THE WORLD'S SAFEST HIGH-PERFORMANCE ALTERNATIVE TO CONVENTIONAL EXPLOSIVES

MINING | QUARRIES | CIVILS

Safety Switch™
Dual-Stemming™
Autostem™ Sequential
Waterproof

HIGH PERFORMANCE, SELF-STEMMING
NON-DETONATING CARTRIDGES

AUTOSTEM™ TECHNOLOGY SOLUTIONS FOR EVERY BLASTING ENVIRONMENT

AUTOSTEM

THE SAFER ALTERNATIVE TO EXPLOSIVES ACCREDITED WORLDWIDE AS A GAS GENERATOR UN0432, 1.4S

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ABOUT US

Committed To Continued Innovation In Blasting Technology

We are the global leaders in the research, development and commercialization of alternative explosive technology offering a safer, environmentally friendly and more cost-effective replacement for explosives.

Our research and development team remains unmatched, having developed the world-patented, novel self-stemming technology and the safety switch in Autostem Generation III.

AUTOSTEM MEETS INTERNATIONAL SAFETY REQUIREMENTS

ALL AUTOSTEM PRODUCTS ARE ACCREDITED AND ENDORSED FOR USE BY ALL MAJOR EXPLOSIVE REGULATORY BODIES GLOBALLY.

WHY CHOOSE US?

SAFETY

- Safety Switch technology.
- No potential for human error.
- Completely harmless gas profile suitable for underground use in confined areas.
- No clearing area required beyond 20 meters.
- No damage to hanging wall, footwall or surrounding equipment/ structures.
- No flying rock or debris.
- Can't be used in criminal activities.
- Extremely safe to use.

EASE OF USE

- No stemming required – this is the world's first 'drop-and-go' cartridge.
- Accelerated loading time by eliminating the need for stemming.
- Suitable for above ground, underground and deep level mining applications.

EFFECTIVENESS

- Sequential firing capability (pyrotechnic and/ or shocktube).
- No measurable noise vibration and no shock wave created.
- No pulverization of ore – high value commodity recovered (no fines/ dust).

CLASSIFICATION

- No police or guard escort required (can even be transported on a commercial passenger airline).
- 18-month shelf life.

BAM Bundesanstalt für Materialforschung und -prüfung

Queensland Government

Natural Resources Canada | Ressources naturelles Canada

Canada

Primary and Secondary Blasting System | Integrates any Centralized Blasting System | Sequential Ignition | Continuous Blasting Cycle | Self-Stemming | Non-Detonating | No Airblast | Low Vibration | No Overbreak | Controlled Fly Rock | Decreased Danger Area | No Noxious Emissions | No Evacuation Of Personal and Equipment Necessary | No Explosive Registered Delivery Vehicle Required.

THE WORLD PIONEER OF THE AWARD-WINNING TECHNOLOGY

Autostem cartridges are non-detonating, self-stemming rock breaking cartridges that are developed by Non-Detonating Solutions (Pty) Ltd. The Company has a long history in the development of innovative non-detonating rock breaking solutions for mining, civil and quarrying works.

We are the global leaders in the research, development and commercialization of alternative explosive technology offering a safer, environmentally friendly and more cost-effective replacement for explosives.

The **Autostem Generation I** cartridge was released to market in 2013, as NDS's most advanced rock breaking solution for deep level, and hard rock, Underground or Surface mining and civil environments. In 2014 **Autostem Generation II** was introduced as the worlds first dual self stemming cartridge offering greater power charges.

Our research and development team remains unmatched, having developed the world-patented, novel self-stemming technology and the safety switch in **Autostem Generation III** which was launched in 2017. The award-winning technology in the Generation III cartridge has gained international recognition as a true alternative for primary and secondary applications in any blasting environment world over.

Generation I

Autostem Generation 1 was launched in 2013 a revolutionary non-detonating Autostem Cartridge. The worlds first self-stemming rock blasting technology.

Generation II

AutoStem Gen II was introduced in 2014 as the world's first 43mm pyrotechnic cartridge range with dual self-stemming capability and available in power charges up to 300g..

Generation III

AutoStem Gen III was launched to market in 2017. The products are the most powerful and safest range of non-detonating cartridges ever developed and span the entire range of hole size requirements from the ultra-small mini cartridge of 6mm to the largest self-stemming cartridge ever developed at 87mm and integrates seamlessly with any blasting system.

