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FROM THE SECRETARY GENERAL'S DESK

"The Safety of the People shall be the Highest Law"

Marcus Tullius Cicero-Roman Statesman

This is what we as an industry strive for and attempt to achieve as our main goal. SAFEX International was created out of this by a number of industry leaders 62 years ago ,with the objective to assist in a global safety drive by all the explosives companies. From this relatively small beginning where the organization assisted in safety related information sharing, across borders and cultures, SAFEX has grown to an organization assisting the Industry over a broad base:

- Information sharing through an extensive database
- Congresses focused on safety networking and learning
- eLearning for distance-based learning
- Expert Panel for neutral safety assistance
- Good Practice Guides developed by international Working Groups
- Classroom Training at conferences
- Newsletters
- Liaison with similar organizations globally
- Website

The above was achieved with the help of you as an industry and I implore you to remain involved in the SAFEX activities. With your invaluable support we will be able to stay relevant in supporting the industry to become safer if not the safest as members of the global manufacturing industries!

SAFEX CONGRESS XX
SALZBURG 2020

24 MAY TILL 30 MAY 2020

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The eLearning Portal has grown from humble beginnings of having only one module in English -the Basis of Safety- to having the following modules available on the Portal:

- Basis of Safety in English, Portuguese and Spanish
- Incident Investigation
- Introduction to Explosives
- Primary Explosives
- Secondary Explosives

These are all available for training by members and non-members. Please send any enquiries to me.

Six Incident Notifications has been filed by members during the last quarter:

- IN18-01 Trailer fire
- IN18-02 Cartridge Initiation
- IN18-03 Fusehead Initiation
- IN18-04 Fusehead Initiation
- IN18-05 Hopper Detonation
- IN18-06 ANSol Transport Fire

Please let me have reports on all your incidents and critical near misses. Remember that the learning from any incident potentially saves lives and business interruption. If you are in doubt as to what to report, please contact me.

The organization of the SAFEX Congress 2020 is well advanced and in this issue the details of the Congress are revealed .Please support this event by attending the training event, Work Groups and Plenary sessions .The first call for papers has already been issued and I thank those members who already responded to this call.

SAFEX INTERNATIONAL CONGRESS 2020

Introduction

The Congress in 2020 will be held at the Sheraton Hotel Conference Centre in Salzburg Austria. The Project Office has been appointed and the Contract signed. The in-country hosts will be Austin Powder in Austria and SAFEX thanks their management for their assistance and help thus far.

Again, the Congress will have as an objective information sharing, explosives education and development of safety initiatives. Take this opportunity by penciling the event into your diaries well ahead of time.

Conference Facility

The conference facility is centrally located adjacent to the Sheraton Hotel. There are, however, several hotels in short walking distance to the conference facility.

Front/outside view of Conference Facility with Sheraton Hotel on the left

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The conference facility (State owned and operated) and hotels are centrally located, within short walking distance from restaurants, shopping area and other historical venues. The facility is spacious and will easily handle in 200 to 300 people.

The provisional Conference Programme is detailed in the table below:

DATE	ACTIVITY	CONCURRENT ACTIVITY
Sunday, 24 May	Registration - Training	
Monday,25 May	Registration - Training Training Session	
Tuesday, 26 May	Training Session Registration – Workgroups	
Wednesday,27 May	Registration - Workgroups Workgroup Sessions Registration - Congress Welcome Reception	FEEM AGM
Thursday,28 May	Registration - Congress Plenary Sessions – Open Day Chairman's Programme Board Meeting	Spouses' Programme
Friday, 29 May	Plenary Sessions – Closed Day General Assembly of Members Gala Dinner	Spouses' Programme
Saturday, 30 May	Congress Excursion	

Training Event

This event will be run over the first two days of the Congress under the tutorship of Martin Held and Andy Begg. It will cover in broad the Basis of Safety in the following areas:

- Incidents in maintenance
- Classification of primary and secondary explosives

The sessions will be limited to 40 people only ,so early registration will be necessary.

Work Groups

The following Work Group Sessions are planned for the Congress:

- Decontamination -Noel Hsu
- Emulsion-Martin Held/Cheryl Kelly
- Explosives Transport-Noel Hsu
- Remediation- Mervyn Traut

These Groups will be run in parallel sessions on the Wednesday and the attendance of all experts across the industry is welcomed.

Plenary Sessions

The Plenary sessions will as traditionally be taking place over a 2day period. Noel Hsu will be responsible for the

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Open Day:

- Behavioral issues determining the Safety Culture
- Manufacturing technologies and impact on safe operations
- Emergency response

The Closed Day session will be organized by Martin Held:

- Members only day
- Focusing on Incident Reporting
- Learning from Plant Design and Management of Change
- Closed day to be "policed" to ensure exclusivity for Members.

Social Program

The social program was chosen such that the tastes of everybody will be catered for, from sightseeing, cultural heritage and nature. Again, the company assisting with this has shown a high level of professionality. The proposed program is outlined below:

Thursday 21 May 2020

Three main factors are responsible for Salzburg's world-wide fame: the incomparable charm of its architecture, the beauty of the surrounding countryside and the fortune that W.A. Mozart was born here in 1756.On this walk of the Old Town the Cathedral and St. Peter's Abbey, the Residence, the Festival-Theatres, the oldest café, Salzach river, the mountains in town and many other sights will be shown. The tour also includes a trip to the fortress by funicular to enjoy a wonderful view of the town and its magnificent alpine surroundings. Fortress Hohensalzburg is an imposing castle complex from the 11th century, a real eye-catcher over the Baroque towers of the city. Lunch will be served at the Restaurant M32 high above the city on Mönchsberg.

After lunch the excursion continue by bus to famous Hellbrunn Castle

Friday 22 May 2020

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Salzburg celebrates W.A. Mozart 260 years after his birth, nowhere else is Mozart more alive than in Salzburg!
As the city in which Wolfgang Amadeus Mozart was born and grew up, Salzburg can fairly claim the title of City of Mozart. One of the most popular museums in Austria is Mozart's Birthplace, tucked away in the Getreidegasse. Take a journey back into the 18th century. Mozart's fortepiano, on the other hand, can be found at the Mozart Residence on Makartplatz Square. We pass by the Mozart Monument, which has stood watch over Mozart Square since 1842.
Walk to unique St. Peter's Cemetery and visit the grave of Mozart's sister Nannerl. See the buildings where the Mozart family lived, hear about their lives and amusing stories. Listen to Mozart's music .Enjoy a private concert of approx.30-40 minutes in one of the townhouses. Lunch will be served at Restaurant St. Peter's Stiftskeller one of the oldest restaurants of Salzburg.

Saturday 23 May 2020 Congress Excursion
The Lake District and Hallstatt

The Salzkammergut area (Lake District), with a total of 76 lakes, is one of the most impressive regions in the heart of Austria. While we are travelling east, we pass Lake Fuschl and reach St. Gilgen, the birthplace of the mother of Mozart. In St. Gilgen a wonderful cruise on the Lake "Wolfgangsee "will start. After approx. 1 hour on board we will end at the village St. Wolfgang. The 11 kilometres long and up to two and a half kilometres wide lake is located on the northern border of the Alps at 539 meters above sea level. The village St. Wolfgang owes its name to holy Wolfgang who was looking for refuge in the area more than 1000 years ago. During the 15th and 16th century St. Wolfgang was besides Rome, Aachen and Einsiedeln one of the most outstanding pilgrimage towns. Walk through St. Wolfgang and have a look at the Michael Pacher Altar, the impressive winged altar, finished in 1481.Lunch will be served in the famous White Horse Inn on the boarder of the lake. After lunch in St. Wolfgang – one bus will bring back guests for flights in the afternoon. Rest of the group will continue to Hallstatt.
The history of this little village is remarkable since the salt mining dates back over 7000 years. The whole area around the village has been appointed UNESCO World Cultural and Natural Heritage. Engage with this tradition of salt mining and learn how it changed the destiny of this area forever. On arrival in Hallstatt it is hard to know where to start, perhaps with a mountain train ride up to the entrance of the World's Oldest Salt mine, from here a great view down onto Hallstatt, giving you both – a magnificent view and helping you understand how Hallstatt started life. Take a leisurely lakeside walk seeing how the houses above you cling onto the mountainside, pass by the Mullbach waterfall which allowed Hallstatt somewhere to grow. Other "must see" places like the Bone House behind the Catholic Church, providing an interesting view into local family life.

