® Matrix Blend

Description

TITAN 9000xero matrix blend is a blend of ammonium nitrate emulsion (TITAN 9000) and a functional bulk additive, resulting in a reduced weight strength bulk explosive, designed to assist with post blast fume management.

Application

TITAN 9000xero matrix blend is suitable for applications where soft, wet/damp ground conditions are encountered. TITAN 9000xero matrix blend is sensitised and delivered via auger into dry/dewatered blastholes or pumped to the bottom of wet blastholes. TITAN 9000xero matrix blend is a water resistant alternative to ANFO for use in ground affected by water and/or ground considered to be incompetent.

Features and Benefits

TITAN 9000xero matrix blend is a post blast fume (NOx) reducing formulation. The high emulsion content provides optimal water resistance for use in dewatered or wet conditions. Delivery via auger or pumping provides greater flexibility for loading when bench and weather conditions change unexpectedly.

Priming Requirements

TITAN 9000xero matrix blend is booster sensitive and requires a minimum 400g cast booster. Smaller booster types may reduce the performance of the explosive. Additional boosters should be used when the column height exceeds 10 metres or where there is risk of column disruption. Please consult your Dyno Nobel representative if you intend using detonating cord down lines.

Maximum Hole Depth

The recommended maximum hole depth for TITAN 9000xero matrix blend is 40m. Maximum hole depth is determined by the level of sensitisation.

Sensitisation

TITAN 9000xero matrix blend is chemically sensitised as the product is delivered to the blasthole. Allow at least 30 minutes at 20°C for the gassing reaction to occur before the blasthole is stemmed (longer at lower temperatures). The level of sensitisation necessary (as given by the open cup density) is dependent on the depth of the blasthole.

Incorrectly sensitised gassed blends may lead to poor detonation, poor ground fragmentation and/or the formation of excessive post blast fumes (NOx).

Sleep Time

TITAN 9000xero matrix blend has a maximum sleep time of 14 days under ideal conditions. In non ideal conditions this time may be reduced.

Reactive Ground Conditions

An alternative matrix may be required for use in reactive conditions. For use in reactive ground conditions contact your Dyno Nobel representative. It is essential that the appropriate test work be conducted to develop site specific guidelines for determining the maximum sleep time of the bulk explosive in reactive ground conditions.

Ground Temperature

TITAN 9000xero matrix blend is suitable for use in ground with a temperature of 0°C to a maximum of 55°C. For applications in ground with temperatures outside this range, contact your Dyno Nobel representative.

Shelf Life

TITAN 9000xero matrix blend has a shelf life of three (3) months, when transported and stored under ideal conditions.

Properties	
Density (g/cm^3) [1]	1.15
Recommended Minimum Diameter (mm)	150
Energy (MJ/kg) [2]	2.0
Typical VoD (m/sec) [3]	3400 – 5000
Relative Weight Strength (RWS) [5]	54
Relative Bulk Strength (RBS) [5]	76

1 Values are indicative average densities only, determined under laboratory conditions by Dyno Nobel technical personnel at Dyno Nobel's Mt Thorley Technical Centre. Observed densities may differ or vary under field conditions. Nominal in hole density only.

2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.

3 These results represent a range of Velocities of Detonation collected from numerous Dyno Nobel blast sites throughout the Asia Pacific region over a period of time. The Velocity of Detonation (VoD) actually recorded in use is dependent upon many factors, including: the initiation system used, the product density, blasthole diameter and ground confinement. The values stated are typical of those recorded for the product in various hole diameters, densities and ground types, and may not be achievable under all circumstances.

4 Relative Weight Strength (RWS) and Relative Bulk Strength (RBS) are determined against ANFO at a density of 0.82g/cm^3 with energy of 3.7MJ/kg.

5 RBS depends on the final density of the product at the time of loading.


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PACKAGED EXPLOSIVES®

Dyno Nobel offers a range of packaged explosive products for your open cut mining needs. The tailored strengths and handling characteristics of our product range can help with safe and productive blasting.

ANFO (Bagged)

Description

ANFO is a nominal 94:6 (%wt) blend of porous ammonium nitrate prill (Detaprill®) and fuel oil. It is a dry, free flowing explosive, formulated to ensure the appropriate oxygen balance providing optimal energy and sensitivity.

Application

ANFO has a wide variety of applications in dry hole blasting conditions. It is one of the most cost efficient blasting agents available for use in small, medium or large diameter applications. When pneumatically loaded, ANFO may also be used effectively in underground development and tunnelling applications.

Features and Benefits

ANFO is a dry and free flowing product, allowing delivery by loose pour or pneumatic loading. The low bulk density of ANFO provides excellent charge distribution in the blasthole. ANFO provides excellent heave energy.

Priming Requirements

It is recommended that ANFO should be primed with a cast booster for all hole diameters. Depending on the application, ANFO may be primed with a suitable diameter detonator sensitive cartridge explosive (Powermite® Pro). For specific priming requirements, please contact your Dyno Nobel representative. Additional boosters should be used when the column height exceeds 10 metres or where there is risk of column disruption.

Maximum Hole Depth

ANFO can be detonated successfully in depths up to 75m.

Sleep Time

Under normal conditions in dry and stemmed blastholes, ANFO may be slept for periods up to six (6) weeks. The sleep time may be limited to the recommended sleep time of the initiating system. The presence of water will dramatically reduce the sleep time. For applications where unusual or specific conditions exist, consult your Dyno Nobel representative for advice.

Water Resistance

ANFO has zero water resistance.

Reactive Ground Conditions

ANFO is not designed for use in reactive (pyritic) ground conditions. For applications in reactive ground conditions consult your Dyno Nobel representative.

Ground Temperature

ANFO is suitable for use in ground with a temperature range of 0°C to a maximum of 55°C. For applications in ground with temperatures outside this range, consult your Dyno Nobel representative.

Shelf Life

ANFO has a maximum shelf life of six (6) months dependent on temperature and humidity conditions. Storage in a high humidity and high temperature environment will accelerate product breakdown and should be avoided. Signs of ANFO degradation are hardening or caking which can lead to difficulty in loading and as a result, may lead to poor blasting performance.

Packaging

Bagged ANFO is available in packaged form. Bag sizes available are 10kg, 20kg, 25kg and 500kg.

All bags are delivered on one (1) tonne product only weight pallets i.e. 2 x 500kg, 100 x 10kg, 50 x 20kg or 40 x 25kg plastic bags per pallet.

Properties	Poured	Blow Loaded
Density (g/cm^3) [1]	0.82	0.95
Min Diameter (mm)	75	25
Energy (MJ/kg) [2]	3.7	3.7
Typical VoD (m/sec) [3]	2500 – 4500	2000 – 4000
RWS [4]	100	100
RBS [5]	100	116
Recommended Max Sleep Time [6]	6 Weeks	

1 Values are indicative average densities only, determined under laboratory conditions by Dyno Nobel technical personnel at Dyno Nobel. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – PRODET. Other programs may give different values.
3 These results represent a range of VoD's collected from numerous Dyno Nobel blast sites through the Asia Pacific region over a period of time. The VoD actually recorded in use is dependant upon many factors, including: the initiation system used, the product density, blasthole diameter and ground confinement.
4 Relative Weight Strength (RWS) and Relative Bulk Strength (RBS) are determined using a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
5 RBS is dependant on the final density of the product at the time of loading.
6 The Recommended Maximum Sleep Time in ideal conditions (dry, stemmed, non-reactive ground), is up to 6 weeks. The presence of water will dramatically reduce the sleep time. For more information or for applications where unusual or specific conditions exist; please contact your Dyno Nobel representative.

DynoSplit® RiGHT®

Description

Dynosplit® RiGHT® explosive is an inhibited high strength emulsion based explosive produced in a continuous cartridged form suitable for use as a pre-split product. Dynosplit RiGHT explosive is detonator sensitive and has 8.5 g/m detonating cord running externally down the length of the product. The detonating cord has the high temperature rating (100°C/8 hours) required for this application.

Application

Dynosplit RiGHT explosive has been specifically designed for pre-split blasting where hot and/or reactive ground conditions exist. It can be used in final pit walls, high walls, construction cuts and other special applications. Pre-split holes should be drilled at diameters and spacing determined by local conditions and requirements.

Features and Benefits

The cartridged form results in excellent lateral decoupling, reducing charge concentrations. The continuous length of detonating cord ensures a consistently high velocity of detonation, required for pre-split operations. Dynosplit RiGHT is suitable for a range of blasthole diameters. Dynosplit RiGHT explosive is available in 32 mm diameter cartridges. The continuous cartridged product can easily be loaded by one person. The external string secured by the plastic clips provides support for the product in vertical applications.

Priming Requirements

A minimum No. 8 strength detonator is required for reliable initiation. Alternatively 5 g/m detonating cord can be used as an initiating downline. At temperatures of 70°C and above, only detonating cord with the correct temperature rating should be used.

Sleep Time

The maximum sleep time of Dynosplit RiGHT explosive is dependent on the ground temperature and the level of ground reactivity, and is limited to the shortest time of all components of the explosives system at the temperature of use. As a guide in non-reactive ground, sleep times of 8 hours at 100°C and 24 hours at 90°C are available. Please consult your Dyno Nobel customer representative to arrange testing to ascertain the available sleep time in your application.

Water Resistance

Dynosplit RiGHT explosive has excellent water resistance.

Reactive Ground Conditions

Dynosplit RiGHT explosive is suitable for use in reactive ground. The available sleep time will vary according to the reactivity of the ground and the temperature of use. Please consult your Dyno Nobel representative in order for the required testing to be performed to ascertain the available sleep time in your application.

Ground Temperature

Dynosplit RiGHT explosive is suitable for use in ground with a temperature range of 0ºC to 100ºC.

Shelf Life

Dynosplit RiGHT explosive has a recommended maximum shelf life of eighteen (18) months, when transported and stored under ideal conditions.

Packaging

Dynosplit RiGHT explosive is produced in 20kg cases. All weights quoted include the external 8.5 g/m detonating cord.

Diameter (mm)	Charge (kg/m)	Quantity (m/case)	Case Weight (kg)
32	0.78	26.2	20.4

Properties	
Nominal Density (g/cm^3) [1]	1.10 – 1.14
Velocity of Detonation (VoD) [2]	
Emulsion (m/s)	4700 – 5100
Detonating Cord (m/s)	7000
Water Resistance	High
Maximum Temperature and sleep time [3]	100°C for 8 hours

1 Values are indicative average densities only, determined under laboratory conditions by Dyno Nobel technical personnel at Dyno Nobel's Mt Thorley Technical Centre. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 VoD of product is dependent on VoD of detonating cord.
3 In hot ground. In reactive ground the maximum sleep time available will vary according to the reactivity of the ground and temperature of use. Please consult your Dyno Nobel customer representative in order for the required testing to ascertain the available sleep time to be performed.

DynoSplit® Pro

Description

DynoSplit Pro explosive is a high strength emulsion explosive produced in a continuous cartridged form used in pre-splitting applications. It is detonator sensitive and has 10g/m detonating cord running internally through the entire length of the product.