Generation IV

COMING SOON !

We are currently in development stages of our latest range of Autostem cartridges. **'Our scientists and development team are pushing the technology with concepts never seen before',** offering more world first features which will be released with the **AUTOSTEM GENERATION IV** cartridges.

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GENERATION III

THE WORLD'S SAFEST MOST POWERFUL NON-DETONATING CARTRIDGE RANGE

Electric and detonator-shocktube product options available

GENERATION 3 the 35mm (1.38 inch) cartridge

- Suitable for borehole sizes up to 40mm (1.65 inch)
- Available in 100g, 180g and 300g charges
- Available with electric initiation and detonator capable initiation
- Suitable for deep level mining, trenching, civil blasting

GENERATION 3 the 43mm (1.69 inch) cartridge

- Suitable for borehole sizes up to 55mm (1.96 inch)
- Available in 350g and 550g charges
- Available with electric initiation and detonator capable initiation
- Suitable for deep level mining, tunneling, embedded rock, hard blast environments

GENERATION 3 the 87mm (3.42 inch) cartridge

- Suitable for borehole sizes up to 94mm (3.70 inch)
- Available in 1700g charges
- Available with electric initiation and detonator capable initiation
- Suitable for large borehole blasting and benching

All Gen III products can be integrated with centralized blasting systems

35mm product range with detonator/shocktube integrated

43mm product range with detonator/shocktube integrated

87mm product range with detonator/shocktube integrated

Sequential firing capability utilizing standard explosive accessories

AutoStem Gen III seamlessly integrates into any blasting system, from any supplier, anywhere in the world

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MINI-CARTRIDGES

We identified a need for a smaller cartridge that could be used without compressors, rock drills, diesel and air hoses. The Autostem Mini range was thus designed for applications where our customers prefer to use hand-held electric drills, rather than incurring the cost and labour in using compressors and rock drills. The cost of rock/concrete breaking using the Autostem Mini range are in some cases more than 90% cheaper per cubic meter than conventional breaker equipment.

The 9mm range of AutoStem Mini

- Available in 3g, 6g and 9g charges
- Self-stemming
- Electric initiation
- Highly delicate blasting work
- Max borehole size: 12mm

The 17mm range of AutoStem Mini

- Available in 20g, 30g and 40g charges
- Self-stemming
- Electric initiation
- More significant blasting work
- Max borehole size: 20mm
- Performance: 20g = 1 cube / cartridge
  30g = 2 cubes / cartridge
  40g = 2.5 cubes / cartridge

CONTROL YOUR BLASTING WITH SPECIFIC MICRO POWER CHARGES

The Autostem Mini-range is perfect for sensitive blasting without sacrificing power. Autostem Mini blasting cartridges are available in 17mm diameter **Fragmentor**, suitable for a 20mm borehole and in a 9mm **Splitter**, suitable for a 12mm borehole. Power charges range from 3g – 40g making for the widest range of blasting products in the Mini-Cartridge size category.

Product code: 9mm x 3g
Performance: 0.3 cubes / cartridge

Product code: 9mm x 6g
Performance: 0.5 cubes / cartridge

Product code: 9mm x 6g
Performance: 1 cube / cartridge

AUTOSTEM MINI-CARTRIDGES

The cost of rock/concrete breaking using the AutoStem Micro range is in some cases more than 90% cheaper per cubic meter than conventional breaker equipment. It has various other uses, including selective or targeted blasting, blasting of oversize crusher hang-up's, concrete demolition, residential blasting and logging.

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HIGH PERFORMANCE, SELF-STEMMING, NON-DETONATING CARTRIDGES

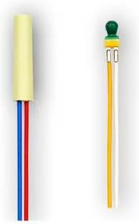
Self-Stemming. Safety Switch Technology. Gen III Booster. Auto Sequential.

					
POWER AutoStem delivers twice the power than conventional high explosives so less is required	**ACCESSORIES** AutoStem products do not require expensive accessories such as detonators, which also does away with the requirement for strict stock control and inventory of these products	**MANUFACTURING** AutoStem production processes are more simplified, greener and less expensive.	**TRANSPORTATION** AutoStem does not require special vehicles with security escorts for transportation, and storage is simplified.	**SAFETY** Using AutoStem does not require clearing of equipment and personnel for more than 50m and in a mining environment re-entry is immediate.	**STORAGE** Shelf-life of AutoStem is years, so if not used immediately it is not wasted – explosive are months.