Gala Dinner
The Gala Dinner is planned to be held at The Stieglkeller. The Stieglkeller is located at the foot of the fortress "Hohensalzburg" in the middle of the historic town. In addition to its impressive banquet hall, the grand „hunting room" what is certainly one of Salzburg's most beautiful beer gardens, the Stieglkeller offers its guests a magnificent view of the city. Hearty Austrian cooking, fine Stiegl beers and a local atmosphere guarantee an enjoyable evening.

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IGUS/CIE CONFERENCE IN OTTOWA, CANADA

by

Richard Turcotte and Ken Price

Canada welcomes IGUS EPP & CIE 2018

Canada hosted the 27th IGUS Explosives, Propellants and Pyrotechnics (EPP) Working Group meeting and the 18th International Conference for the Chief Inspectors of Explosives (CIE) in Ottawa in April 2018. IGUS is the International Group of Experts on the Explosion Risks of Unstable Substances. The two meetings were organized by the Explosives Safety and Security Branch of Natural Resources Canada and gathered sixty-five delegates from fourteen different countries. The delegates were also invited to tour the facilities of the Canadian Explosives Research Laboratory (also part of Natural Resources Canada.)

The IGUS EPP Working Group deals with explosive properties, general test methods and thermodynamic ratings, phenomenology of explosions, safety and regulatory aspects related to explosives, pyrotechnics and propellants. The CIE conference aims to provide safety and security benefits to the public and industry by promoting best practice in the field of explosives regulation. Both meetings provide networks for communicating information between members; to encourage the development of a harmonized approach to standards and regulation development; and to enhance the education and transfer of learning about explosives among members.

Several of the various IGUS EPP agenda presentations provided a forum for discussing safety issues that may lead to proposals being submitted to the United Nations Sub-Committee of Experts on the Transport of Dangerous Goods. The proposals can lead to improvement in the Model Dangerous Goods Regulations and the Manual of Tests and Criteria that are used by countries around the world as a basis of regulating explosives and other dangerous goods.

The meetings were a great success and the Explosives Safety and Security Branch of Natural Resources Canada thanks both IGUS and CIE for allowing us to host the meeting and conference.

IGUS EPP & CIE 2019 will be held in Namibia. For more details, please visit http://www.igus-experts.org/index.html

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Report on the EPP and CIE meetings, Ottawa, 2018

The Explosives, Propellants and Pyrotechnics (EPP) working group of IGUS and the International Conference of Chief Inspectors of Explosives held their annual meetings in Ottawa last April, hosted by be the Explosives Regulatory Division, ESSB, Natural Resources Canada.

For those who came in late:

IGUS is the International Group of Experts on the explosion risks of Unstable Substances. It was originally formed as a consultative group for OECD to advise the United Nations Committee of Experts on Transport of Dangerous Goods, a role it still performs though it is no longer associated with OECD. The aim of IGUS is to exchange information on the behaviour of unstable substances, with respect to production, handling, storage and transport.

The remit of the Explosives, Propellants and Pyrotechnics (EPP) working group includes: explosive properties, general test methods and thermodynamic ratings, phenomenology of explosions, safety, and regulatory aspects related to explosives, pyrotechnics and propellants. The CIE Conference aims to provide safety and security benefits to the public and industry by promoting best practice in the field of explosives regulation.

The Conference is held annually, to increase knowledge of working practices, technical developments and incidents in the explosives industry; to establish networks for communicating information between members; to encourage the development of a harmonized approach to standards and regulation development; and to enhance the education and transfer of learning about explosives among members.

The 2018 Meetings

The meeting was attended by nearly 70 people from sixteen countries and more than 40 different organisations and a brief summary of some of the salient issues is presented below.

Delegates commenced their discussions at an informal reception hosted by the Canadian Explosives Industry Association on Sunday evening and got down to serious work on Monday morning.

UN Issues

A major agenda item discussion was a review of papers intended to be submitted, or already tabled for the June meeting of the United Nations Subcommittee of Experts and its Explosives Working Group. The CIE/EPP meeting is a great forum for identifying issues of concern and hopefully resolving them before the more formal processes in the UN and this meeting was no exception. There was extensive discussion on:

- The revision of Chapter 2.1 of GHS;
- The problems faced by industry and regulators clarifying the different features of electric and electronic detonators;
- The rationale (or lack thereof) in setting arbitrary limits on the carrying capacity of explosives trucks;
- How to find a test protocol that addresses the different properties and behaviours of emulsions, suspensions and gels, balancing the need for stability in pumping, good performance in an MBP test and not producing a false positive Koenen test;
- Some options for the shipping container for explosives samples.

As part of the introduction to this session there was a brief presentation on the origin of the United Nations classification system for explosives. This will be the subject of a separate paper in the next SAFEX newsletter.

Accidents

The meetings always have a session on accidents, however 2018 included a session with a difference. Using the Texas ammonium nitrate explosion in West as the focus, the Chief Inspector from Queensland spoke about the issues facing regulators in other places when such an accident occurs. Each of the issues from the report into the accident has been assessed with respect to its application in Queensland and steps taken to ensure that all are addressed, both fo r new and existing sites.

Technical Issues

As would be expected from a forum with many participants from testing laboratories (government and indus-

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try) front line technical papers were presented on a variety of issues.

Nitrocellulose test methods were considered with a methodology for assessing friction hazards and a summary of the formal proposals to the United Nations Explosives working group on the work done by BAM over many years,

Ammonium nitrate, of course, was discussed with a paper on the possible initiation sources for the devastating explosion at Tianjin.

SMS and SAAMI spoke on the importance of assessing the potential for electrostatic ignition of explosives as part of a risk assessment process.

AIST (Japan) has also done some research into the sensitivity of electrical ignitors to mechanical shock with a view to avoiding accidental initiations in transport.

Regulatory issues

On the regulatory front, there was discussion on how to assess classifications of materials that may be packaged as 1.4S explosives when dispatched, but which may subsequently be reclassified after the package is opened.

The IME updated the group on the latest developments of IMESAFR, which is increasingly being used as a tool by regulators to guide them in positioning explosives magazines.

Want more details

Come to the next meetings in Namibia in mid March 2019.

Contact Ken Price, ken@riskom.com.au

REQUIREMENTS FOR EXPLOSIVES RISK ASSESSORS/ASSESSMENTS IN SOUTH AFRICA

Petrus Cloete, Risk Assessor, Orepass & Mining Technologies (Pty) Ltd

The quality of Risk Assessments and Reports in the South African Explosives Industry have improved significantly during the past ten years. This is mainly the result of legislative requirements introduced by the South African Department of Labour Inspectorate, the accreditation of Explosives Inspection Bodies by the South African National Accreditation System (SANAS) as well as the training of competent Risk Assessors by the University of South Africa (UNISA). This tripartite alliance has proved to be a success model that can be implemented world-wide.

The Explosives Regulations under the Occupational Health and Safety Act specifies that risk assessments shall be compiled by Approved Inspection Authorities (AIAs). The Inspection Bodies are accredited by SANAS according to ISO 17020, Conformity Assessment – Requirements for the Operation of Various Types of Bodies Performing Inspection. The Department of Labour (DoL) then approves these accredited Inspection Bodies.

Accreditation can be defined as the Transparent and Impartial examination of the competence of a facility against a specific scope by an independent body.

The benefits of accreditation include:

- Impartial feedback from independent examinations by experts against a defined scope of activity;
- Comparisons of technical ability against similar facilities;
- Customer has access to an independent complaint mechanism;
- National and International recognition of competence; and
- International benchmarking.

Accreditation and Approval is a, more-or-less 18-month process, that include the following steps:

Step 1 - Online Application

Step 2 – Application Review

Step 3 - Document Review

Step 4 - Pre-assessment

Step 5 - DoL Temporary Approval

Step 6 - Initial Assessment

Step 7 – SANAS Accreditation

Step 8 - DoL Approval

The competence and experience of Risk Assessors as well as the minimum requirements of the Risk Assessment Report are specified in the SANAS TR71 Technical Requirements document. Strong emphasis is placed on the Impartiality and Independence of the Inspection Body and their Risk Assessors.