Application

DynoSplit Pro explosive has been specifically designed for perimeter control blasting where a continuous length of decoupled charge is required. It can be used in smooth wall blasting, trim and pre-split for final pit walls, high walls, construction cuts and other special applications.

Features and Benefits

The small diameter (with associated decoupling) and high Velocity of Detonation (VoD) minimises blast damage to the blasthole wall resulting in minimal wall damage. DynoSplit Pro explosive is water resistant. DynoSplit Pro explosive is suitable for a range of blasthole diameters. It is available in 26mm and 32mm diameter cartridges. The continuous cartridge product can easily be loaded by one person.

Priming Requirements

A minimum No. 8 strength detonator is required for reliable initiation. Alternatively 5g/m detonating cord can be used as an initiating down-line.

Sleep Time

The maximum sleep time is dependent on ground conditions and the recommended sleep time of other products in the hole.

Water Resistance

DynoSplit Pro explosive pre-split product has excellent water resistance.

Reactive Ground Conditions

Dynosplit explosive can also be formulated for use in reactive and high temperature ground conditions. Prior to such applications it is essential that the reactivity potential of the material be tested for suitability.

Ground Temperature

Recommended for use in ambient temperatures from 0°C to 55°C.

Shelf Life

DynoSplit Pro explosive has a recommended shelf life of 12 months when transported and stored under ideal conditions.

Packaging

DynoSplit Pro explosive is produced in 17kg cases. All weights quoted include the internal 10g/m detonating cord.

Diameter (mm)	Charge (kg/m)	Quantity (m/case)	Case Weight (kg)
26	0.225	27.0	17
32	0.355	20.0	17

Properties	
Nominal Density (g/cm^3) [1]	1.15 – 1.21
Velocity of Detonation (VoD) [2]	Min 6500 m/sec
Water Resistance	High
Maximum Temperature	55°C
Relative Weight Strength (RWS) % [3]	100%
Relative Bulk Strength (RBS) %	147%

1 Values are indicative average densities only, determined under laboratory conditions. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 VoD of product is dependant on VoD of detonating cord.
3 RWS and RBS are determined using a proprietary detonation code with a density of 0.8g/cm^3 and an energy of 3.7MJ/kg for ANFO.

DynoSplit® Pro RiGHT®

Description

DynoSplit Pro RiGHT explosive is an inhibited high strength emulsion based explosive produced in a continuous cartridged form double clipped at 400mm intervals. It is detonator sensitive and is internally traced having 10g/m detonating cord running internally down the length of the product. The detonating cord (like the emulsion) is rated for the higher temperature use (100°C/8 hours) required for this application.

Application

DynoSplit Pro RiGHT explosive has been specifically designed for perimeter control blasting where hot and/or reactive ground conditions exist and where a continuous length of decoupled charge is required. It can be used in smooth wall blasting, trim and pre-split for final pit walls, high walls, construction cuts and other special applications.

Features and Benefits

The small diameter (with associated decoupling) and high velocity of detonation minimises blast damage to the blasthole wall resulting in minimal wall damage. The product can be used in both hot and reactive ground conditions. DynoSplit Pro RiGHT explosive is water resistant. DynoSplit Pro RiGHT explosive is suitable for a range of blasthole diameters. It is available in 32mm diameter cartridges. The continuous cartridge product can easily be loaded by one person.

Priming Requirements

A minimum No. 8 strength detonator is required for reliable initiation. Alternatively 5g/m detonating cord can be used as an initiating down-line. At temperatures of 70°C and above, only detonating cord with the correct temperature rating should be used.

Sleep Time

The maximum sleep time of DynoSplit Pro RiGHT explosive is dependent on the ground temperature and the level of ground reactivity, and is limited to the shortest time of all components of the explosives system at the temperature of use. As a guide in non-reactive ground, sleep times of 8 hours at 100°C and 24 hours at 90°C are available. Please consult your Dyno Nobel representative to arrange testing to ascertain the available sleep time in your application.

Water Resistance

DynoSplit Pro RiGHT explosive has excellent water resistance.

Reactive Ground Conditions

DynoSplit Pro RiGHT explosive is suitable for use in reactive ground. The available sleep time will vary according to the reactivity of the ground and the temperature of use. Please consult your Dyno Nobel customer representative in order for the required testing to be performed to ascertain the available sleep time in your application.

Ground Temperature

DynoSplit Pro RiGHT explosive is suitable for use in temperatures from 0°C to 100°C.

Shelf Life

DynoSplit Pro RiGHT explosive has a recommended maximum shelf life of twelve (12) months, when transported and stored under ideal conditions.

Packaging

DynoSplit Pro RiGHT explosive is produced in 25kg cases. All weights quoted include the internal 10g/m detonating cord.

Diameter (mm)	Charge (kg/cart)	Quantity (m/case)	Case Weight (kg)
32	0.355	30	25

Properties	
Nominal Density (g/cm^3) [1]	1.08 – 1.12
Velocity of Detonation (VoD) [2]	6500 m/sec
Water Resistance	High
Maximum Temperature and Sleep Time [3]	100°C for 8 hours
Relative Weight Strength (RWS) % [4]	104%
Relative Bulk Strength (RBS) %	153%

1 Values are indicative average densities only, determined under laboratory conditions. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 VoD of product is dependant on VoD of detonating cord.
3 In hot ground. In reactive ground the maximum sleep time available will vary according to the reactivity of the ground and temperature of use. Please consult your Dyno Nobel customer representative in order for the required testing to ascertain the available sleep time to be performed. In hole temperature monitoring, and testing of representative rock samples from the specific site will need to be performed to confirm the specific sleep time able to be achieved for the specific customer site.
4 RWS and RBS are determined using a proprietary detonation code with a density of 0.8g/cm^3 and an energy of 3.75MJ/kg for ANFO.

Powermite® Pro

Description

Powermite Pro explosive is a detonator sensitive emulsion explosive, packaged in a plastic film cartridge.

Application

Powermite Pro explosive is formulated as a high energy explosive for use in hard blasting conditions. This product has also demonstrated excellent performance in “lifter holes” in underground mining operations. It may be used as a primer of ANFO, Heavy ANFO and ANFO PS in small diameter blastholes.

Features and Benefits

The relatively high Velocity of Detonation (VoD) makes this product particularly suitable for use in hard rock blasting conditions. However, the product still has sufficient gas energy to provide optimal diggability. Being an emulsion based product, it has inherent resisitance to water, both static as well as dynamic, and is suitable for use in wet conditions.

Priming requirements

Powermite Pro explosive is formulated to be sensitive to a No.8 strength detonator. The preferred method of initiation is via the NONEL® system. When inserting the detonator into the cartridge, always use a wooden skewer, not the detonator, to pierce the plastic film.

Sleep Time

The sleep time of Powermite Pro explosive will be limited to the recommended sleep time of the explosive it is priming or that of the initiation system.

Water Resistance

Powermite Pro explosive provides high water resistance, minimising product loss to the environment in wet conditions.

Reactive Ground Conditions

Powermite Pro explosive can also be formulated for use in reactive and high temperature ground conditions. Prior to such applications, it is essential that the reactivity potential of the material be tested for suitability. The maximum sleep time will be dependant on the ground temperature and the level of ground reactivity.

Ground Temperature

Suitable for use in ground with a temperature range of 0°C to 50°C. For applications in ground temperatures outside this range, consult your Dyno Nobel representative.

Shelf Life

Powermite Pro explosive products have a recommended shelf life of one (1) year when transported and stored under ideal conditions.

Packaging

Diameter and Length (mm)	Cart weight (kg)	Nominal cartridges per case
25 x 200	25	209
25 x 700	25	59
32 x 200	25	133
32 x 700	25	38
55 x 400	25	23
65 x 400	25	17
80 x 400	25	11

Properties	
Density (g/cm^3) [1]	1.16 – 1.23
Energy (MJ/) [2]	2.78
Typical VoD (m/sec) [3]	3400
Relative Weight Strength (RWS) % [4]	75
Relative Bulk Strength (RBS) %	109
Recommended Temperature Range [5]	0 – 50ºC

1 Values are indicative average densities only, determined under laboratory conditions by Dyno Nobel technical personnel at Dyno Nobel. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – PRODET. Other programs may give different values.
3 These results represent a range of VoD’s collected from numerous Dyno Nobel blast sites through the Asia Pacific region over a period of time. The VoD is dependant on the VoD of the detonating cord.
4 RWS and RBS are determined using a proprietory detonation code with a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
5 For applications in ground temperatures outside the recommended temperature range or for applications where unusual or specific conditions exist, please contact your Dyno Nobel representative.

Powermite Thermo®

Description

Powermite Thermo booster is an emulsion based, high detonation pressure explosive booster. The formulation is comprised of a sensitised, inhibited and aluminised emulsion based mixture cast into a 600g cartridge in heat stable packaging.

Application

Powermite Thermo booster is a booster designed for blasting use in elevated temperature and reactive ground conditions. In hot and non-reactive ground, Powermite Thermo booster is rated to 130°C for 48 hours, and the product may be slept at up to 150°C for 24 hours when enclosed in a seismic container. In reactive ground, Powermite Thermo booster should be used in accordance with procedures developed on a site-by-site basis, in consultation with Dyno Nobel and the regulatory authorities.

Features and Benefits

The explosive composition achieves high detonation pressure and provides excellent priming efficiency. Powermite Thermo booster will accept NONEL® and detonating cord initiation systems.

Application Recommendations

When inserting the detonator into the cartridge always use a wooden skewer, not the detonator, to pierce the plastic film. If initiating with detonating cord, pass the cord around the chub and tie off to ensure the primer is secured to the cord.

Priming Requirements

The Powermite Thermo booster is reliably initiated using a No.8 strength detonator or a 5g/m detonating cord or greater. The Powermite Thermo booster will not be reliably initiated by cord strengths of less than 5g/m. For use at temperatures over 70°C, detonating cord with the required temperature rating must be used.

Sleep Time and Ground Temperature

The sleep time of the Powermite Thermo booster is dependent on the ground temperature and level of ground reactivity. As a guide, in non-reactive ground a sleep time of 96 hours is available at 105°C, and 48 hours at 130°C. When enclosed in a seismic container, a sleep time of 24 hours is available at 150°C. Please consult your Dyno Nobel representative for specific information about the available sleep time for your application. At all temperatures the available sleep time of the Powermite Thermo booster is limited to the lower of the recommended sleep times for the bulk product it is priming or for the other initiating system components.

Water Resistance

The Powermite Thermo booster provides high water resistance, minimising product loss to the environment in wet conditions.

Reactive Ground Conditions

Powermite Thermo booster is designed for use in reactive ground conditions when used with site specific loading procedures. Please consult your Dyno Nobel representative for information about the development of suitable site specific procedures.

Shelf Life

The Powermite Thermo booster has a recommended shelf life of one (1) year, when transported and stored under ideal conditions.