SUMMARY TECHNICAL INFORMATION

					
ENERGY CONTENT 2.0 x more powerful than the next best packaged explosive at 5,121 j/g energy capacity	**SPEED OF DEFLAGRATION** 340 m/s – Ensuring minimal vibration impact to surrounding environment	**PRESSURE** 500 MPa – With reaction runaway, AutoStem Cartridges reach maximum pressure within milliseconds sufficient to break out the hardest rock	**DENSITY** 1.1 g/cm3 – Highest packing and mix density makes Gen III Cartridges the most powerful blasting cartridge available worldwide	**VIBRATION** PPV reduction relative to conventional explosives by up to 90% (depending on cartridge size, rock competency and application type)	**WATER RESISTANT** Water resistant as a standard to a depth of 50m (6 bar)

AUTOSTEM ACCESSORIES



ELECTRIC IGNITOR (FUSE HEAD) AND INITIATORS

- Highest quality fuse head for reliable ignition
- Multiple wire lengths available (1.5m, 3.0m and 5.0m)
- Electrical resistance: 0.5 ohm
- Safety impulse: 8 mj per ohm
- Initiation impulse: 16 mj per ohm
- Safe electrical current: 0.45 A
- Activating electric current: 2.12A

741 MODEL SHOT EXPLODER

- 650V Nominal Firing Voltage
- 8.0J Nominal Output Energy
- Firing mechanism: Spring return key switch
- Up to 50 Cartridges in Series
- Battery Type: Rechargeable
- Capacity: Typically 1,000 firings
- Charging: Charged from mains power (100-250 V, 47-65 Hz)
- Charging time: 6 hours to full charge
- Unit dimensions: 120mm x 82mm x 40mm
- Unit mass: 0.55kg

1351 MODEL SHOT EXPLODER

- 1350V Nominal Firing Voltage
- 40.0J Nominal Output Energy
- Firing mechanism: Spring return key switch
- Up to 250 Cartridges in Series
- Battery Type: Rechargeable NiCd
- Capacity: Typically 500 firings
- Charging: Charged from mains power (220V)
- Charging time: 14 hours to full charge
- Unit dimensions: 163mm x 125mm x 66mm
- Unit mass: 1.9kg

CONTINUITY TESTER

- SABS approved and intrinsically safe
- Light emitting diode to confirm continuity
- Continuity indicated for up to 1,000 ohms
- Battery life: 1 million testing's
- Unit dimensions: 72mm x 50mm x 23mm
- Unit mass: 150g

OHM METER

- SABS approved for use in fiery mines
- Liquid crystal display
- Range of up to 2,000 ohms
- Battery life: 200 hours of continuous testing
- Unit dimensions: 102mm x 72mm x 32mm
- Unit mass: 240g

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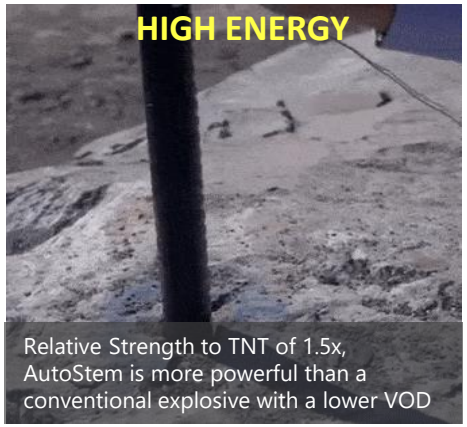
AUTOSTEM APPLICATIONS

The World's safest and most advanced high performance blasting technology.

SAFETY

For safer transport, storage and handling, the cartridge is fitted with the unique AutoStem Safety Switch™

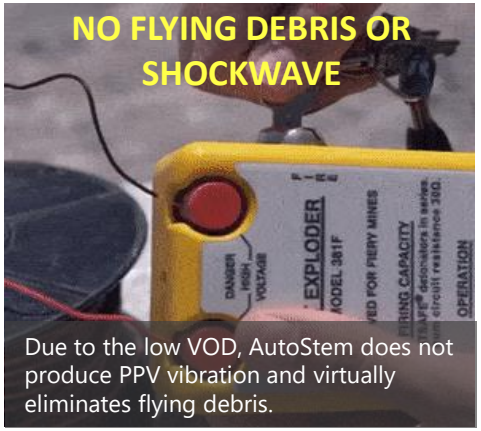


HIGH ENERGY

Relative Strength to TNT of 1.5x, AutoStem is more powerful than a conventional explosive with a lower VOD