The University of South Africa (UNISA), Centre for Blended-learning Studies, College of Economic and Management Sciences, is an integral partner for the education of Risk Assessors. The modules in Explosives Technology are adequately structured to train qualified Risk Assessors.

Acknowledgements:

1. Mr Rudzani Ramabulana. RSA Department of Labour Inspectorate.
2. Ms Linda Grundlingh. SANAS Accreditation Manager.
3. Prof Heinz Schenk. University of South Africa.
4. Mr Johan Blignaut. OMT Managing Director.

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Security shortcoming exposed

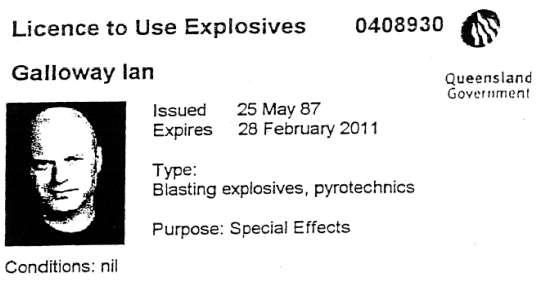
by

Geoff Downs

When we think of security, we normally are looking at people who can have access to explosives, should have access to explosives, and those who shouldn't have access to explosives not to gain access to explosives. This tends to focus on physical access and in particular those who have supervised and unsupervised access to explosives. This article is based on a true story from my time in the Queensland Explosives Inspectorate that captures many important fundamental issues in the life-cycle management of explosives. The event happened in Queensland Australia in May 2006 and this resulted in changes to legislation regarding security matters during the sale and supply of explosives.

An incident occurred at the Movie World Theme Park where three operators had been seriously injured in the preparation of special effects for the Police Academy stunt show which was a regular feature at the theme park. Following the incident an enforceable undertaking was entered into between the workplace safety regulator and Movie World. The enforceable undertaking included the drafting of the code of practice for special effects. Simtars was contracted to write the code in conjunction with a group of special effects operators, other specialists and regulators. During these sessions, some of the special effects operators told us about strange things that were happening in their industry. The special effects operators provided the special effects for the local movie industries on the Gold Coast. They spoke of a person who was saying that he was from an American film company and he was wanting to get special effects for a movie he was going to make where he was wanting to blow up a car in a local town using high explosives and there were nails in the top of the charge which would give a glittering effect falling back to the ground. The ways things were described to the licensed operators didn't make sense. He then requested to hire them and as a part of this request, the operators were requested to prove that they were properly licensed by providing a photocopy of their Licence to Use Explosives.

The next we heard was feedback from the operator whose cousin worked for an explosives supplier. This licensed person had been buying explosives and apparently didn't really know what he was doing. The regional inspector investigated the report. We were provided with a copy of the License to Use Explosives and the driver's licence, see Pictures 1 and 2 below. The Licence to Use Explosives number and other details were not on the licensing database. The licence number was for a transport vehicle. It was apparent that the License to Use Explosives was a forgery. Details within the standard format had been altered. The drivers licence provided also appeared to be a forgery. The address did not exist and other details on the standard licence had been altered. The period of licence was two years and this was not an available option and also a date of birth DOB had been altered to a date of death DOD. Not only was it a forgery, but it was making another statement to the seller. The photos on the two licences were the same. The photos were of Michael Chiklis, an actor in the Fantastic Four, a popular Marvel movie at that time. Other information provided for the documentation of the alleged American film company were false. Upon investigation it was found that the company did not exist, the addresses and phone number also did not exist. The regional inspector referred this matter to the Queensland Police intelligence branch. We were working on this on a Sunday morning. On the Monday night, the police received an email with a photograph of an explosive device and an associated message with a threat of using the device. The police raided the residence of the suspect on the Tuesday. The bomb squad entered the bedroom of the suspect where the explosives devices and other equipment were kept and exited much faster than entered. The equipment made to set the device off was home made. The house was in a built-up area in a normal Brisbane residential suburb.


Licence to Use Explosives 0408930

Galloway Ian

Queensland Government

Issued 25 May 87
Expires 28 February 2011

Type:
Blasting explosives, pyrotechnics

Purpose: Special Effects

Conditions: nil

Picture 1 - Copy of Licence to Use Explosives

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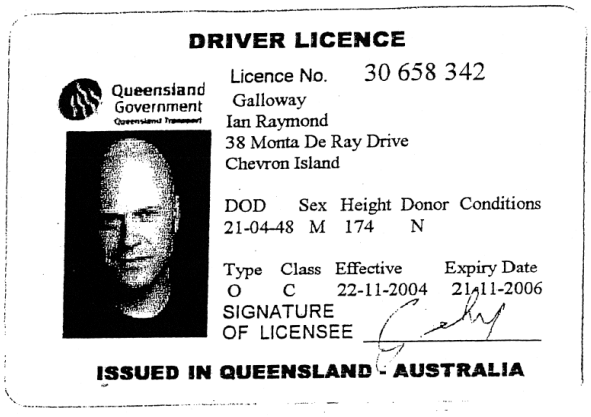
DRIVER LICENCE

Queensland Government

Licence No. 30 658 342
Galloway
Ian Raymond
38 Monta De Ray Drive
Chevron Island

DOD Sex Height Donor Conditions
21-04-48 M 174 N

Type Class Effective Expiry Date
O C 22-11-2004 21-11-2006

SIGNATURE OF LICENSEE

ISSUED IN QUEENSLAND - AUSTRALIA

Picture 2 - Copy of driver's licence

Picture 3 - Explosive Device with nails on top

The device in Picture 3 above was made from cap sensitive emulsion explosives, about 25 kg in total. He had about 53 kg of explosives including high explosives and detonators in his possession. The metal object protruding from the surface are nails which were described as providing a glittering from the special effect when initiated. The event made national news.

Important points arising from the investigation included:

- the suspect was a school teacher (manual arts) at a local high school. He was allegedly going to use the device on the family of his girlfriend/ex-girlfriend in the very near future
- the person had represented himself as the holder of an explosives licence. Documents provided to the explosives supplier were forgeries including the driver's licence and the Licence to Use Explosives
- the person presented himself as many different people from a film company. The number of aliases was in excess of six including passing himself a off as a female over the phone. He had facsimiles purporting to be from the USA but the facsimile had a header on it from a local Brisbane post office
- the person phoned the Government Explosives reserve posing as a client to get the required process
- the explosives supplier did not follow their process by allowing the person to pay cash and buy the explosives in part box lots. He parked his car out of sight at the suppliers premises. The car was not suitable to transport explosives. Following the initial purchase he then got technical advice from the supplier on how to use the explosives. He purchased the cap sensitive emulsion explosives and the detonators on separate occasions
- he had done testing in his own backyard.

The event was treated very seriously at all levels of government. It was initially being treated as a terrorist incident and the person was the first person to be charged under the national anti-terrorism laws in Queensland. These charges were later dropped and he was charged with other offences under state legislation including the Explosives Act. Our Minister was very

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impressed with the role of the Explosives Inspectorate in this matter. He had explained to us that our role in preventing the explosives incident from occurring was a great service to Queensland and indeed Australia. If the explosives had been used in anger, this would have been seen as a terrorist incident and Queensland, and indeed Australia, would have been declared an unsafe tourist destination. The government foreshadowed the changes to security matters for the supply of explosives would change. After a few weeks, we were summoned by the policy officers on a Monday afternoon to say that changes to the Explosives Regulations must be done this week. We immediately provided a set of drafting instructions, met with the Parliamentary draftsman late on the Tuesday afternoon working past midnight to draft up the necessary regulatory changes. The drafts were reviewed and edited on the Wednesday and processed through the system and signed by the Governor in Council on the Thursday morning as law. This was incredibly fast.

The Explosives Amendment Regulation was a 15 page document which included regulatory changes providing for a closed loop system in the supply and sale of security sensitive explosives and to prevent similar types of events from occurring in the future. The regulatory changes addressed the following areas :

- a requirement to report suspect or unusual requests to purchase security sensitive explosives
- restrictions on the holders of licenses selling security sensitive explosives to new clients and existing clients
- recordkeeping obligations
- security plan obligations
- transitional provisions
- defining security sensitive explosives.