Packaging

Net case weight	25 kg
Case quantity	41 units
Case dimensions	540 x 336 x 240mm

Properties	
Density (g/cm^3) [1]	1.12 ± 0.02
Energy (MJ/kg) [2]	3.6
Velocity of Detonation (VoD) (m/sec) [3]	4500 – 5400
Relative Weight Strength (RWS) % [4]	96
Relative Bulk Strength (RBS) %	138
Recommended Temperature Range [5]	48 hours at 130ºC

1 Values are indicative average densities only, determined under laboratory conditions by Dyno Nobel technical personnel at Dyno Nobel. Observed densities may differ or vary under field conditions. Nominal in hole density only.
2 All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – PRODET. Other programs may give different values.
3 These results represent a range of VoD's collected from numerous Dyno Nobel blast sites through the Asia Pacific region over a period of time. The VoD is dependant on the VoD of the detonating cord.
4 RWS and RBS are determined using a proprietory detonation code with a density of 0.82g/cm^3 and an energy of 3.7MJ/kg for ANFO.
5 The Recommended Maximum Sleep Time stated is for hot ground only. In reactive ground the recommended maximum sleep time will vary according to ground reactivity and the temperature of use. For more information or for applications where unusual or specific conditions exist; please contact your Dyno Nobel representative.


digishot plus
Dyno Nobel
DYNO NOBEL

In initiation systems, it all started with the invention of safety fuse and then, the detonator. Dyno Nobel has a range of superior detonators, including the NONEL® non-electric initiation system and a suite of precise electronic initiation systems.

Detonating Cord

PRIMACORD 5

PRIMALINE 10

Description

PRIMACORD® and PRIMALINE® detonating cords are flexible linear explosives with a core of PETN explosive encased in an outer jacket. PRIMACORD detonating cord is encased in a textile jacket, PRIMALINE detonating cord is encased in a plastic jacket.

Application

PRIMACORD detonating cord is designed for use as surface and downhole initiating lines. PRIMALINE detonating cord is used for side initiation of explosives and may be used in combination with PRIMACORD detonating cord.

Features and Benefits

Used in combination with cord clips, Dyno Nobel detonating cord provides a safe, quick and reliable method of initiation.

Dyno Nobel detonating cord exhibits excellent knot tying capabilities and a high tensile strength.

Dyno Nobel detonating cord has excellent water and abrasion resistance.

Sleep Time

The sleep time of Dyno Nobel detonating cord may be limited to the recommended sleep time of the explosive it is priming.

Water Resistance

Dyno Nobel detonating cord exhibits very high water resistance.

Ground Temperature

Dyno Nobel detonating cord can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

Dyno Nobel detonating cord has a recommended shelf life of five (5) years, when transported and stored under ideal conditions.

Packaging

	Primacord 5	Primaline 10
Spools per case	2	2
Length / Spool (m)	500	350

Properties	Primacord 5	Primaline 10
Nominal Coreload (g/m)	5.3	10
Nominal Diameter (mm)	3.99	4.7
Tensile Strength (kg)	68	68
Colour / Counter	Red / 2 black	Red

NONEL® EZTL™

Description

NONEL non-electric delay detonator EZTL detonator units consist of a length of yellow shock tube, with a surface detonator (low strength) 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. An easy to read colour-coded J-hook is affixed near the sealed end. The J-Hook also displays the nominal firing time prominently.

NONEL EZTL units are designed for use with NONEL MS / NONEL MS HD detonator units to provide effective and accurate surface timing between blastholes and/or rows of blastholes in surface and underground blasting designs and can reliably initiate up to six shock tube leads clipped into the EZ connector block. The block design makes surface tie-in simple.

NEVER use NONEL EZTL units with detonating cord. The low strength surface detonator will not initiate detonating cord.

Features and Benefits

NONEL shock tube systems provide a very safe and quick method of blasthole initiation. In addition the system has proved to be very reliable under a full range of conditions. The tube is designed to provide the right blend of strength, stretch and powder adhesion properties. It also exhibits superior abrasion resistance and resistance to penetration of hydrocargons (both liquid and gaseous).

Sleep Time

The sleep time of the NONEL EZTL unit is dependent on the temperature and type of explosive in contact with the unit. Please contact Dyno Nobel for further information.

Water Resistance

The NONEL EZTL unit provides very high water resistance.

Ground Temperature

The NONEL EZTL unit can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

For maximum shelf life of three (3) years, NONEL EZTL units must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old. Accuracy of delay detonators may deteriorate with age and stocks should be rotated regularly.

Packaging

Length (m)	Units/case	Configuration
4.8	150	Figure 80
6	140	Figure 80
7.2	125	Figure 80
9	100	Figure 80
12	75	Figure 80
15	75	Figure 80
18	50	Figure 80

Properties	
Delay Time (milliseconds)	**Connector Block Colour**
9	Purple
17	Yellow
25	Red
42	White
67	Blue
109	Black
176	Orange

NONEL® Lead Line 1000

Description

NONEL Lead Line 1000 is a reel-off NONEL tube system used as a lead-in line for blast initiation.

Application

NONEL Lead Line is used as a reel-off lead-in line, providing the shot firer with control over the clearance between the firing point and blast.

A length of NONEL Lead Line tube is reeled out between the blast initiation point and a safe firing location. After cutting to length, the NONEL Lead Line tube is joined to a standard NONEL EZTL™ or a similar detonator unit. The join must be made using the special tube joiners provided. The open end of the remaining tube on the spool must be sealed with the special end cap provided. This will help prevent moisture penetrating into the tube during storage.

NONEL Lead Line is initiated with the DynoStart™ unit or a NONEL Starter Gun.

Features and Benefits

NONEL Lead Line can be cut to the length required, minimising tube wastage.

NONEL Lead Line can be run out over the top of surface initiation systems without disruption or interference.

NONEL Lead Line provides a high level of safety against accidental initiation by stray electrical current, radio transmissions or static electricity.

Sleep Time

The sleep time of the NONEL Lead Line is dependent on the temperature and type of explosive in contact with the unit. Please contact Dyno Nobel for further information.

Water Resistance

The splice join of NONEL Lead Line 1000 may prove to be unreliable due to moisture ingress causing shutdowns. The use of NONEL Starter is recommended for wet conditions.

Ground Temperature

The NONEL Lead Line tube system can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

NONEL Lead Line has a recommended shelf life of three (3) years, when transported and stored in a sealed box under ideal conditions. If tube is cut, end caps must be used to prevent moisture ingression.

Packaging

Case Dimensions	555mm x 280mm x 255mm
Case Weight	12.5kg
Number of Reels per case	2
Sealing caps	Each case of NONEL Lead Line 1000 is packaged with 8 end caps and 8 tube joiners

Properties	
Colour	Yellow
Tube	Standard
Tube diameter (mm)	3 (external)
Velocity of Detonation (m/sec)	2100 +/- 300

NONEL® MS CONNECTOR™ Series

Description

NONEL MS CONNECTOR units are bi-directional units that consist of a 46cm length of shock tube with a detonator crimped to each end. The detonators are housed in a color-coded plastic connector block designed to facilitate easy attachment to detonating cord. Colour-coded delay tags display the nominal firing time prominently.

Application

NONEL MS CONNECTOR units are used to provide surface delay time between individual or multiple blastholes for blasting applications in which detonating cord is used as the primary initiation system. NONEL MS CONNECTOR are a surface delay detonator series, featuring six (6) standard delays.

Features and Benefits

The NONEL MS CONNECTOR units are bi-directional providing a redundant two-path initiation system. They are quick and easy to use, easy to disconnect and have excellent handling characteristics.

Application Recommendations

ALWAYS use Primacord® 4 (3.6g/m; 18g/ft) coreload detonating cord or higher with the NONEL MS CONNECTOR detonator.

ALWAYS protect the NONEL MS CONNECTOR block and shock tube from impact or damage. The surface connectors contain detonators and are subject to detonation caused by abuse such as impact. Shock tube which has been cut, ruptured or damaged may cause misfires.

ALWAYS use in-hole delays to minimise the chance of surface cut-offs with NONEL MS CONNECTOR units.

ALWAYS trim excess lengths of detonating cord from the NONEL MS CONNECTOR block after connecting each block to the detonating cord. Tails of detonating cord lying across or adjacent to the shock tube between the connector blocks will interfere with the functioning of the assembly and may cause misfires.

ALWAYS store in a cool, dry, well-ventilated magazine for maximum shelf life.

ALWAYS rotate explosive inventory to ensure old stock is used before old.

NEVER connect NONEL MS CONNECTOR units to detonating cord trunklines until all blastholes have been primed and loaded and the blast site has been cleared of personnel and equipment.

NEVER drive any equipment over NONEL MS CONNECTOR blocks, detonating cord or shock tube.

Water Resistance

The NONEL MS CONNECTOR series provides high water resistance.

Ground Temperature

The NONEL MS CONNECTOR series can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

For maximum shelf life (3 years), NONEL MS CONNECTOR must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old.

Packaging

Packed 200 to a case.

Properties	
Delay Time (milliseconds)	**Connector Block Colour**
17	Yellow
25	Red
42	White
67	Blue
109	Black
176	Orange

NONEL® MS Series

Description

NONEL non-electric delay detonator MS units consist of a length of red shock tube with a high strength detonator attached to one end and the other end sealed. A cord clip displaying the nominal time prominently is affixed near the sealed end, providing easy means of connection to detonating cord.

The NONEL MS Series unit is designed to provide in-hole timing delay for underground and surface blast applications in the mining, quarry and construction industries and can be used in combination with a detonating cord trunkline and NONEL MS CONNECTOR™ or NONEL EZTL™ units for maximum timing flexibility.

Application

The NONEL MS Series unit is designed for down hole initiation of shorter blastholes. The lower tensile strength allows for the offering of an appropriately strong unit which remains cost effective. This is achieved while maintaining all the other essential requirements for such a shock-tube product viz powder adhesion, resistance to water and hydrocarbon attack and low plastic 'memory'.

Features and Benefits

The NONEL MS Series unit provides increased water resistance in blasting applications where saturated ground conditions exist. The shock tube exhibits excellent handling characteristics and enables longer sleep times down the hole. The NONEL MS series unit has a colour-coded stamped cord clip for easy identification.

Maximum Hole Depth

This product is ideally used for holes up to 12m in depth although depths of up to 24m can also be accommodated.

Sleep Time

The sleep time of the NONEL MS Series unit is dependent on the temperature and type of explosive in contact with the unit. Please contact Dyno Nobel for further information.

Water Resistance

The NONEL MS Series unit provides very high water resistance.

Ground Temperature

The NONEL MS Series unit can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

For maximum shelf life of three (3) years, NONEL MS Series units must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old.