VARYING DEPTHS

Usable in conventional explosive blast holes to varying depths

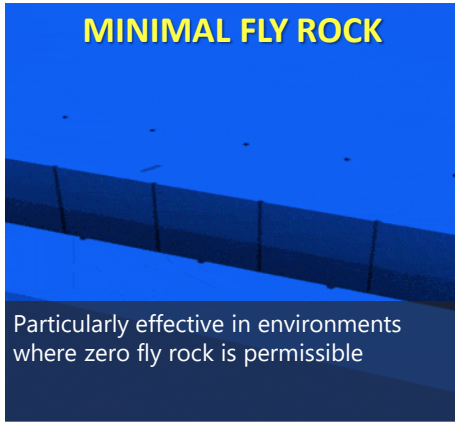


NO FLYING DEBRIS OR SHOCKWAVE

Due to the low VOD, AutoStem does not produce PPV vibration and virtually eliminates flying debris.

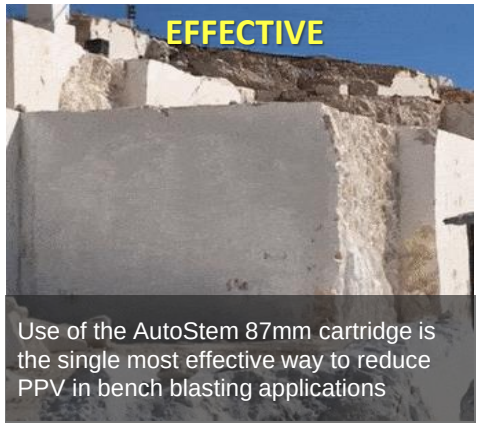
MINING & QUARRYING

The world's first dual self-stemming, non-detonating benching cartridge



MINIMAL FLY ROCK

Particularly effective in environments where zero fly rock is permissible



EFFECTIVE

Use of the AutoStem 87mm cartridge is the single most effective way to reduce PPV in bench blasting applications

INHERENT SAFETY

Blasting with AutoStem 87mm cartridge permits one to remain along with equipment, on-the-bench, when blasting due to inherent safety

UNCONFINED IGNITION

SAFETY SWITCH OFF DURING IGNITION

The cartridge can not be inserted into a drilled borehole without the safety switch set in firing position or be initiate and posses no explosive risk– a world first safety feature.

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AUTOSTEM CIVILS

Safe civils blasting using AutoStem blasting cartridges

Inserting cartridge in columns

Vibration damage kept to a minimum

No shockwave, eliminating the potential for damage to surrounding structures

Inside of buildings, built-up areas and in residential and commercial environments

AUTOSTEM UNDER WATER

Autostem blasting cartridges are waterproof to a depth of over 50 meters

The highest profile under water project to which AutoStem has supplied cartridges has undoubtedly been the salvaging of the Costa Concordia off the coast of Italy.

AutoStem 35mm range of cartridges has been utilized on numerous occasions in deep sea and harbor salvage

No explosive accessories were required on board, facilitating a security free and safe environment

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AUTOSTEM VS. CONVENTIONAL EXPLOSIVES

CATEGORY	AUTOSTEM TECHNOLOGY	CONVENTIONAL EXPLOSIVES
Classification	Product of pyrotechnic, 1.4s, UN 0432	Explosive 1.1
Detonation vs. Deflagration	Low speed deflagration No shockwave No flying debris beyond 30m No dust or harmful gases	High speed detonation Shockwave Flying debris Dust and toxic fumes
Safety	Will not initiate unless the safety switch is unlocked. Can be initiated outside of a borehole however posses no explosive risk. Does no require any explosive accessories	Will explode anywhere Required explosives accessories including detonator, shock tube, etc.
Stemming	Revolutionary patented Autostem concept, requires no stemming Safer Quicker Low cost (no tamping)	Requires boreholes to be tamped Stemming required to confine blast Time personal intensive Significant cost
Transportation and Storage	Transported using normal vehicle, standard truck, rail, sea –freight and passenger plan No explosive magazine required	Required explosives magazines, explosives registered trucks, cannot be transported by plan Extensive permits required
Waterproof	Same cartridge can be used above -, below-, and underwater Fully waterproof	Cannot be used under water or in wet holes
Accessories	Does not require explosive accessories Minimal inventory required	Requires a detonator / shock tube to be used Large inventory required
Pulverization of high-volume commodity	Due to avoiding shockwave, Autostem does not pulverize higher value commodity in mining situations	Due to shockwave, explosives destroy up to 40% of high value mining commodity
Product Range	Mini-range available (9mm), mini range available 17mm) Standard range available (35-89mm)	Only standard product sizes available No small blasting products
User Advantages	Can be used in built-up areas Close to foundation and gas pipes Allows for continuous mining underground and in pit operations Blasting near cities and villages	Not permitted in built up areas Cannot be used near strategic infrastructure Long blasting cycle times Not permitted near villages
Shelf Life	Shelf life of up to 18 months	Limited shelf life with product instability issues