Controls were needed to be implemented but they could not be applied to all explosives, only those with a security requirement. Applying controls to unrestricted explosives is not meaningful and so a definition was required for explosives which had security requirements attached to them. A term called security sensitive explosives was defined to include :

- blasting explosives
- propellant powder
- fireworks other than an unrestricted fireworks, and
- security sensitive ammonium nitrates.

Suspicious activities for the sale and supply of explosives should be acted upon both internally and with the regulator. For a requirement to report suspect or usual requests to purchase security sensitive explosives, the licensed seller must give the chief Inspector notice of the details of the request which is suspicious due to but not limited to things such as:

- request for cash sale
- amount of explosive is unusual
- proposed use of explosives is unusual
- proposed location proposed use is unusual
- purpose is not consistent with the explosives permitted under the licence allowed to be used under the licence
- request shows an absence of detailed knowledge of the security sensitive explosives or their particular use

Systems should be in place to ensure that any new client for a licensed explosives seller is legitimate in all respects. It is not always possible for a licensed seller to establish the legitimacy and authenticity of a person's credentials, e.g. licences forged or tampered with. For a restriction on the licence holder selling security sensitive explosives to a new client, i.e. someone to whom the seller has not previously sold security sensitive explosives, the seller must not supply the explosive unless cleared to do so by the regulator. The seller must obtain particular information and records from the new client. New clients can be either individuals or corporations. The information and records include :

- name, address and contact details and documents for evidence of such
- documents bearing evidence of signature. This includes the original signatures witnessed by the seller or certified copies of the signature
- statements of proposed use of explosives

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- where licence holder is a corporation, the particulars for individuals within the corporation who are authorised to purchase and receive on behalf of the corporation at nominated locations. It is not expected that every person working for a corporation will be permitted to carry out all these activities universally under the security plan
- the system must be a living system to account for changes in personnel.

The request is then sent to the chief inspector to validate the new client. This included, amongst other things :

- checking that the licence is genuine on the database when checked against the certified copy provided
- licence holder is permitted to buy the explosives being sought under the licence, and
- phoning the new client to confirm that the new client actually placed the order.

Under the legislation, the employee of a licence holder is also regarded as a licence holder. This raises issues under the security plan for a corporation where employees have specific duties and specific authorised activities. The proposed changes to the legislation took account of only authorised people within an organisation are allowed to purchase explosives on behalf of the corporation and also only authorised persons are allowed to receive explosives at defined locations on behalf of the corporation. Even having a security clearance does not necessarily allow purchase or receipt of explosives without the knowledge, authority and approval of the organisation.

Licences are issued for one or five years and can be renewed. Under the sellers system, there are restrictions on the holder of a licence selling security sensitive explosives to the existing client after their records show the licence has expired. The seller must send a request to the Chief Inspector to validate the renewed licence for the existing client similar to the new client process.

These changes have been seen to be essential to ensure the robustness of the sell and supply system where previously a licence number was provided without confirming that licences had been renewed and the current.

Record-keeping obligations were placed on the licensed seller. A summary of monthly sales must be provided to the chief inspector each month within 7 days after the end of the calendar month. This also included nil sales. The sales records were scrutinised by the regulator to look for any unusual trends or activities. The strategy included looking at the big picture to see if there was replication and duplication across sellers where on its own sales activity may not be unusual but if it was repeated across all licence sellers this may tell a different story.

Security plan obligations were placed on the licensed seller. These included making a written security plan for security sensitive explosives sold or to be sold that had processes in place to ensure:

- explosives are kept secure
- the chain of possession of all explosives can be traced from the holder to the purchaser at the place where the explosives were delivered under the relevant contract and order
- records kept to allow auditing for compliance
- revision of the security plan if problems arose with keeping the explosives secure, traceability and delivery to the purchaser.

The chain of possession applies to all persons involved in the sell and supply cycle including order pickers, magazine keepers, truck drivers. The person receiving the explosives should be physically present and authorised to receive and verify the quantity and description of the explosives being supplied and sign for them. Documentation must be returned to the supplier under the closed loop system. It was common practice at the time for bulk loads of ammonium nitrate to be delivered without verification and validation of the product and the quantity against the order. Payment was made on receipt of an invoice. The paper trail must exist to the extent that the seller must receive actual verification that the order was true and correct and received.

The underlying principles were applied to the supply and sale process of explosives to prevent a similar type of incident from occurring and also ensuring that the duty of care for the supply of explosives occurs only for people to whom explosives should be supplied and conversely to ensure that people who shouldn't be sold and supplied with explosives or certain types of explosives are not. A person who is security cleared for unsupervised access of explosives is not automatically entitled to

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have access any explosives, only the explosives they are entitled to have access to.

The reporting of suspicious activities is fundamentally an explosives incident and this amplified clearly the intentions of the requirements for incident reporting.

While the fundamental principles are sound, the application of these principles can be a challenge in a dynamic world where staff are regularly changing and yet maintaining the lists of authorised personnel can be difficult. This can also be complicated by the tyranny of distance where supply and receipt and sales offices may be separated by very large distances. The closed loop system with feedback built in for defining the types of explosives, who can purchase and who can receive explosives captures the essence of security for sale and supply of explosives. These changes were not embraced by the other states within Australia. However, we do need to be vigilant and for the protection of the community and the industry, robust systems need to be in place to prevent unwanted incidents and events from occurring that can have detrimental outcomes and consequences and ensuring that when major incidents happen, the cure is not extreme.

Reference – Explosives Amendment Regulation(No 1) 2006 – No 108 2006. (https://www.legislation.qld.gov.au/view/html/asmade/sl-2006-0108)

SAFEX COMMENT: This article emphasises the need for sellers of explosives to be really sure that their systems for vetting customers - especially smaller ones - are legitimate.

Safety Management System Series
By
Andy Begg

Control of loose articles

Explosion incident reports frequently identify the presence of a foreign body in the mix or materials that somehow gets into the processing equipment such as a mixer, extruder, pump, cartridging machine, press, augers, hoppers as the source of initiation. The foreign body becomes trapped in the moving parts and in the presence of explosives causes a friction event/explosion. Tools or small pieces of equipment that are dropped can also initiate explosives by impact. There are several sources of foreign bodies – they can be in the raw materials as delivered from a supplier, in intermediate products, they can enter the raw materials while processing in poorly controlled plant operations, they can be parts that break off equipment or they can be small tools or personal items introduced accidentally by the operators, maintenance personnel or visitors. The latter 2 categories we refer to as “loose articles”. There are several well used methods for controlling/preventing foreign bodies depending on the type/source. In this section we will consider only “loose articles”. The other types of foreign bodies will be dealt with in future sections of the SMS.

In addition to being a potential source of initiation, loose articles that get into the process can cause damage to expensive equipment and cause quality issues and therefore it is general good practice to exercise control of them using the same principles as for explosion prevention,

Additional details of methods for the control of loose articles can be found in the SAFEX GPG01 – Controlling foreign bodies in Explosives Manufacture.

Procedure for the control of loose articles in explosives plants

The objective of this procedure is to control loose articles by:

- Providing strict control of all items that are permitted for the normal operations of the area – **authorized articles**.

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- Preventing the introduction into explosives processing areas of all unnecessary items of equipment, tools and of a personal nature – **unauthorized articles.**

Scope

Foreign bodies can enter the process flow at any stage from raw material handling to final processing. This procedure therefore should be applied equally to raw material handling and explosives processing operations.

Principles

The specific procedures implemented will depend on the sensitivity of the explosives to friction and impact. However, in many factories where there are several types of explosives with differing sensitivities being handled it is frequent practice to adopt the strictest controls in all operations to avoid confusion. Where different operations have different standards for control it must be very clearly stated what the specific requirements are at each.