Packaging

Length (m)	Units / Case	Configuration	Length (m)	Units / Case	Configuration
3.6	250	Coiled	9	120	Coiled
4.8	200	Coiled	12	75	Sleeve
6	150	Coiled	15	75	Sleeve
7.2	150	Coiled	18	75	Sleeve

Properties			
Period / Delay Time (msec)	**J-Hook Colour**	**Period / Delay Time (msec)**	**J-Hook Colour**
1 / 25	Red	15 /375	Crimson
2 / 50	Blue	16 / 400	Yellow
3 / 75	Brown	17 / 425	Dark Blue
4 / 100	Orange	18 / 450	Green
5 / 125	Aqua	19 / 475	Orange
6 / 150	Gold	20 / 500	White
7 / 175	Lime Green	21 / 550	Dark Red
8 / 200	Pink	22 / 600	Grey
9 / 225	Black	23 / 650	Black
10 / 250	Purple	24 / 700	Dark Brown
11 / 275	Light Blue	25 / 750	Red
12 / 300	Dark Green	26 / 800	Blue
13 / 325	Mauve	27 / 900	Brown
14 / 350	Mustard	28 / 1000	Orange

NONEL® MS HD Series

Description

NONEL nonelectric delay detonator MS HD units consist of a length of heavy duty orange shock tube with a high strength detonator attached to one end and the other end sealed. A cord clip prominently displaying the nominal time is affixed near the sealed end, providing easy means of connection to detonating cord.

Designed to be used in demanding environments, the NONEL MS HD Series unit provides in-hole delay time for underground (non-coal) and surface blast applications in the mining, quarry and construction industries and can be used in combination with a detonating cord trunkline, NONEL MS CONNECTOR and NONEL EZTL™ detonators for maximum timing flexibility.

Application

The NONEL MS HD Series unit is designed for down hole initiation of long to very long blastholes. The superior tensile strength provides an appropriately strong unit which also has improved abrastion resistance. This is achieved while maintaining all the other essential requirements for such a shock-tube product viz powder adhesion, resistance to water and hydrocarbon attack and low plastic 'memory'.

Features and Benefits

The NONEL MS HD Series unit provides increased water hammer resistance in blasting applications where saturated ground conditions exist. The NONEL MS HD Series unit shock tube exhibits excellent handling characteristics and enables longer sleep times down the hole. The NONEL MS HD Series unit has a colour-coded stamped cord clip for easy identification.

Maximum Hole Depth

This product is ideally used for holes from 18m to 80m deep, although longer depths can be accommodated.

Sleep Time

The sleep time of the NONEL MS HD Series unit is dependent on the temperature and type of explosive in contact with the unit. Please contact Dyno Nobel for further information.

Water Resistance

The NONEL MS HD Series unit provides excellent water resistance.

Ground Temperature

The NONEL MS HD Series unit can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

For maximum shelf life of three (3) years, NONEL MS HD Series unit must be stored in a cool, dry, well ventilated magazine. Explosive inventory should be rotated. Avoid using new materials before the old.

Packaging

Length (m)	Units/case	Configuration
6	150	Coiled
9	100	Coiled
12	75	Figure 80
15	75	Figure 80
18	75	Figure 80
24	40	Figure 80
30	30	Spool
36	30	Spool
45	30	Spool
60	30	Spool
80	30	Spool

Properties			
Period / Delay Time (msec)	**J-Hook Colour**	**Period / Delay Time (msec)**	**J-Hook Colour**
1 / 25	Red	15 /375	Crimson
2 / 50	Blue	16 / 400	Yellow
3 / 75	Brown	17 / 425	Dark Blue
4 / 100	Orange	18 / 450	Green
5 / 125	Aqua	19 / 475	Orange
6 / 150	Gold	20 / 500	White
7 / 175	Lime Green	21 / 550	Dark Red
8 / 200	Pink	22 / 600	Grey
9 / 225	Black	23 / 650	Black
10 / 250	Purple	24 / 700	Dark Brown
11 / 275	Light Blue	25 / 750	Red
12 / 300	Dark Green	26 / 800	Blue
13 / 325	Mauve	27 / 900	Brown
14 / 350	Mustard	28 / 1000	Orange

NONEL® MS HT Series

Description

The NONEL MS HT Series shock tube/detonator assembly is a millisecond, high strength delay unit specifically designed for use in high in-hole temperatures up to 70°C.

Application

The NONEL MS HT Series unit provides a reliable downhole initiating system appropriate for high in-hole temperature applications. It is recommended that the MS HT Series unit be used as a single inhole delay in conjunction with the EZTL™ unit surface initiation system. This will provide adequate downhole delay time in most blasting applications. The NONEL MS HT Series unit can also provide hole-by-hole delay sequencing by utilising the downhole delay in conjunction with detonating cord and MS CONNECTOR™. It is recommended to use either 3.6g/m or 5g/m detonating cord to initiate the NONEL tube.

Features and Benefits

The NONEL MS HT Series unit provides resistance to high in-hole temperatures. The NONEL Supertube™ shock tube is easily deployed and enables longer sleep times down the hole due to increased resistance to oil migration into the tube at elevated in-hole temperatures. The NONEL MS HT Series unit assembly has a colour-coded stamped cord clip for easy identification.

Application Recommendations

It is recommended that the NONEL MS HT Series unit be used as a single inhole delay in conjunction with the EZTL™ unit surface initiation system. This will provide adequate downhole delay time in most blasting applications. The NONEL MS HT unit can also provide hole-by-hole delay sequencing by utilising the downhole delay in conjunction with detonating cord and MS CONNECTOR™. It is recommended to use either 3.6g/m or 5g/m detonating cord to initiate the NONEL tube.

Maximum Hole Depth

This product is ideally used for holes from 18m to 80m deep, although longer depths can be accommodated.

Sleep Time

The sleep time of the NONEL MS HT Series unit is dependent on the temperature and type of explosive in contact with the unit. Contact your Dyno Nobel representative for further information.

Water Resistance

The NONEL MS HT Series unit provides high water resistance.

Ground Temperature

The NONEL MS HT Series unit can be safely used in ground with a temperature range of -40 °C to + 70°C.

Shelf Life

The NONEL MS HT Series unit has a recommended shelf life of three (3) years, when transported and stored under ideal conditions. Accuracy of delay detonators may deteriorate with age and stocks should be rotated regularly.

Packaging

Length (m)	Units / Case	Configuration
12	75	Coiled (Detpak)
15	75	Coiled (Detpak)
24	30	Spool

Properties	
High strength detonator	No 12 strength
Tube colour	Orange
Tube diameter (mm)	3.0 (STD)
Velocity of detonation (m/sec)	2100 +/- 300

NONEL® Starter

Description

The NONEL Starter is used as a lead-in line from a safe firing position to the blasting location. A NONEL Starter consists of a length of NONEL tube sealed at one end and a NONEL detonator and connector block attached at the other end.

Application

The NONEL Starter can be used to initiate blasts with NONEL detonators or detonating cord.

Features and Benefits

The NONEL Starter provides a high level of safety against accidental initiation by stray electrical current, radio transmissions or static electricity.

Sleep Time

The sleep time of the NONEL Starter is dependent on the temperature and type of explosive in contact with the unit. Please contact your Dyno Nobel representative for further information.

Water Resistance

The NONEL Starter provides very high water resistance.

Ground Temperature

The NONEL Starter can be safely used in ground with a temperature range of -40°C to +70°C.

Shelf Life

The NONEL Starter has a recommended shelf life of three (3) years, when transported and stored in a sealed box under ideal conditions. Accuracy of delay detonators may deteriorate with age and stocks should be rotated regularly.

Packaging

Length (m)	Reels/Case
100	16 reels
300	4 reels
500	4 reels

Properties	
Colour	Yellow
Tube	Standard
Tube diameter (mm)	3 (external)
Velocity of Detonation (m/sec)	2100 +/- 300
UV Block capacity	10 std NONEL tubes

NONEL® Primafire

Description

The NONEL Primafire is a short length of NONEL MS tubing with a 600 millisecond detonator in a plastic block designed for connection to detonating cord.

Features and Benefits

The NONEL Primafire is a detonating cord initiator designed to incorporate detonating cord downlines into NONEL MS downline blasting patterns, particularly where hot hole conditions preclude the use of NONEL downlines.

Application

The NONEL Primafire unit may be initiated by NONEL EZTL™ or detonating cord trunk lines and will reliably initiate detonating cords from 5 to 10g/m. When used with Primaline or Primacord detonating cord downlines, NONEL Primafire provides a delay to match with NONEL MS #22 inhole delays.

Application Recommendations

With NONEL inhole delays use the NONEL Primafire unit to match the firing times. Before making the surface system connections, clip the NONEL Primafire unit to all detonating cord downlines in the blast. When connecting the NONEL Primafire unit into the surface delay system ensure that connections are made at least 500mm from the detonator to ensure full run-up in the shock tube.

Ground Temperature

The NONEL Primafire tube system can be used as described on this technical information sheet in ambient temperatures ranging from -40°C to +70°C. Where blast surface temperatures exceed 70°C the use of high temperature detonating cord trunklines is recommended. Note: all high temperature and hot hole blasting should be conducted under approved procedures.

Shelf Life

The NONEL Primafire unit has a recommended shelf life of three (3) years, when transported and stored under ideal conditions. Accuracy of delay detonators may deteriorate with age and stocks should be rotated regularly.

Packaging

Case Dimensions	540mm x 365mm x 245mm
Case Weight	11kg
Number of Units Per Case	300

Properties	
Explosives Class: 1.1B	U.N. No: 0360
Detonator	No. 8 Strength
Detonator delay	600 milliseconds
NONEL Tube Colour	Yellow
Tube	Standard
Tube diameter (mm)	3 (external)
Velocity of detonation (m/sec)	2100 +/- 300

TROJAN® TWINPLEX® Cast Boosters

Description

The TROJAN TWINPLEX cast booster is detonator sensitive, high density, high energy molecular explosives. TROJAN TWINPLEX cast boosters are designed with two (2) detonator wells and an enlarged through-tunnel to accommodate the use of two (2) detonators where required. TROJAN TWINPLEX cast 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 makes the TROJAN TWINPLEX cast booster more visible on the blast site and reduces the possibility of misplaced charges.

Features and Benefits

The explosive composition achieves high detonation pressure and provides excellent priming efficiency. The TROJAN TWINPLEX cast booster will accept Dyno Nobel's range of non-electric and electronic detonators.

Application

The Trojan Twinplex cast booster is specifically designed for applications where (for whatever reason) there is a concern that the integrity of the downline may have been impaired. The use of twin downlines ensures certainty of the initiation signal getting to the booster. Only one booster is required thus saving cost as well as time in deployment.

Application Recommendations

Always use detonator(s) only with TROJAN TWINPLEX cast boosters. Never use detonating cord with TROJAN TWINPLEX cast boosters. The through tunnel has been widened to accommodate two detonators, where required. Use of detonating cord may cause misfires, which may kill or injure. 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 TROJAN TWINPLEX cast booster. Notify your Dyno Nobel representative.

Ground Temperature

Minimum detonator is No. 8 strength for temperatures above -40° C (-40° F). A high strength detonator is recommended for temperatures below -40° C (-40°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.

Shelf Life

The TROJAN TWINPLEX cast booster has a recommended shelf life of five (5) years from the date of manufacture. Explosive inventory should be rotated. Avoid using new materials before the old.