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THE SAFER ALTERNATIVE TO EXPLOSIVES
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COMPARISON WITH MECHANICAL BREAKERS FOR OVERSIZE MANAGEMENT VS AUTOSTEM™ CARTRIDGES

MECHANICAL BREAKER

SCOPE OF WORKS

Mechanical Breaking of Secondary Oversize Material:
In this comparison, an excavator fitted with a rock breaking moil were utilised.

PERFORMANCE VALUES

The breaking works was preformed by one operator daily.

The total number of true operating hours were recorded as 540 hours. (This accounts for: machine downtime; maintenance; part replacements; blasting schedules; miscellaneous) Equivalent to 67 fully functional days per annum.

Total number of boulders broken:
- 3,350 (avg. 50 per day)

Tons worked:
- 10,050 tons (avg of 3 tons per cubic meter)

COSTS AND PRODUCTIVITY

Considering all costs for plant equipment consumables and labour and productivity cycles:

CONCLUSION

This conventional method is costly, and productivity is limited to operator and equipment efficiency.

AUTOSTEM GEN I CARTRIDGES

SCOPE OF WORKS

Drill and Blast of Secondary Oversize Material:
In this comparison, Drilling and blasting with Autostem Cartridges were utilised.

PERFORMANCE VALUES

The blast hole drilling was preformed, by a single rock drill operator who prepared the holes, by hand, with a pneumatic rock drill and compressed air. AutoStem Generation 1 cartridges where utilised by the blaster for the blasting of the oversize material. The drilling and blasting was preformed on a continuous drill and blast cycle daily with only a local clearance and no evacuation of the site for blasting.

Total number of boulders drilled and broken:
- 3,350 holes drilled and blasted
(avg. 70-100 holes drilled per day)

Tons worked:
- 10,050 tons (avg of 3 tons per cubic meter)

COSTS AND PRODUCTIVITY

Considering all costs for plant equipment consumables, labour and productivity cycles;

CONCLUSION

In support of optimization, the innovative Autostem solution greatly reduces costs, increases productivity, improves efficiencies and is a value add to any blasting operation.

THE WORLD'S SAFEST AND MOST ADVANCED HIGH-PERFORMANCE BLASTING TECHNOLOGY

COMPARISION OF AUTOSTEM AND CONVENTIONAL EXPLOSIVES ON BENCHING

NO	DESCRIPTION	AUTOSTEM	EXPLOSIVES
1	Bench height (m)	10	10
2	Hole length (m)	10	10.5
3	Drilling pattern S x B (m)	3x3	3x3
4	Total blasted volume (m3)	1200	1200
5	Amount of blasting agents (kg)	81.6	440
6	Total drilled hole (pcs/meter)	12 units /120 meters	12 units/ 126 meter
7	Sub-drilling (m)	no need to sub-drilling	min 0,5 meter
8	Specific charge (kg/m3)	0.068	0.367
9	Specific drilling (m/m3)	0.100	0.105
10	Detonation velocity (m/s)	340	>3200
11	Back break	No deformation 2 meters above the last hole	Back breaks makes unstable and non-uniform faces for next blasts
12	Transportation	Easy transportation with any vehicle	Can be transported only ADR specific vehicles
13	Remained material	Can be stored at construction site	Must be destroyed
14	Stemming	No necessary in case of need	Must stemmed with homogenous aggregate material
15	Fly rock	No fly rock after 50 meters	Could fly more than 1 km
16	Working environment	All equipment's can keep working after 50-meter radius	At least 500-meter radius must be cleared
17	Waterproof	Totally waterproof	Need to use specified explosives
18	Hazardous classification	1.4S class	1.1 class
19	Labour work	Less labour work due to less amount of material	More blasting agent and more bags to carry