Control of authorized articles

Authorized articles are those small items - frequently tools - needed for the day-to-day operations in the plant such as tools only used for equipment set-up, those for cleaning and so on as well as normal operation. These could include, but are not limited to,

- Knives
- Scissors
- Scrapers
- Hand brushes
- Scoops
- Shovels
- Pens
- Spatulas
- Waste containers
- Mallets
- Wrenches
- Adhesive tapes
- Bottles of printing inks

As you can see the list can be long. In any explosives operation it is very important that only those items that are required for the operation are identified prior to the operation starting, they are provided by management and that there is a place for each to be kept securely when it is not in actual use. If something is required to do a job but is not provided, then the operator is likely to find something that will do the job from somewhere in the plant – or even bring it from home. This can be very hazardous and has to be avoided by ensuring that all items needed are identified and provided. This is particularly important for items such as knives and scrapers and scoops where the item must to be made from a “soft” material or a conducting material depending on the hazards of the explosive being processed. So, knives may have to be brass, scoops of conductive plastic and so on. It is not acceptable to switch loose articles from one building to another “just because it is needed”.

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There are 3 very common traditional methods to help control authorized tools and these are:

- Use List or Permitted Article List
- Skeleton or Shadow Board
- Lanyard

Whichever methods are being used should be included in the operating instructions for that activity.

Use List

This should include all small items determined by the management/supervision as necessary for the operation. It should include the item and description e.g. small brass knife and the number allowed. Only items on the list should be present in the plant.

The Use List should be readily available for review or inspection – in many plants it is laminated and posted on the compartment wall for easy view. It should be dated, review date specified and approved by a supervisor/manager. It should be consistent with the relevant Operating Instructions.

Skeleton Board

Normally this would be positioned on a suitable wall not directly above any working zone. If pins are used to hold the tools etc in position they should be secured such that they cannot become loose and fall out. Traditionally glued wooden dowel was used but steel pins are now being used. Standard building nails should be avoided as they could rust and may break off in future. The tools may also be hung from a pin using a small lanyard.

If items cannot easily be positioned on a wall, then it is acceptable to have a skeleton board on a horizontal work surface.

Lanyard

A lanyard is a piece of line (cord, SS cable etc) secured to an item and the other end secured in a convenient position on the plant and of such a length that if the tool is dropped it cannot fall fully into a mixer, hopper etc. Typical use would be where bags of material are being opened using a knife and poured directly into a hopper. The knife would be "tied" to the structure around the hopper – long enough for easy use but short enough to prevent it falling so far into a hopper that it becomes trapped in an auger discharge at the bottom of the hopper, or cause friction in the mixer for example.

Control of unauthorized articles

Unauthorized articles are by definition all small articles not required for the operation or task that may be taken into the plant (accidentally or on purpose) by personnel – operators, maintenance personnel, supervisors and visitors.

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a. Tools and equipment not specifically supplied by the company for the operation in question and not to the required specification e.g. “home made” knives, tools from other processes.

b. Items of a personal nature, in particular into areas where friction and impact sensitive materials are handled. The following items are typical personal items that should be controlled:

- watches, pens, rings, piercings, coins, necklaces, earrings, cuff-links, keys, cell phones, pagers etc

c. Radio frequency sources such as radios, cellphones where induced currents could be a hazard.

Loose Article Management

To prevent loose articles from entering raw materials, intermediates and finished products the following steps can be taken:

Prevention

1. All manufacturing facilities should have a location where all visitors can be briefed about the safety aspects of the facility and should provide secure facilities in which to store all personal loose articles prior to entering the facility. In a small facility this could be a supervisor’s office. Plant personnel should leave their belongings at change room. Some ID card (badge) with metallic clip should be avoided. This procedure should be communicated during induction of all new employees.
2. Each operating building or compartment should have a posted list of authorized loose items or tools. Items not on the list are not to be allowed. Storage facilities shall be provided outside the explosives processing area for the storage of employees’ personal effects.

Control

1. Placing a “skeleton board” inside all buildings or compartments where hand tools can be placed when they are not in use.
2. Authorized tools that are routinely used near or at open hoppers, mixers, containers etc. should be secured by a lanyard of suitable length that permits the tool to be used effectively but will prevent it from falling into the process.
3. Tradesmen conducting work inside process areas should have their toolkits organized in such a way that they can effectively confirm that all tools and other loose items such as spare parts, nuts and bolts etc. are being removed from the area at the completion of their work. Keys for lock out/tag out should be secured by lanyard to the tradesman at all times when in process buildings.
4. All facilities should have a local procedure for the control of employees’ personal jewelry. All items with closures such as piercings, watches, necklaces etc should be prohibited in process areas. Items such as rings should either be removed or taped over to ensure they cannot slip off. Eyeglasses including safety glasses may need to be secured by a neck strap
5. Cell phones and communication radios should only be permitted into explosives plants after special authorization

- In areas where there are electric detonators all sources of RF energy are prohibited.

6. In some areas it may be advisable that process and maintenance personnel’s clothing should have no external pockets above waist height and not be fitted with metal buttons.

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Audit

Loose articles

- Are there local requirements for the control of loose articles?
- Are there requirements for visitors to remove personal items that could be considered as "loose articles" e.g. jewellery, watches, keys, cell phones etc ? Are there facilities for the safe storage if visitor articles?
- Are there lists of authorised items for specific buildings/operations including
    - ◊ Production and buildings?
    - ◊ Raw material stores and handling?
    - ◊ Magazines?
    - ◊ Laboratories?
    - ◊ Testing and destruction facilities?
- Are authorized items posted on a list in the appropriate compartments and are these lists consistent with the Operating Procedures?
- Are skeleton boards and lanyards available in relevant locations?
- Are tradesmen required to confirm that they have removed all tools, spares etc from the plant area when they have completed work? This should be part of the PTW requirements for the hand back of the plant to operations.
- Are there any special clothing requirements e.g. no external pockets above waist height?

Inspection guide for the auditor.

Check

- Were you requested to remove items of personal jewellery?
- Are operators/maintenance workers wearing personal jewelry?
- Are authorised tools or equipments lists posted in the relevant buildings?
    - ◊ Are there any items in the plant that are not on the list?
    - ◊ Are there any home-made tools?Are there any spare parts lying about? Check in drawers, ledges etc but be careful.
    - ◊ Check for "hidden" items on high ledges, in cabinets etc
- Are the requirements in the Operating Instructions consistent with the posted authorised list?

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- Are skeleton boards in use?
  - ◊ Is there a place for every tool/item?
  - ◊ Check that the board is correctly used – if tools are not for/in immediate use they should be on the skeleton board
- Are small items that are in constant/regular use secured by a robust lanyard?
  - ◊ Is the length of the lanyard correct? – e.g. not so long that the item can still fall into vessel
- Are the items in good condition? – knives sharp, no loose parts and lanyards strong and not damaged

DEVELOPMENT OF A GREEN PROPELLANT

by

Ing. Jan Zigmund, PhD., VÚPCH, Explosia a. s., Czech Republic

Ing. Petr Kohlíček, ISS Vsetín, Czech Republic

Ing. Ivo Varga, Explosia a. s., Czech Republic

Explosia a.s. is a traditional manufacturer of propellants and explosives for both military and civil uses. The Explosia propellant department's production programme includes, in addition to black gunpowder, also nitrocellulose (NC) powders, nitroglycerin (NG) powders and also nitroguanidine (NQ) powders for modules. All smokeless powders contain nitrocellulose.

Besides the above traditional propellants, the manufacture of a new type of propellant was launched in 2013, intended for automotive seat belt pretensioners.

How do the seat belt pretensioners work?

Briefly described ,before the airbags are released from the panels during a crash, the belt pretensioners are activated to hold the passengers on their seats. A pretensioner enhances the seat belt's efficiency by eliminating the looseness (slack) caused by belt elasticity and inadequate belt tensioning (the “film reel effect”). This belt extension can make as much as 10 cm in real circumstances. The pretensioners will restrict the passengers' forward motion to mere centimetres. The forces acting on the passengers' bodies will be more uniformly distributed in time and any injuries may be less severe. A person without a seat belt will hit the car interior at a speed identical with the car speed before the collision.

A layout of the belt retractor block with a section through the pyrotechnical mechanism of the pretensioner is shown in the figures. The balls will set in motion on the action of the gaseous propellant combustion products from a Micro Gas Generator (MGG). The energy of motion is then transmitted from the balls via a toothed wheel to the belt retractor.