Packaging

Unit Weight/Net Explosive Content (NEC) (g)		450
Unit Dimensions	**Length (cm)**	11.7
	Diameter (cm)	5.7
Units/Case		36
Net Weight/Case (kg)		15.9
Case Dimensions (cm)		42 x 33 x 14

Note : All weights are approximate

Properties	
Nominal Density (g/cm^3)	1.60
Velocity (m/sec)	7,550
Detonation Pressure (Kbars)	235
Water Resistance (with no loss of sensitivity)	6 months
Maximum Water Depth (m)	90
Maximum Usage Temperature (°C)	70

TROJAN® NB Universal Cast Boosters

Description

The TROJAN NB Universal cast booster is a detonator and detonating cord sensitive, high density, high energy, molecular explosive. The TROJAN NB Universal cast booster is especially designed to optimise initiation of all cast booster sensitive and/or detonator sensitive explosives. Each TROJAN NB Universal cast booster is manufactured with two internal through-tunnels and a detonator well for easy use with either 5 or 10 g/m detonating cord or commercial detonators. The bright yellow container enhances visibility on the bench and minimises misplaced charges.

Application

TROJAN NB Universal cast boosters are designed for instances where the explosive product used cannot relaibly be initated by the small base charge of a standard detonator. The booster itself is sensitive enough to be initiated by the detonator and the resulting detonation serves to initate the surrounding (relatively insensitive) explosive. These explosives are usually of the bulk variety that have been loaded into larger diameter blastholes.

Features and Benefits

The explosive composition achieves high detonation pressure and provides excellent priming efficiency.

The TROJAN NB Universal cast booster will accept Dyno Nobel's range of non-electric and electronic detonators.

The TROJAN NB Universal cast booster is recessed at one end to provide protection to the initiation line.

Sleep Time

The sleep time of the TROJAN NB Universal cast booster will be limited to the recommended sleep time of the explosive it is priming or the recommended sleep time of the initiating system.

Water Resistance

TROJAN NB Universal cast booster exhibits very high water resistance.

Ground Temperature

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.

Shelf Life

For maximum shelf life of five (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/Net Explosive Content (NEC) (g)		400
Unit Dimensions	**Length (cm)**	11.9
	Diameter (cm)	5.5
Units/Case		20
Net Weight/Case (kg)		16.3
Case Dimensions (cm)		42 x 33 x 14

Properties	
Density (g/cm^3) Avg	1.60
Velocity (m/sec)	7,800
Detonation Pressure (Kbars)	245
Water Resistance (with no loss of sensitivity)	6 months
Shelf Life Maximum (from date of production)	5 years
Maximum Water Depth (m)	90
Maximum Usage Temperatures (°C)	70
All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.	

TROJAN® SPARTAN Cast Boosters

Description

The TROJAN SPARTAN cast boosters are detonator sensitive, high density, high energy molecular explosives available in various sizes designed to optimise initiation of all booster sensitive explosives. All TROJAN SPARTAN cast boosters are manufactured with an internal through-tunnel and detonator well for easy application with either electronic or non-electric detonators or 10.6 g/m (50 g/ft) minimum strength detonating cord. TROJAN SPARTAN cast 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 makes the TROJAN SPARTAN cast booster more visible on the blast site and reduces the possibility of misplaced charges.

Application

TROJAN SPARTAN cast boosters are designed for instances where the explosive product used cannot relaibly be initated by the small base charge of a standard detonator. The booster itself is sensitive enough to be initiated by the detonator and the resulting detonation serves to initate the surrounding (relatively insensitive) explosive. These explosives are usually of the bulk variety that have been loaded into larger diameter blastholes.

Features and Benefits

The explosive composition achieves high detonation pressure and provides excellent priming efficiency.

The range of sizes available provide priming solutions for most blasthole applications.

The TROJAN SPARTAN cast booster will accept SmartShot® and NONEL® detonators.

The TROJAN SPARTAN cast booster is recessed at one end to provide protection to the initiation line.

Sleep Time

The sleep time of the TROJAN SPARTAN cast booster will be limited to the recommended sleep time of the explosive it is priming or the recommended sleep time of the initiating system.

Water Resistance

The TROJAN SPARTAN cast booster exhibits very high water resistance.

Ground Temperature

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.

Shelf Life

For maximum shelf life of five (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 / Net Explosive Content (NEC) (g)		150	400
Unit Dimensions	**Length (cm)**	11.9	11.9
	Diameter (cm)	3.6	5.5
Units/Case		48	20
Net Weight/Case (kg)		16.3	16.3
Case Dimensions (cm)		42x 33 x 14	42 x 33 x 14

Properties	
Density (g/cm^3) Avg	1.65
Velocity (m/sec)	7,300
Detonation Pressure (Kbars)	220
Water Resistance (with no loss of sensitivity)	6 months
Shelf Life Maximum (from date of production)	5 years
Maximum Water Depth (m)	90
Maximum Usage Temperatures (°C)	70
All Dyno Nobel energy values are calculated using a proprietary Dyno Nobel thermodynamic code – Prodet. Other programs may give different values.	

DigiShot® Plus Electronic Detonator

Description

DigiShot Plus is a truly flexible, user friendly and fully programmable electronic initiation system. It has accurate timing benefits, quick deployment with robust downline wire and all-weather surface connectors. The detonators can be connected to the busline in any convenient order... not just the firing order! The DigiShot Plus electronic initiation system also provides these additional features –

- Remote firing capability
- Tag-on-connect
- The ability to initiate larger blasts (up to 9,600 detonators)
- ViewShot™ PC based blast design software enables timing patterns to be downloaded directly from the PC into the DigiShot Plus Bench Box.

With safety always Dyno Nobel's number one priority, the DigiShot Plus Tagger (used on the bench for testing and assigning row and hole number to individual detonators) is inherently safe and does not produce sufficient voltage to fire the detonator. In addition, the DigiShot Plus detonators are fully testable with two-way communication which facilitates easy fault identification and repair. Individual detonators, rows of detonators or the entire pattern can be tested prior to connection to the blasting machine.

Features and Benefits

Electronic accuracy enables customers to achieve a variety of benefits ranging from better fragmentation to improved crusher throughput to happier neighbours resulting from decreased Peak Particle Velocity (PPV) and/or improved frequencies.

- A DigiShot Plus blast can be initiated using the remote firing (RF) wireless feature or the more typical hard-wired initiation.
- Easy to use menu-driven software.
- With Dyno Nobel's ViewShot PC-based blast design software, blast designs and timing can easily be transferred from the PC to the DigiShot Plus Bench Box.
- The blast design can be pre-loaded into the Bench Box while separated from the detonators, or after connection from a safe location.
- Minimal on-bench components... just the electronic DigiShot Plus detonator (in the blasthole) and a 2-wire busline on the pattern.
- The DigiShot Plus Tagger assigns a detonator position (row and hole number) to each detonator when it is loaded and tested in the blasthole. The fully programmable DigiShot Plus system allows each detonator's delay to be determined individually but also offers an automated delay assignment process.

Application Recommendations

Due to the system's flexibility, contact your local Dyno Nobel representative for application recommendations.

Packaging

Length (m)	Case Quantity	Case Weight (kg)
9	84	12.9
15	60	14.0
18	50	14.6
24	40	15
30	32	14.9
37	24	13.5
46	24	16.2
55	18	15.5
75	15	17.2

Properties	
Detonator Shell	Copper
Cable Colour	Green
System Operating Temperature (range)	-20°C to +80°C
Detonator Strength	#12
Net Explosive Quantity (per 100 units)	0.1000kg
Maximum Delay	20,000 milliseconds
Maximum Detonators per Blaster	9,600 (synchronised 4 x Bench Boxes)
Maximum Surface Wire Length	2.5km

SmartShot® Electronic Initiation System

Description

The SmartShot electronic initiation system offers innovative features including wireless remote blasting and complete timing flexibility. Specialised waterproof and dirt displacing connectors ensure quick, easy and reliable connections, and prevent leakage.

SmartShot Detonator – To hook up, the male connector of one unit simply snaps into the female connector of the next unit, and so on, along a row.

SmartShot Base Station – Used to initiate the blast remotely from a safe distance. The PIN protected SmartKey must be docked in the Base Station to arm and fire the shot.

SmartShot Bench Box – The receiver unit that allows remote firing via radio frequency from the Base Station, passing the signal onto the detonators in order to initiate the blast.

String Starter – Connected between the blast and the Bench Box to interface 2-wire with 4-wire communication. It also assists in identifying any faults.

End Plug – Connected to the end of each string to indicate the end of a string to the control equipment.

SmartShot Tagger – Hand-held unit to test and assign timings to individual detonators and defines the hole configuration.

Packaging

Accessories		
	Units per case	Packaging Dimensions
SmartShot Base Station	1	523 x 375 x 260mm
SmartShot Bench Box	1	523 x 375 x 260mm
String Starters & End Plugs	10	200 x 165 x 92mm
Smart Keys	1 set (1 red, 4 yellow)	146 x 86 x 38mm
Tagger	1	300 x 250 x 140mm
Connection Block and Cable	1	200 x 165 x 92mm

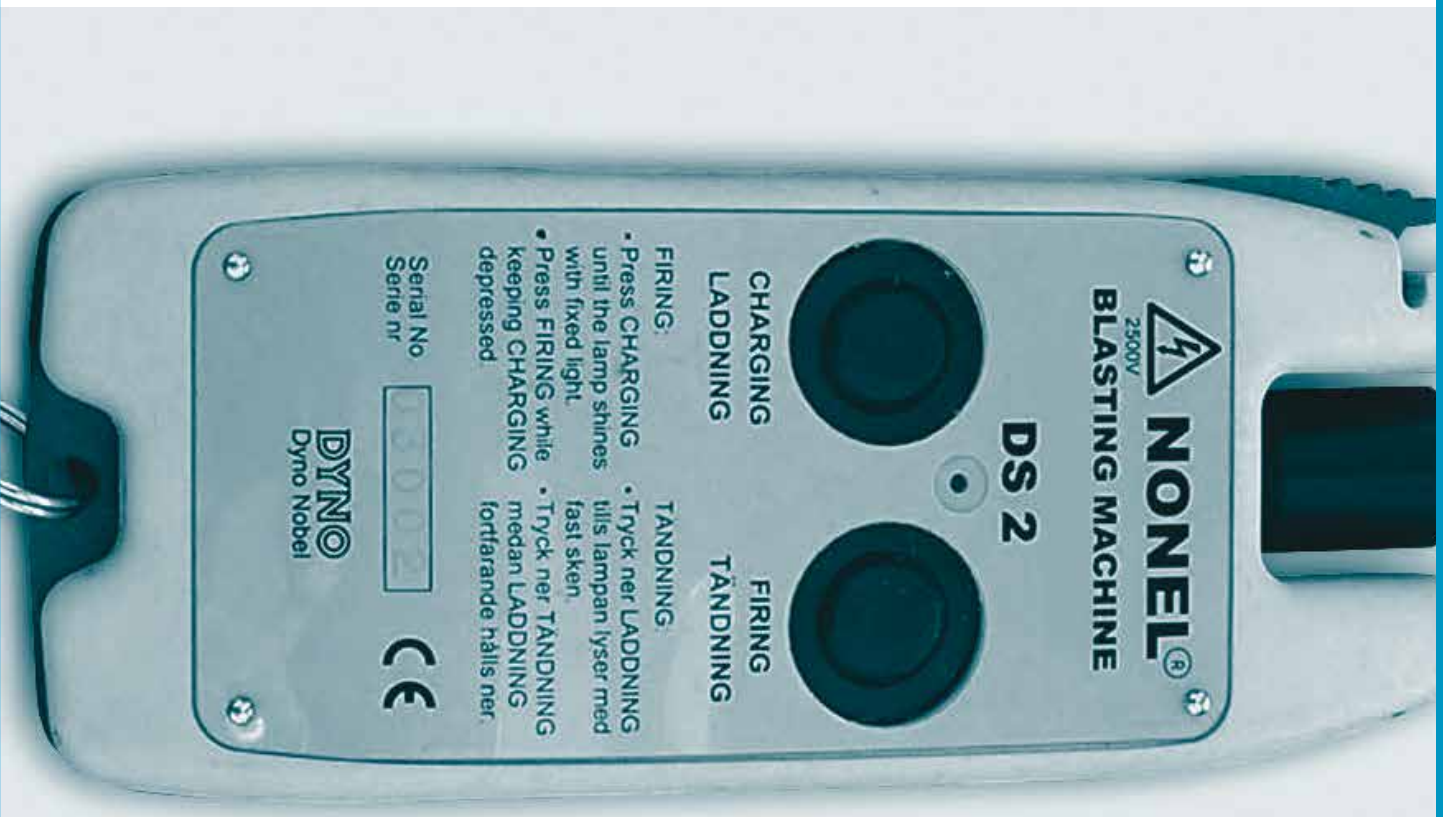
Detonators		
Downline x Surface Length (m)	Units per case	Packaging Dimensions
10 x 7	18	480 x 215 x 245mm
20 x 10	18	480 x 215 x 245mm
20 x 15	18	480 x 215 x 245mm
25 x 0.2	18	480 x 215 x 245mm
35 x 0.2	18	480 x 215 x 245mm
45 x 0.2	18	480 x 215 x 245mm
60 x 0.2	8	480 x 215 x 245mm