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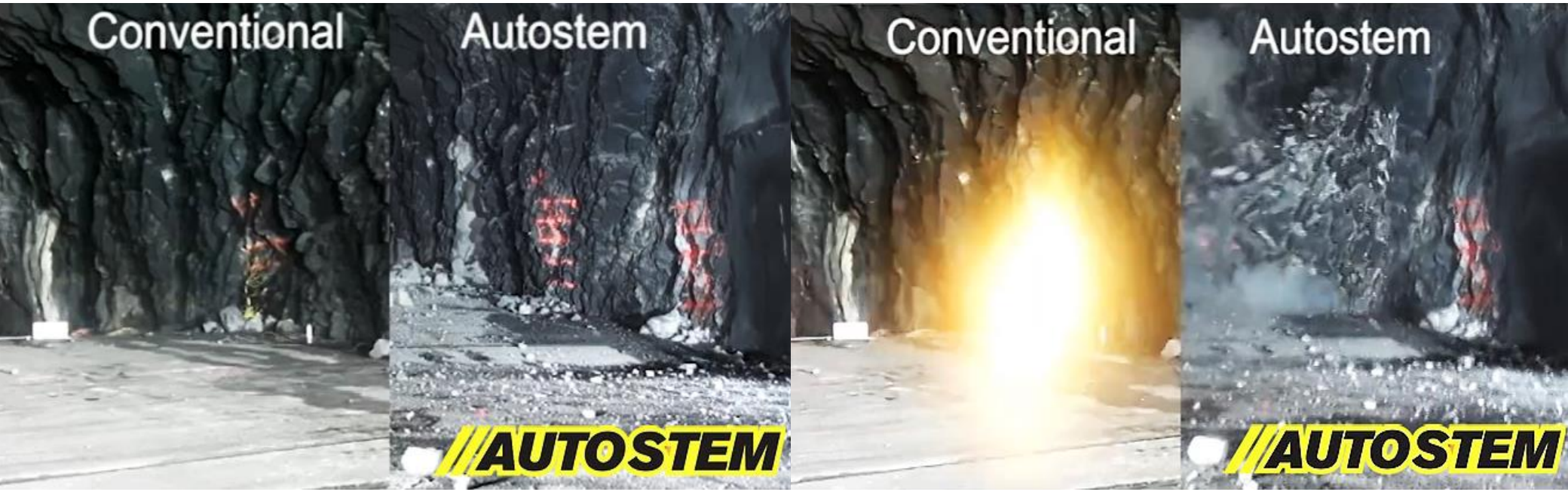
AUTOSTEM VS CONVENTIONAL EXPLOSIVES



66% reduction in vibration using Gen III

4.8kg of AutoStem used versus 10.0kg of conventional packaged explosives for a 1.2m advance, 90% reduction in dust, and vibration at 6m, 12m and 18m markedly reduced. Immediate re-entry possible with no toxic gas concentration

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THE WORLD'S SAFEST AND MOST ADVANCED HIGH-PERFORMANCE BLASTING TECHNOLOGY

COMPARISION OF AUTOSTEM AND CONVENTIONAL EXPLOSIVES ON TUNNELING

NO	DESCRIPTION	AUTOSTEM	EXPLOSIVES
1	Face advancement (m)	1.80	1.62
2	Hole length (m)	1.9	1.9
3	Drilling pattern S x B (m)	1x1	1x1
4	Cross-section of face (m2)	120	120
5	Total blasted volume (m3)	216	193.8
6	Amount of blasting agents (kg)	44.55	82
7	Total drilled hole (pcs/meter)	74 units /140,6 meters	74 units/ 140,6 meters
8	Sub-drilling (m)	no need to sub drilling	no need to sub drilling
9	Specific charge (kg/m3)	0.206	0.423
10	Specific drilling (m/m3)	0.651	0.725
11	Detonation velocity (m/s)	340	>3200
12	Back break	No deformation 20 centimeters above the contour holes	Back breaks makes unstable and non-uniform faces for next blasts
13	Transportation	Easy transportation with any vehicle	Can be transported only ADR specified vehicles
14	Remained material	Can be stored at construction site	Must be annihilate
15	Stemming	No need to stemming, with self-stemming feature Autostem deflagrates just at the bottom of blast hole	Better to stem, because explosive could throw out from hole with detonation
16	Efficiency	> %95	< %85
17	Fly rock	No fly rock after 50 meters	Could fly more than 500 m
18	Working environment	All equipment's can keep working after 50-meter radius	At least 500-meter radius must be cleared
19	Waterproof	Totally waterproof	Need to use specified explosives
20	Hazardous classification	1.4S class	1.1 class
21	Labour work	Less labour work due to rigid outer shell while pushing hole	More blasting agent & more bags to carry. Explosives will be deformed while pushing hole and charging time will increase.