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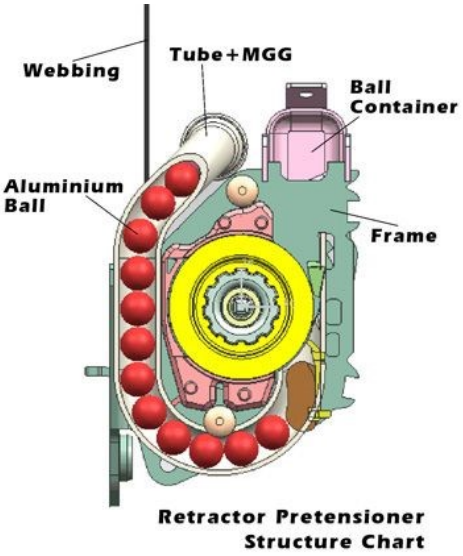
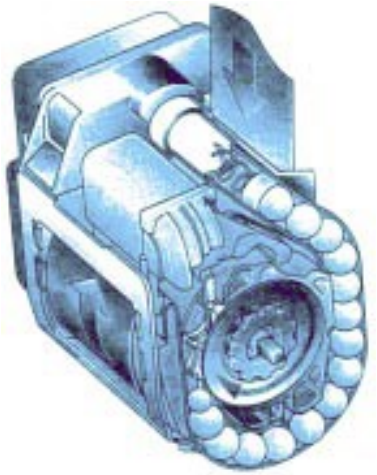
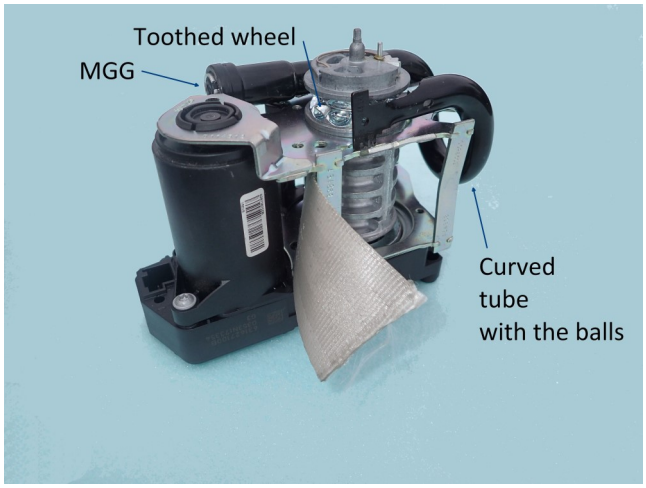


MGG - micro gas generator; it is filled with nitrocellulose powder or the green propellant

(The MGG photograph was taken from the ISS Vsetín website)



Layout of the seat belt pretensioner with the MGG and balls



Photograph of the pretensioner mechanism with the MGG and the toothed wheel

The manufacturer of the tensioners, however, required a new propellant type the properties of which would be similar to those of the nitrocellulose powders, but the combustion products, were to be nontoxic. Such a material is commonly referred to as a **green propellant.**

The requirements for the propellant included a high chemical stability, low water absorption and, of course, ballistic properties identical with those of the hitherto used nitrocellulose powders. The requirements for this new propellant type were considerably more stringent than those required for gun cartridges for civil or military applications.

For the propellant combustion products to be free from toxic substances, the material must have a zero “oxygen balance”. This means that it must contain precisely such an amount of oxygen as is required to burn carbon to carbon dioxide (CO_2) and hydrogen to water (H_2O). If the amount of oxygen is too low, the combustion products contain carbon monoxide (CO), ammonia (NH_3), hydrogen cyanide (HCN) and other toxic substances. If the amount of oxygen is too high, the combustion products contain oxides of nitrogen (NO_x) and/or other toxic substances.

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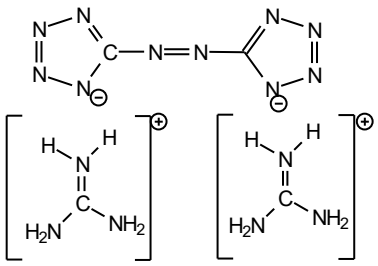
Since the compounds that are normally used to make up smokeless propellants were unusable for the formulation of a material producing nontoxic gases, we focussed on pyrotechnical mixtures.

A vast number of mixtures for automotive safety systems have been patented worldwide. They are compositions based on azides, nitrates, perchlorates as well as new substance types rich in nitrogen, such as 5-aminotetrazole (5-ATZ) and guanidinium azotetrazolate (GZT).

A mixture of ammonium perchlorate (NH_4ClO_4) and strontium nitrate ($Sr(NO_3)_2$) in a ratio such that all chlorine from the perchlorate would react with the strontium from the nitrate to form the relatively harmless strontium chloride ($SrCl_2$). GZT served as the nitrogen source was selected. The predominating combustion products include carbon dioxide, nitrogen and water. The remaining combustion products make up about 5%.

Guanidinium azotetrazolate - GZT

Guanidinium azotetrazolate (GZT) looks like gold-yellow cotton wool. It is prepared by oxidation of 5-aminotetrazole with potassium permanganate in a basic solution and condensation of the intermediate product with guanidinium carbonate. GZT synthesis was successful owing to the well-conceived basic research into energy-releasing nitrogen materials by J. Pokorná et al. during the 1990s.



The following GZT properties are relevant from the explosive aspect: density 1.54 g·cm^{-3}, nitrogen content 79%; melting point 240°C (decomp.); standard enthalpy of formation +1515 kJ·kg^{-1}. This compound is not hygroscopic, insensitive to mechanical stimuli and is not classed as an explosive. No information regarding any health effects is available.

The chemical formula and appearance of the GZT-based Z04-053 green propellant is included in the table. NaCMC stands for sodium carboxymethylcellulose.

Ingredient	
Ammonium per-chlorate	
Strontium nitrate	
GZT	
NaCMC	
Additives	

Appearance: yellow pellets

Size: d = 1.4 – 1.7 mm. l = 1.5 – 2.2 mm.

Bulk density: 0.98 – 1.03 g.cm^{-3}

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The thermochemical properties of a Z04-053 sample at a 50 MPa (500 bar) pressure are listed in the report below. The combustion products are listed in descending percentage order. The first 3 gases – N_2, H_2O and CO_2 – make up over 70% of the combustion products.

Calculation of Powder Force. **Z04-053**

p = 50 MPa

Mass fractions of source components		Fractions: %
Ammonium perchlorate:	NH_4ClO_4	35
Strontium nitrate:	$Sr(NO_3)_2$	35
GZT:	$C_4H_{12}N_{16}$	25
NaCMC	$NaC_8H_{11}O_7$	5

Oxygen balance: 0.49 %

Following rapid expansion at the normal pressure of 1 bar (0.1 MPa) the chemical composition of the combustion products "freezes" at the following values:

Adiabatic expansion **Z04-053**

p = 0.1 MPa

T = 1734 K

Combustion product concentrations, %:

N_2	28.502
CO_2	22.721
H_2O	21.904
$SrCl_2(c)$	11.505
$SrCl_2$	7.274
SrO(c)	4.355
HCl	1.286
NaCl	1.198
SrOHCl	0.655
O_2	0.481

The symbol "(c)" denotes condensed (solid or liquid) combustion products.

The first 6 "nontoxic" compounds make up 96% of the combustion products.

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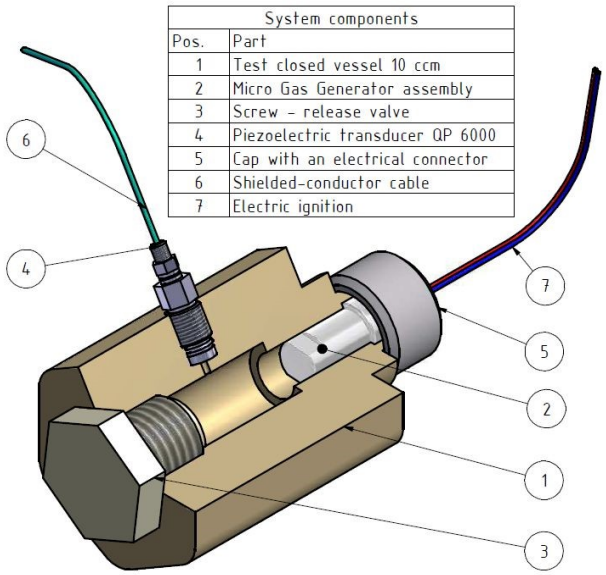
How was the green propellant tested?