Properties	
System Limits	
Maximum Total Delay Time (milliseconds)	20,000
Maximum Number of Detonators (per Bench Box)	2400*
Maximum Number of Bench Boxes for synchronised blasting	4 (9600 detonators)
Maximum line-of-sight distance for RF blasting	3000m*
Lead in Length (wire)	2000m*
Maximum in-hole lead length	60m
Detonator	
Detonator Shell	Copper
Cable colour	Green with a coloured stripe
Tensile Strength	>250N
System Operating Temperature	-20°C to +50°C
Detonator Strength	#12
Net Explosive Quantity (per 100 units)	0.1000kg
Dynamic Shock Resistance	>12,000psi 500ns pulse width
ESD Resistance	Passes EN 13763-13
RF Immunity	Passes CEN TS 13763-27
Base Charge	PETN
Timing	Fully or auto programmable

* Dependant on shot layout, please refer to training manual before use.

BLASTING ACCESSORIES®

Dyno Nobel has a range of innovative blasting accessories for use with our initiation systems.



Detonating Cord Cutters

Description:

The Detonating Cord Cutter is a single acting, heavy duty approved cutting tool, with a long life stainless steel blade and synthetic anvil.

Application:

Detonating Cord Cutters are used for cutting detonating cord and NONEL® tube.

Packaging:

Sold in single units. Holsters are also available.

DynoStart™ DS2

Description

DynoStart is a battery powered electronic blasting machine for initiation of NONEL® tube. No part of the device is explosive in nature. It is not approved for use in confined areas which may contain flammable gas e.g. underground coal.

Application

Electrical energy is converted into a strong shock wave of high temperature that, when applied inside a NONEL tube by the means of an electrode, initiates the tube. DynoStart uses a common 9V battery and a durable electrode. Both battery and electrode are easy to change. The electrode can be removed from the blasting machine at any time to prevent unauthorised usage. DynoStart is designed to require the use of both hands when initiating the blast. This is to avoid unintentional firing of a blast.

Packaging

Sold in single units.

NONEL® Starter Gun

Description

The NONEL® Starter Gun is a simple and highly effective hand held blasting machine, robustly constructed from metal alloys and stainless steel. It has an integral safety device and uses Shot Shell Primers No.20 as primer caps. It is a complete blasting machine, no other equipment being needed to initiate a NONEL tube.

J Cord Cutter

Description

The J Cord Cutter is a drag knife for cutting detonating cord and NONEL® tube. Low cost, limited life tool with no moving parts.

Application

Approved cutting device for initiation products.

Packaging

Sold in bundles of 10.

EXPLOSIVE DELIVERY SYSTEMS

As a valued Dyno Nobel customer, you benefit from our range of state-of-the-art delivery systems. Our Mobile Processing Units (MPUs) are the latest technological advancements that may help to increase safety and productivity and reduce costs.

QUAD MPU

The QUAD MPU is designed to provide a complete range of explosive products direct to the blasthole from ANFO to fully waterproof gassed emulsion blends.

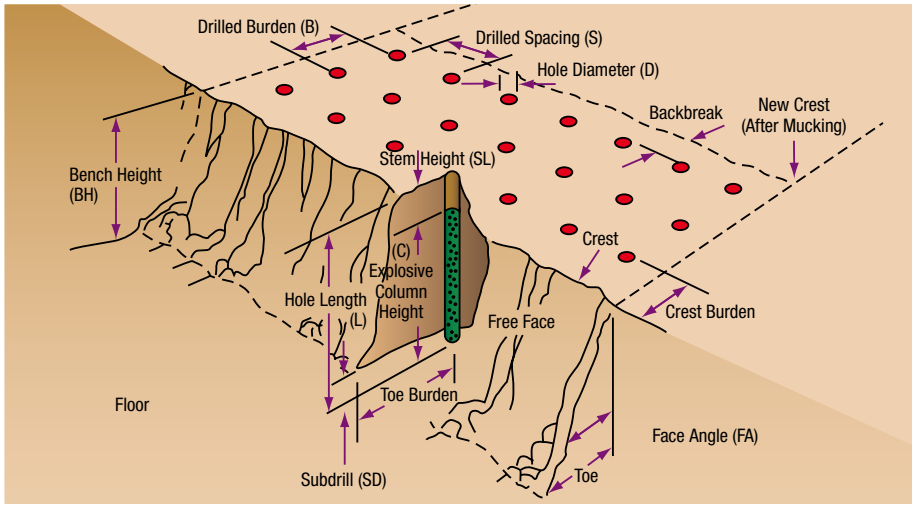
The QUAD is available in two designs:
(1) a low capacity/low discharge rate design optimised for small operations and
(2) a high capacity/high discharge rate design for large operations.
The high capacity unit is designed to maximise load carrrying capacity and minimise turnaround times. Discharge rates are optimised for 150mm diameter and larger blastholes.

TTT MPU

The TTT MPU is designed to deliver a range of bulk explosive products direct to the blasthole. The truck is designed to incorporate large product bins, maximising the carrying capacity and thereby minimising turn-around times. Discharge rates are optimised for 150mm diameter and greater blastholes. All ranges of bulk are available from the truck, from ANFO to fully waterproof gassed emulsion blends.

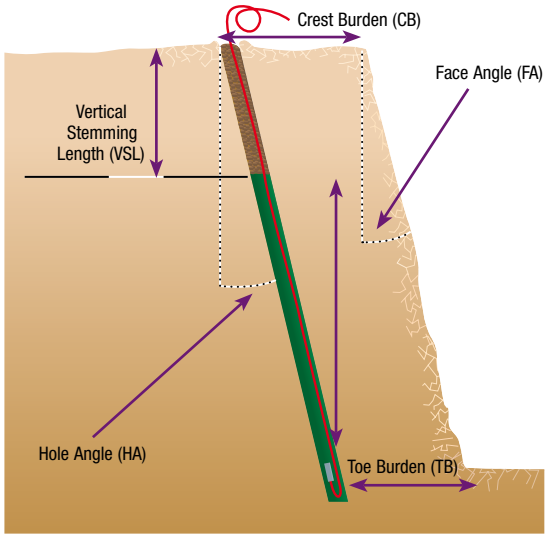
Blast Design Terminology and Formulas

Hole length (L) =	BH + SD
Charge length (C) =	L – SL
Blast Volume (V) =	B x S x BH x N
Blasted tonnes (T) =	V x Density of rock in t/m^3
Volume of blasthole (Vb) =	π x $D^2/4000$ x L
Mass of explosive per hole (kg) =	Volume of hole length charged x Explosive density
PF (kg/m^3) =	Total explosives in the blast/volume of rock blasted (for kg/Tonne, divided by blasted tonnes T)
RWS =	AWS of explosive/AWS of ANFO
RBS =	(RWS explosive x explosive density) / (RWS ANFO x ANFO density)
Energy factor =	PF x RWS
Vertical length of angled holes =	Measured hole length x cos $\propto$



$\propto$ = Angle subtended from the vertical by the inclined hole
π = 3.1428 (the ratio of the circumference of a circle to its diameter)
AWS = Absolute Weight Strength
B = Drilled burden (m)
BH = Bench height (m)
C = Explosive column height or charge length (m)
D = Hole diameter in millimetres
L = Hole length (m)
N = Number of holes in a blast
PF = Powder factor
RBS = Relative bulk strength
RWS = Relative weight strength
S = Drilled spacing (m)
SD = Subdrill (m)
SL = Stemming length (m)
T = Blasted tonnes
V = Blast volume (m^3)

Angle Faced Holes



Calculating burdens

Crest Burden (CB)
= Distance blasthole collar is from crest

Vertical Stemming Length (VSL)
= (measured stemming length x cos [HA])

Toe Burden (TB)
= Burden at floor level
= ([tan (FA) x bench height] + CB) – (tan [HA] x bench height)

Rules of Thumb

These rules provide a first estimate in the absence of any better data.

Blasthole diameter in mm ≤	15 x Bench height (BH) in metres
Bench height (BH) in metres ≥	(Blasthole diameter (D) in mm)/15
Burden (B) =	(25 to 40) x (D)
Spacing (S) =	1.15 x B (This gives an equilateral pattern)
Sub drill =	(3 to 15) x D
Charge length (C) ≥	20 D
Stemming ≥	20 x D or (0.7 – 1.2) x B
Burden stiffness ratio =	BH/B : 2 to 3.5 good fragmentation : > 3.5 very good fragmentation
Stemming material size =	D/10 to D/20 (Angular material with minimum fines)

Presplit blasting

Spacing =	Hole diameter x 12
Burden =	0.5 x production blast burden (B)
Uncharged length at top =	10 x D
Powder Factor =	0.5kg per square metre of face

Do not stem holes.

Fire all holes on the same delay, or in Groups of ≥ 5 holes.

Smooth Blasting

Spacing =	15 x Hole diameter (hard rock) 20 x Hole diameter (soft rock)
Burden =	1.25 x Spacing

Fire as many holes as possible on one delay.

Stem holes.