AUTOSTEM

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DRILL AND CHARGE – THE AUTOSTEM SOLUTION

- For the first time ever, a viable safe automated and mechanical drill-and-charge solution made possible with Autostem™
- World's first fully functional and safe drill-and-charge equipment.
- Multiple units operational since 2018 at:
  - Finsch Mine, South Africa
  - Rio Tinto, Australia
- Designed by Autostem™ exclusively for use with the self-stemming capability of the Autostem™


AUTOSTEM CARTRIDGE


AUTOSTEM CARTRIDGE CHARGING


LASER, TELEMETER, CAMERAS, SPRINKLER ARE OPERATOR'S ASSISTANT


INSERTION CARTRIDGE CHARGING

SANDVIK DB331 AUTOSTEM CARTRIDGE

SANDVIK

Generation III

- Autostem™ cartridges adapted to be able to hold themselves securely in up-holes without any needed stemming
- Autostem loading tool integrated with Sandvik DB 331 charging unit
- No explosive accessories required at all – neither on board or in the drill-and-charge solution
- No emulsion mixing tanks or charging up systems required
- Sandvik DB331 Secondary breaking solution can adapt the AutoStem chemical cartridge.
- The chemical cartridges offer good rock breaking performance, yet little shock and vibration.
- Autostem™ cartridges requires no stemming, no explosive accessories and a minimal clearing area.
- Accredited as 1.4s in each of the world's main markets including the USA, the 27 member states of the EU, Eastern Europe, North-America, Australia, Africa and India.
- AutoStem is in full compliance with the standards set by the United Nations under the Series 6 Requirements for the Transportation and Storage of Dangerous Goods.

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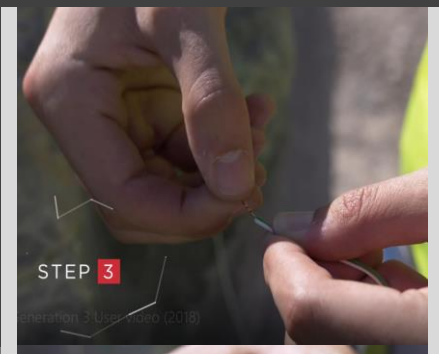
STEP 1

Unlock the cartridge by turning the rotational safety lock anti clockwise to the fire position aligning the fuse head with the granular mix.

STEP 2

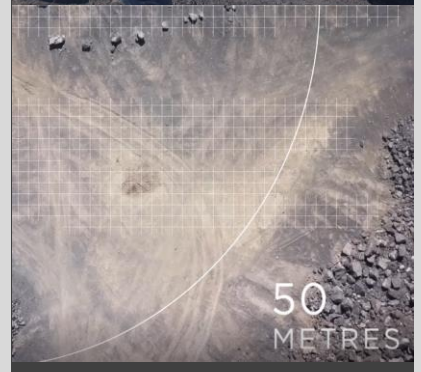
Drop the cartridge into the borehole making sure that the borehole is the correct diameter.

STEP 3



Wire it up and test the circuit for continuity.

STEP 4



Stand clear with a recommended area of 50 meters.

STEP 5

Connect to the firing box and initiate.

AUTOSTEM TRAINING ACADEMY

THE WORLD'S FIRST TRAINING ACADEMY FOR AUTOSTEM™ PRODUCTS OF PYROTECHNIC UN0432, 1,4s, P2 CLASSIFICATION

We are pleased to announce the establishment of the exclusive Autostem Training Academy in Turkey. We offer comprehensive theoretical and practical training courses to certify competency in all aspects of AutoStem, including usage in mining, tunneling, benching, quarrying, civil demolition, civil engineering marine work, storage, and transportation. The academy also offers technical engineering consultation services for any application.

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THE WORLD'S SAFEST HIGH-PERFORMANCE ALTERNATIVE TO CONVENTIONAL EXPLOSIVES

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