The basic test for green propellants is acceptance in a ballistic bomb. A green propellant sample is weighed into an MGG aluminium crucible, the latter is closed hermetically in a squib – a duralumin sleeve with a detonator, ignition enhancer and electric contacts (bottom of the MGG with a blue short-circuiting insert). The MGG is inserted into a 10 cm^3 test chamber, which is then closed with a screw system. Ignition proceeds electrically, and the pressure development is measured with a piezoelectric sensor.



System components	
Pos.	Part
1	Test closed vessel 10 ccm
2	Micro Gas Generator assembly
3	Screw – release valve
4	Piezoelectric transducer QP 6000
5	Cap with an electrical connector
6	Shielded-conductor cable
7	Electric ignition

The customer – automotive seat belt manufacturer – requires that the pressure should ALWAYS, in any circumstances and at any temperature, fall within the limits indicated by the dashed lines in the records shown below.

Although burning poorly in air, the green propellant with GZT always exhibited excellent ballistic properties. The manufacturing technology was improved during the development, which – along with modifications in the MGG ignition system – led to satisfactory results. The pressure development patterns during green propellant combustion in the MGG are now similar to those of the normal nitrocellulose powders.

Design validation based on Toyota specifications was performed on a green propellant sample. The following tests were carried out:

a)	High temperature (+107°C) exposure for 400 hours	Passed
b)	Low temperature (-40°C) exposure for 400 hours	Passed
c)	Exposure to 1000 thermal shocks (30 minutes at +85°C / 30 minutes at -40°C)	Passed
d)	Mechanical shocks	Passed
e)	Vibrations	Passed
f)	Exposure for 1000 hours to 85°C at .98% RH, monitoring current	Passed
g)	Pre-detonation zone length - no detonation, sample only burns out	Passed
h)	Water absorption - 2% wetness critical. Sample burns more slowly, lower pressure. It burns down completely	Passed
i)	Kneading time effect on the ballistics	Minimal
j)	Kneading temperature effect on the ballistics	Appreciable
k)	Propellant grain size effect on the ballistics	Slight
l)	Bonfire test - no detonation, sample only burned out	Passed

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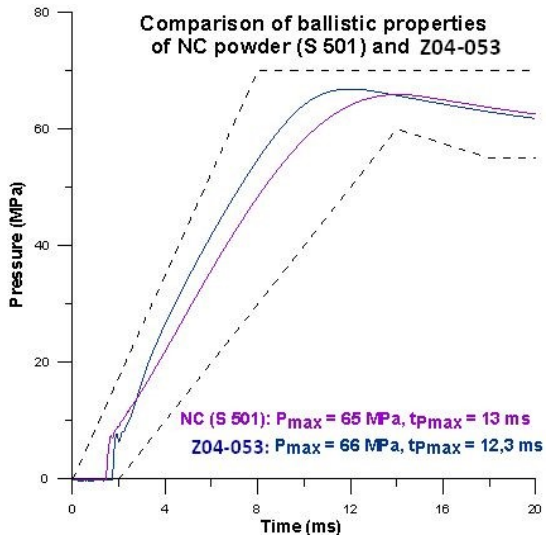
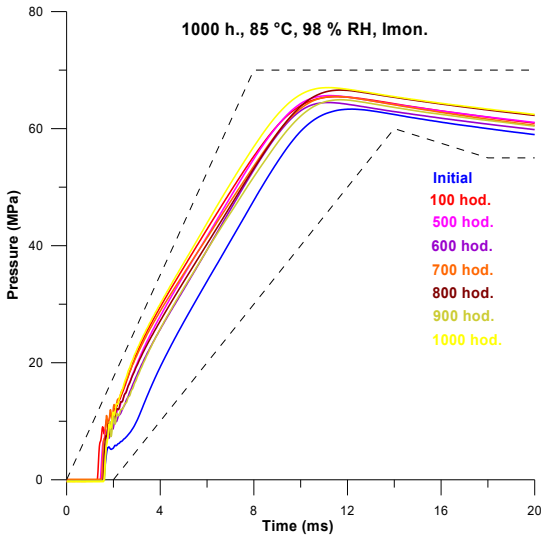


Ballistic property comparison between the propellants



1000 hours exposure. 85°C, 98 % RH, monitoring current

A gas tester with detection tubes (similar to an alcohol tester) reacting specifically with the various gaseous combustion products was used to rapidly establish the chemical composition of the green propellant's combustion products. The not very high accuracy is a drawback of this method. The table below demonstrates that the chemical composition of the combustion products of the green propellant prepared by VÚPCH is more favourable than that of the competitive products. The concentrations are in ppm (number of combustion product particles in a million particles of air).

Gas	TRW	Tokai-Rika	Z04-053
CO	1200	1120	800
NO	30	94	15
NO_2	150	18	2.5
NO_x	180	112	18
HCl	1	/	4.5
HCN	5	46	17
H_2S	0.2	94	2.5
Cl_2	0.2	10	0

Tests gave evidence of the excellent properties of this new propellant, which withstood all loads at any temperature and whose ballistic properties remained within the prescribed limits also after the exposure. This green propellant is even more resistant than certain MGG components.

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Manufacturing technology

The green propellant manufacturing technology comprises the following operations.

a. Oxidant drying, milling and sieving
b. Kneading
c. Pressing
d. Fibre cutting
e. Product graphitization
f. Sieving
g. Drying
h. Surface finishing
i. Homogenization
j. Product packing

Conclusion

While developing a green propellant for automotive seat belt pretensioners we succeeded in preparing new polymer-bound propellant types, not used in the explosives technology until now. Quite a number of them were tested. Water-soluble cellulose ethers were found to suit best. Their launching is a sensation from both the technology and safety aspects. The propellant formulas are nontoxic when processed and, if wet, are also insensitive and non-flammable. A lower cohesion of the propellant grains is a drawback, but it does not pose any problem in the intended application.

Over 500 samples were prepared within the green propellant development process. The starting green propellant development phases were arduous. Two employees spent 2 hours cutting the 60g “spaghetti-like” samples. A continuous air cutter was subsequently set up to alleviate this procedure. It enabled the green propellant fibres to be cut directly under the press.

Owing to the air cutter it was possible within a few years to satisfy the constantly growing customer's needs and deliver all the goods ordered, although this was sometimes a true issue. During the final development stages, we prepared the green propellant formula in 2 laboratory mixers (300 g and 600 g, respectively), and alternatively charged 2 extrusion cylinders. The cutter nearly never stopped. If well organized, the manufacturing chain can provide a daily output of 2 - 3 kg of the propellant. This was a sufficient quantity for the prescribed design validation (DV) tests at the customer's site and for launching mass-scale production of the MGGs by the customer. A total of perhaps up to 200 kg of various green propellant samples were prepared in the laboratory and in pilot-scale equipment.

Seeking for the optimum chemical composition by the trial-and-error approach, i.e. by measuring the combustion product toxicity for hundreds of propellant samples with the detection tubes was out of the question for financial reasons. We were able to select a favourable chemical composition by a shorter route – by using the RealWin software.

Research and development of the green propellant, including the manufacture of GZT on a pilot-plant scale, was completed during the course of one and a half years, to be followed by thorough performance tests. The Green Propellant is an entirely new propellant type. A water-based propellant is something that has never been used before. The customer has been manufacturing automotive safety systems for many years by using normal powders, and caution had to be exercised when launching a new propellant type. One can read or hear from the media from time to time how many million cars are withdrawn from the owners or the market by the car manufacturers for repair if any fault is detected.

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Propellant dough kneading

Green propellant - the final product

And the future...?

It would be shame to waste all the knowledge and experience gained during the research & development of the green propellants. Research into additional prospective formulas is under way and it is believed that the propellants may find application not only in the automotive industry but also in the aerospace domain.