Powder factors

Typical powder factors used in mass blasts

Rock type	PF (kg/m^3)
Hard	0.7 – 0.8
Medium	0.4 – 0.5
Soft	0.25 – 0.35
Very Soft	0.15 – 0.25

Typical powder factors used in presplit and smooth blasting

Hole diameter	PF (kg/m^3)
Hard	0.6 – 0.9
Medium	0.4 – 0.5
Soft	0.2 – 0.3

Loading Density

Hole Diameter mm	Hole Diameter in	Kg of explosive per meter of column for given density (g/cm^3)														Hole Diameter mm	Hole Diameter in
		0.60	0.80	0.82	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.30	1.35	1.40		
25	1	0.29	0.39	0.40	0.42	0.44	0.47	0.49	0.52	0.54	0.56	0.59	0.64	0.66	0.69	25	1
32	1 1/4	0.48	0.64	0.66	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.05	1.09	1.13	32	1 1/4
38	1 1/2	0.68	0.91	0.93	0.96	1.02	1.08	1.13	1.19	1.25	1.30	1.36	1.47	1.53	1.59	38	1 1/2
45	1 3/4	0.95	1.27	1.30	1.35	1.43	1.51	1.59	1.67	1.75	1.83	1.91	2.07	2.15	2.23	45	1 3/4
51	2	1.23	1.63	1.68	1.74	1.84	1.94	2.04	2.14	2.25	2.35	2.45	2.66	2.76	2.86	51	2
57	2 1/4	1.53	2.04	2.09	2.17	2.30	2.42	2.55	2.68	2.81	2.93	3.06	3.32	3.44	3.57	57	2 1/4
64	2 1/2	1.93	2.57	2.64	2.73	2.90	3.06	3.22	3.38	3.54	3.70	3.86	4.18	4.34	4.50	64	2 1/2
70	2 3/4	2.31	3.08	3.16	3.27	3.46	3.66	3.85	4.04	4.23	4.43	4.62	5.00	5.20	5.39	70	2 3/4
76	3	2.72	3.63	3.72	3.86	4.08	4.31	4.54	4.76	4.99	5.22	5.44	5.90	6.12	6.35	76	3
83	3 1/4	3.25	4.33	4.44	4.60	4.87	5.14	5.41	5.68	5.95	6.22	6.49	7.03	7.30	7.57	83	3 1/4
89	3 1/2	3.73	4.98	5.10	5.29	5.60	5.91	6.22	6.53	6.84	7.15	7.47	8.09	8.40	8.71	89	3 1/2
95	3 3/4	4.25	5.67	5.81	6.02	6.38	6.73	7.09	7.44	7.80	8.15	8.51	9.21	9.57	9.92	95	3 3/4
102	4	4.90	6.54	6.70	6.95	7.35	7.76	8.17	8.58	8.99	9.40	9.81	10.62	11.03	11.44	102	4
108	4 1/4	5.50	7.33	7.51	7.79	8.24	8.70	9.16	9.62	10.08	10.54	10.99	11.91	12.37	12.83	108	4 1/4
114	4 1/2	6.12	8.17	8.37	8.68	9.19	9.70	10.21	10.72	11.23	11.74	12.25	13.27	13.78	14.29	114	4 1/2
121	4 3/4	6.90	9.20	9.43	9.77	10.35	10.92	11.50	12.07	12.65	13.22	13.80	14.95	15.52	16.10	121	4 3/4
127	5	7.60	10.13	10.39	10.77	11.40	12.03	12.67	13.30	13.93	14.57	15.20	16.47	17.10	17.73	127	5
133	5 1/4	8.34	11.11	11.39	11.81	12.50	13.20	13.89	14.59	15.28	15.98	16.67	18.06	18.76	19.45	133	5 1/4
140	5 1/2	9.24	12.32	12.62	13.08	13.85	14.62	15.39	16.16	16.93	17.70	18.47	20.01	20.78	21.55	140	5 1/2
146	5 3/4	10.04	13.39	13.73	14.23	15.07	15.90	16.74	17.58	18.42	19.25	20.09	21.76	22.60	23.44	146	5 3/4
152	6	10.89	14.52	14.88	15.42	16.33	17.24	18.15	19.05	19.96	20.87	21.78	23.59	24.50	25.40	152	6
159	6 1/4	11.91	15.88	16.28	16.88	17.87	18.86	19.86	20.85	21.84	22.83	23.83	25.81	26.81	27.80	159	6 1/4
165	6 1/2	12.83	17.11	17.53	18.18	19.24	20.31	21.38	22.45	23.52	24.59	25.66	27.80	28.87	29.94	165	6 1/2
172	6 3/4	13.94	18.59	19.05	19.75	20.91	22.07	23.24	24.40	25.56	26.72	27.88	30.21	31.37	32.53	172	6 3/4
178	7	14.93	19.91	20.41	21.15	22.40	23.64	24.88	26.13	27.37	28.62	29.86	32.35	33.59	34.84	178	7
187	7 1/4	16.48	21.97	22.52	23.34	24.72	26.09	27.46	28.84	30.21	31.58	32.96	35.70	37.08	38.45	187	7 3/8
200	7 1/2	18.85	25.13	25.76	26.70	28.27	29.85	31.42	32.99	34.56	36.13	37.70	40.84	42.41	43.98	200	7 7/8
203	8	19.42	25.89	26.54	27.51	29.13	30.75	32.37	33.98	35.60	37.22	38.84	42.08	43.69	45.31	203	8
216	8 1/2	21.99	29.31	30.05	31.15	32.98	34.81	36.64	38.48	40.31	42.14	43.97	47.64	49.47	51.30	216	8 1/2
229	9	24.71	32.95	33.77	35.01	37.07	39.13	41.19	43.25	45.31	47.37	49.42	53.54	55.60	57.66	229	9
251	9 1/2	29.69	39.58	40.57	42.06	44.53	47.01	49.48	51.95	54.43	56.90	59.38	64.33	66.80	69.27	251	9 1/2
254	10	30.40	40.54	41.55	43.07	45.60	48.14	50.67	53.20	55.74	58.27	60.80	65.87	68.41	70.94	254	10
270	10 1/2	34.35	45.80	46.95	48.67	51.53	54.39	57.26	60.12	62.98	65.84	68.71	74.43	77.29	80.16	270	10 5/8
279	11	36.68	48.91	50.13	51.97	55.02	58.08	61.14	64.19	67.25	70.31	73.36	79.48	82.53	85.59	279	11
311	12 1/4	45.58	60.77	62.29	64.57	68.37	72.17	75.96	79.76	83.56	87.36	91.16	98.75	102.55	106.35	311	12 1/4
381	15	68.41	91.21	93.49	96.91	102.61	108.31	114.01	119.71	125.41	131.11	136.81	148.21	153.91	159.61	281	15
445	17 1/2	93.32	124.42	127.53	132.20	139.98	147.75	155.53	163.30	171.08	178.86	186.63	202.19	209.96	217.74	445	17 1/2

Calculation

Kg/m = 3.14159 x D2 x P / 4,000

Where

D is the hole diameter in mm

To determine the loading factor for explosive densities not listed, select the loading factor.

P is the explosive density in g/cm^3 for the size hole in the 1.00g/cm^3 column then multiply it by the required density in g/cm^3.

Volume Table

CUBIC METRES OF ROCK PER METRE OF BLASTHOLE

HOLE BURDEN (Metres)																							SPACING (Metres)
1.00	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.50**	**4.00**	**4.50**	**5.00**	**6.00**	**6.50**	**7.00**	**7.50**	**8.00**	**8.50**	**9.00**	**9.50**	**10.00**	**11.00**	**12.00**	
1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50													1.00
1.25	1.56	1.88	2.19	2.50	2.81	3.13	3.44	3.75	4.38	5.00	5.63	6.25												1.25
1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.13	4.50	5.25	6.00	6.75	7.50	9.00											1.50
2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	7.00	8.00	9.00	10.00	12.00	13.00										2.00
2.25	2.81	3.38	3.94	4.50	5.06	5.63	6.19	6.75	7.88	9.00	10.13	11.25	13.50	14.63	15.75									2.25
2.50	3.13	3.75	4.38	5.00	5.63	6.25	6.88	7.50	8.75	10.00	11.25	12.50	15.00	16.25	17.50	18.75								2.50
2.75	3.44	4.13	4.81	5.50	6.19	6.88	7.56	8.25	9.63	11.00	12.38	13.75	16.50	17.88	19.25	20.63	22.00							2.75
3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	10.50	12.00	13.50	15.00	18.00	19.50	21.00	22.50	24.00	5.50						3.00
	4.38	5.25	6.13	7.00	7.88	8.75	9.63	10.50	12.25	14.00	15.75	17.50	21.00	22.75	24.50	26.25	28.00	29.75	31.50					3.50
	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	14.00	16.00	18.00	20.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00				4.00
	5.63	6.75	7.88	9.00	10.13	11.25	12.38	13.50	15.75	18.00	20.25	22.50	27.00	29.25	31.50	33.75	36.00	38.25	40.50	42.75	45.00			4.50
		7.50	8.75	10.00	11.25	12.50	13.75	15.00	17.50	20.00	22.50	25.00	30.00	32.50	35.00	37.50	40.00	42.50	45.00	47.50	50.00	55.00		5.00
		9.00	10.50	12.00	13.50	15.00	16.50	18.00	21.00	24.00	27.00	30.00	36.00	39.00	42.00	45.00	48.00	51.00	54.00	57.00	60.00	66.00	72.00	6.00
			11.38	13.00	14.63	16.25	17.88	19.50	22.75	26.00	29.25	32.50	39.00	42.25	45.50	48.75	52.00	55.25	58.50	61.75	65.00	71.50	78.00	6.50
			12.25	14.00	15.75	17.50	19.25	21.00	24.50	28.00	31.50	35.00	42.00	45.50	49.00	52.50	56.00	59.50	63.00	66.50	70.00	77.00	84.00	7.00
			13.13	15.00	16.88	18.75	20.63	22.50	26.25	30.00	33.75	37.50	45.00	48.75	52.50	56.25	60.00	63.75	67.50	71.25	75.00	82.50	90.00	7.50
				16.00	18.00	20.00	22.00	24.00	28.00	32.00	36.00	40.00	48.00	52.00	56.00	60.00	64.00	68.00	72.00	76.00	80.00	88.00	96.00	8.00
				17.00	19.13	21.25	23.38	25.50	29.75	34.00	38.25	42.50	51.00	55.25	59.50	63.75	68.00	72.25	76.50	80.75	85.00	93.50	102.00	8.50
				18.00	20.25	22.50	24.75	27.00	31.50	36.00	40.50	45.00	54.00	58.50	63.00	67.50	72.00	76.50	81.00	85.50	90.00	99.00	108.00	9.00
					21.38	23.75	26.13	28.50	33.25	38.00	42.75	47.50	57.00	61.75	66.50	71.25	76.00	80.75	85.50	90.25	95.00	104.50	114.00	9.50
					22.50	25.00	27.50	30.00	35.00	40.00	45.00	50.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	110.00	120.00	10.00
					24.75	27.50	30.25	33.00	38.50	44.00	49.50	55.00	66.00	71.50	77.00	82.50	88.00	93.50	99.00	104.50	110.00	121.00	132.00	11.00
						30.00	33.00	36.00	42.00	48.00	54.00	60.00	72.00	78.00	84.00	90.00	96.00	102.00	108.00	114.00	120.00	132.00	144.00	12.00

Note: Tonnes of rock blasted can be calculated by multiplying the volume of rock by the density of the rock.
Calculation Cubic metres of rock / metres blasthole (V) = burden (B) x spacing (S).

Properties of Typical Rock Types

Material	Solid Density (t/m^3)	Unconfined Compressive Strength (MPa)	Young's Modulus (GPa)	Poisson's Ratio
Basalt	3.00	78 – 412	20 – 100	0.14 – 0.25
Bauxite	2.05			
Clay – dense, wet	1.70			
Coal, Anthracite	1.60	8 – 50		
Coal, Bituminous	1.36			
Dolerite	2.80	290 – 500		
Dolomite	2.96	15 – 118	20 – 84	0.1 – 0.2
Earth, moist	1.80			
Gneiss	2.88	78 – 240	25 – 60	0.1 – 0.19
Granite	2.72	100 – 275	25 – 70	0.15 – 0.34
Gypsum	2.80			
Iron ore	4.89			
Limestone	2.64	10 – 245	10 – 80	0.1 – 0.23
Limonite	3.76			
Magnetite	5.05			
Marble	2.48	50 – 200	60 – 90	0.2 – 0.35
Mica-Schist	2.70			
Porphory	2.56			
Quartzite	2.50	85 – 350	26 – 100	0.15 – 0.2
Sandstone	2.40	50 – 160	5 – 86	0.1 – 0.3
Shale	2.58	20 – 150	8 – 30	0.1 – 0.3
Silica Sand	2.56			
Siltstone	2.25			
Slate	2.72	98 – 196	30 – 90	0.1 –.0.44
Talc	2.64			

Conversion Table

This unit ▶	Multiplied by ▶	Converts to
Length		
metres (m)	3.280	feet (ft)
	39.370	inches (in)
inches (in)	25.400	millimetres (mm)
kilometres (km)	0.621	miles
Mass		
kilogram (kg)	2.20	lb
metric tonne (t)	1.10	short tons
ounce Avoirdupois (oz)	28.35	grams (g)
ounce Troy (oz)	31.10	grams (g)
grains	0.06	grams (g)
Energy		
joule	0.24	calorie
	0.74	ft-lb
calorie	3.09	ft-lb
kilowatt	1.34	horsepower
Volume		
cubic centimetres (cm^3 or cc)	0.06	in^3
cubic metres (m^3)	1.31	yd^3
cubic feet (ft^3)	0.03	m^3
US gallon	3.79	litres (l)
ounces (US fluid)	29.57	cm^3
Converts to ◀	Divided by ◀	This unit

This unit ▶	Multiplied by ▶	Converts to
Density		
lbs / ft^3	16.02	kg / m^3
gm / cm^3	62.43	lbs / ft^3
Powder Factor		
kg / m^3	1.69	lb / yd^3
Speed		
m / sec	3.28	ft / sec
in / sec	25.4	mm / sec
km / hour	0.62	miles / hour
Pressure		
psi	6.89	kPa
atmosphere (Atm)	14.70	psi
bar	14.50	psi
bar	100	kPa
Temperature		
fahrenheit -32	0.56	centigrade
centigrade + 17.78	1.8	fahrenheit
Area		
cm^2	0.16	in^2
m^2	1550.00	in^2
ft^2	0.09	m^2
Converts to ◀	Divided by ◀	This unit

Perimeter Control

Presplit Blasting is a technique to reduce the overbreak/back break on a blast. It usually utilises decoupled charges in closely spaced blastholes.

The following formula can be used to estimate the centre to centre distances of cartridged product for pre-splitting.

$$PF = \frac{L \times S}{0.5}$$

PF = Required powder factor (usually 0.3 to 0.6 kg/m^2)
L = Length of charged hole
S = Spacing between holes

$$D = \frac{L \times Q_L}{B \times S \times PF}$$

D = Centre – centre distance between cartridges (mm)
Q_L = Charge density of the explosive, in kg/m
B = Burden

Airblast

An airblast is an airborne shock wave that results from the detonation of explosives. The severity of an airblast is dependant on explosive charge, distance, and especially the explosives confinement.

$$P = K\left[\frac{R}{Q^{0.33}}\right]^{-1.2}$$

Where
P = pressure (kPa)
K = state of confinement
Q = maximum instantaneous charge (kg)
R = distance from charge (m)

Typical K factors

Unconfined	185
Fully confined	3.3

Expected damage

kPa	
0.3	Windows rattle
0.7	1% of windows break
7	Most windows break, plaster cracks
30	Risk of damage to ear drums

Minimum levels quoted

Human discomfort	120db(in)
Onset of structure damage or historic buildings where no specific limit exists	130db(in)

Please reference AS2187.2-2006 for further information

Ground Vibration

When an explosive is detonated in a blasthole, a pressure wave is generated in the surrounding rock. As this pressure wave moves from the blasthole it forms seismic waves by displacing particles. The particle movement is measured to determine the magnitude of the blast vibration.

Maximum particle vibration can be estimated using the following formula.

$$V = K\left[\frac{R}{Q^{0.5}}\right]^{B}$$

Where
V = peak particle velocity (mm/sec)
K = site and rock factor constant
Q = maximum instantaneous charge (kg)
B = constant related to the rock and site (usually -1.6)
R = distance from charge (m)

Typical K factors

Free face – hard or highly structured rock	500
Free face average rock	1140
Heavily confined	5000

Recommended maximum Peak Particle Velocities

Housing and low rise residential buildings, commercial buildings not included below	10 mm/sec
Commercial and industrial buildings or structures of reinforced concrete or steel constructions	25 mm/sec
For high rise, hospitals, long floor spans, dams or historic buildings where no specified limit exists	5 mm/sec

Expected damage

PPV (mm/sec)	
13	Lower limit for damage to plaster walls
19	Lower limit for dry wall structures
70	Minor damage
140	>50% chance of minor damage to structures
190	50% chance of major damage

Please reference AS2187.2-2006 for further information

Glossary

Airblast Airborne shock wave resulting from the detonation of explosives.

Back break Rock broken beyond the limits of the last row.

Blasthole pressure The pressure which the gasses of detonation exert on the blasthole wall.

Burden The distance between adjacent rows.

Charge weight The amount of explosive charge in kilograms.

Column charge A continuous charge of explosives in a blasthole.

Critical diameter The minimum diameter for propagation of a stable detonation.

Cutoffs A portion of an explosive column that has failed to detonate due to rock movement.

Decoupling The use of explosive products having smaller volume than the volume of the blasthole it occupies.

Delay blasting The use of delay detonators or connectors to separate charges by a defined time.

Density Mass per unit volume.

Detonation pressure The pressure created in the reaction zone of a detonating explosive.

Explosive Any chemical or mixture of chemicals that can react to produce an explosion.

Free face A rock surface that provides the rock with room to expand when blasted.

Flyrock Rock that is propelled through air from a blast.

Fragmentation Measure to describe the size of distribution of broken rock after blasting.

Ground vibration Ground movement caused by the stress waves emanating from a blast.

Initiation The act of detonating explosives by any means.

Line drilling A method of overbreak control which uses a series of closely spaced holes that are not charged.

Loading density The weight of explosives per metre of blasthole.

Maximum Instantaneous Charge (MIC) Mass of explosive detonating in some defined time period, usually 8 milliseconds.

Particle velocity The speed of movement in a given direction of a rock or soil mass.

Pre-split A controlled blast in which decoupled charges are fired in holes on the perimeter of the excavation prior to the main firing.

Relative Bulk Strength (RBS) The energy yield per unit volume of an explosive compared to ANFO.

Relative Weight Strength (RWS) The energy yield per unit mass of an explosive compared to ANFO.

Spacing The distance between blastholes in the same row.

Stemming Inert material used to confine the gasses generated during detonation.

Swell factor The ratio of the volume of broken rock to the volume of in-situ rock.

Velocity of Detonation (VoD) The velocity at which a detonation progresses through an explosive.

Safe Handling, Transportation And Storage

First Aid

You can find detailed first aid information on the relevant Dyno Nobel Safety Data Sheets. Refer to www.dynonobel.com for more information if required.

Safety

All explosives are classified as dangerous goods and can cause personal injury and damage to property if used incorrectly.

Transportation and Storage

All explosives must be handled, transported and stored in accordance with all relevant regulations. Stock should be rotated so that older products are used first.

Technical Information

Technical information can be found on www.dynonobel.com or speak to your Dyno Nobel Commercial Manager.

We offer a comprehensive range of:

- Technical Data Sheets (TDS)
- Safety Data Sheets (SDS)
- Explosive Engineers' Guide
- Computer-Based Training (CBT) CDs
- Field Training Manuals
- Product Price List

DISCLAIMER

The explosive products discussed in this document should only be handled by persons with the appropriate technical skills, training and licences. While Dyno Nobel has made every effort to ensure the information in this document is correct, every user is responsible for understanding the safe and correct use of the products. If you need specific technical advice or have any questions, you should contact your Dyno Nobel representative. This information is provided without any warranty, express or implied, regarding its correctness or accuracy and, to the maximum extent permitted by law, Dyno Nobel expressly disclaims any and all liability arising from the use of this document or the information contained herein. It is solely the responsibility of the user to make enquiries, obtain advice and determine the safe conditions for use of the products referred to herein and the user assumes liability for any loss, damage, expense or cost resulting from such use.

Dyno Nobel Asia Pacific

Queensland

Principal Place of Business
282 Paringa Road
Gibson Island
Murarrie Qld 4172
Australia
PO Box 3559
Tingalpa DC Qld 4173
Australia
Telephone: +61 7 3026 3900
Fax: +61 7 3026 3999

New South Wales

Mt Thorley Technical Centre
5 Woodland Road
Mt Thorley NSW 2330
Australia
PMB 17
Singleton NSW 2330
Australia
Telephone: +61 2 6574 2500
Fax: +61 2 6574 6849

Western Australia

Perth Office
Suite 3, Level 2
Eastpoint Plaza
233 Adelaide Terrace
Perth WA 6000
Australia
Telephone: +61 8 6188 3000
Fax: +61 8 9325 4910

Indonesia

Jakarta Office
PT. dnx Indonesia
Park View Plaza, 1/F
Jl. Taman Kemang 2 No. 27
Jakarta
Indonesia 12730
Telephone: +62 21 7179 4791
Fax: +62 21 7179 4794

Papua New Guinea

For PNG enquiries,
contact the Gibson Island,
Brisbane office.

www.dynonobel.com

Dyno Nobel Asia Pacific Pty Limited (ACN 003 269 010) is a subsidiary of Incitec Pivot Limited (ACN 004 080 264) Level 8, 28 Freshwater Place, Southbank Vic 3006.

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Groundbreaking Performance