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SOUNDS OF SILENCE
By
Tony Rowe

I recently came across an article in a Johannesburg newspaper portions of which are set out below. The piece was published in response to a "Cash in Transit Robbery" that had apparently taken place on the 19th May 2018 near Boksburg, a city on the East Rand just outside Johannesburg. The statement, allegedly made by a representative of the Hawks' National Bureau for Illegal Firearm Control and Priority Violent Crime asserts the following:

It's in the way they (*the criminals*) carry their assault rifles when they execute these crimes. They carry them in a certain way that an ordinary police officer doesn't. "They are professional, well trained and use tactics that are only taught in the army," the officer said. He said the use of extremely loud explosives to gain access to armoured vans was one of the common scare tactics applied to frighten bystanders. "That is why they can execute this crime in heavy traffic and in broad daylight," he pointed out.

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Motorists were forced to brake and veer off the road, while pedestrians and street vendors took cover when a gang of more than 10 men armed with high-calibre assault rifles targeted two cash vans after they had collected cash from a depot in Ekurhuleni.

My curiosity was aroused not so much by the robbery itself, but rather by the claim that extremely loud explosives (are there any other sort?) were being used to frighten bystanders.

In my naivety I thought that just a few hundred grams of virtually any blasting explosive might sound pretty loud, especially if initiated close to a tarred roadway in a built up area. The bang might of course sound louder still if certain environmental conditions were also met.

Then there is the question of how much was actually detonated as, within certain defined limits, the greater the mass of explosives, the louder would be the subsequent bang. The degree of confinement might also contribute.

If as claimed, such extremely loud explosives are available, where would the robbers get them? I've never seen commercial bulk or cartridged blasting explosives marketed on the basis of their sound output or for that matter, the lack of it. I also assumed (perhaps foolishly) that the explosives and initiators used by criminal elements in these endeavors were stolen from (a) the manufacturers, (b) the transporters, (c) the mines or (d) the military. They were therefore obtained 'somewhat opportunistically' and thus not exactly tailor made.

As to the existence and availability of especially noisy products, I have to confess my ignorance. Have I been kept in the dark like a mushroom and fed fertiliser? Perhaps so, as to this day I remain unaware of any such developments, certainly within the commercial sector. Maybe the military is keeping something very quiet indeed?

The article also mentions high caliber assault rifles - I didn't know much about those either. What are they?

Firearms aside, the major issue for me must be the claim that extremely loud explosives are being deliberately sourced and used with the prime objective of terrifying onlookers and deterring any potential interference. I thought the intention was rather to blow the truck and get away with the cash, not to play psychological games.

However, hidden away within that statement is the implication that if there are extremely loud explosives, there must be extremely quiet ones too, so how would they work?

Let's start the discussion around some of the physical characteristics of the human ear. Humans generally come equipped with two of them. They can be found almost level with the eyes, and are usually placed symmetrically, one on each side of the human head. The outer ear – identifiable by a sort of floppy external appendage – is called the pinna. Sound is directed by the pinna into an opening called the auditory canal and then on down to where the hearing thingy sits. It gets very complicated after that. People say that down there you'll find drums, icicles, sensory hair cells and even snail shells. There's stereocilia and cochlear plus enough earwax to make a candle. Creepy!

Inevitably there are people with big ears and there are people with small ears. A very select few, me included, have hairs sprouting out of them.

You are probably wondering by now if big ears enable you to hear any better?

Sadly the answer is no, but if your feet smell and your nose runs, be assured, you are built upside down.

More to the point, the human hearing range depends on both the pitch of the sound - whether high or low - and the loudness of the sound. Pitch or frequency is measured in Hertz (Hz) and loudness in decibels (dB).

When it comes to pitch, a person with normal hearing can detect frequencies from around 20 Hz in the low range and up to about 20,000 Hz in the higher frequencies. A mosquito on the hunt for supper produces about 17400 Hz when in flight, but when walking, not so much. If you can hear them in flight you are doing OK. My mosquitos are long silent. They still bite though.

The decibel scale on the other hand is really just an exercise in perception. "0" dB, the quietest sound in the scale is inaudible to everyone. It's the joyous state of absolute silence. It is the world inhabited by my Maltese poodle. She is 17 years old and stone deaf, but still barks in her sleep. Her sleeping bark is so different to her bark when she is awake that maybe it is actually Maltese.

The loudest sound that a human being can hear is probably in the region of 160 – 190 dB, but you may only get to experience it once in your life. Above that threshold your eardrums will literally be torn apart. Braille will henceforth become a major part of your life. I know, I know. Just testing.

It gets worse though. The older you get the poorer your hearing tends to become. I for instance can no longer hear a pin drop and my long-suffering wife has to repeat herself quite a lot

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when she talks to me. She can be quite annoying. She should just speak up from the beginning.

Please find below a chart illustrating the mean dB levels of different sounds.

Examples	Sound Pressure Level L_p dBSPL
Jet aircraft, 50 m away	140
Threshold of pain	130
Threshold of discomfort	120
Chainsaw, 1m distance	110
Disco, 1 m from speaker	100
Diesel truck, 10 m away	90
Kerbside of busy road, 5 m	80
Vacuum cleaner, distance 1 m	70
Conversational speech, 1m	60
Average home	50
Quiet library	40
Quiet bedroom at night	30
Background in TV studio	20
Rustling leaf	10
Threshold of hearing	0

Whether or not the existence of noiseless explosives is true or if their development might be beneficial to the industry is highly debatable, but for the foreseeable future at least, blasting activities may still be accompanied by excessive noise, overpressure and ground vibrations. Unfortunately for both the explosives industry and the end users of its products, people can detect both air and ground vibrations at far lower levels than those required to cause even the slightest structural damage.

Wind speed and wind direction can both convey noise (airblast) and also trigger sound focusing downwind. Low cloud cover in the vicinity of blasting operations may further exacerbate the problem as under such conditions, noise and overpressure effects will appear to people in the vicinity to be much higher than normal. As a result and despite whatever end users and the operating companies may be able to scientifically demonstrate they will always be taken to task by those householders and persons living closest to such operations. Blasting activities will inevitably be blamed for any and all structural damage including broken or cracked windows, damaged glassware or crockery, dogs barking or even milk going sour. Construction defects, vandalism, termite and other insect damage, differential soil settlement, cross grain contraction, the kids next door and/or the seasoning of timber members are rarely considered.

A long held belief of mine was that black powder (gunpowder) always produced a much deeper and more resonant ‘bang’ than say the high frequency ‘crack’ of detonating bulk PETN. That of course is subjective opinion, but the dull (low frequency) boom of black powder exploding under confinement always seemed to carry further. You just needed more of it.

During my short time spent blowing things up I learned that local residents got far hotter under the collar when large (1 - 5 kg) single shots were fired at irregular intervals throughout the day than by a full on explosives demonstration running for minutes at a time and consuming far more explosive material. In fact, such grand events were pretty well tolerated.

However, there is one product that could fit the bill. It is known as detonating fuse, detonating cord or simply CORDTEX. Delightful to experience as part of an entertaining demonstration of commercial explosives, it remains the prime contender for the “Noisemaker of the Century Award”. Its ability to create noise pollution is legendary. Detonating fuse can produce an intense, high frequency airblast, indeed it is possibly the highest level known for a given explosive mass. I’m not sure why, but it may be because its detonation front, propagating at up to 7000 meters a second is not localised to just one small area. The detonating front is physically travelling (propagating) over tens or even hundreds of meters. This may create almost a ‘wall of sound’ and believe me, when a couple of hundred meters go pop, it’s a significant airblast. A typical detonating fuse contains around 10 g of a single molecule explosive per meter. There are varieties with both much higher and much lower coreloads, but 10g/m is very common. A couple of hundred meters therefore only contains around 2 kg of explosive. When laid out in a long line on the ground there is not really enough explosive energy liberated in any one place to accomplish much besides a white edged, but shallow depression and a narrow swathe cut through any grass. But don’t be misled, in trained hands detonating fuse is a monster.

Aha! I hear you say, there is your culprit, the robbers are laying out hundreds of meters of a high-coreload detonating fuse and the resultant sound pulse is being reflected and reinforced by the surrounding buildings. It’s clearly a case of a little going a long way. Add some strong winds, stir in some low cloud cover; shake well and Bob’s your aunty. The conundrum is solved, or is it? Personally I doubt it and the video evidence - of which there is plenty - doesn’t support this scenario at all. The bottom line is that I don’t know, so we are back at square one.

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Whilst putting this article together I was often up to my figurative knees in dead insects, dust, cobwebs and the hoarded detritus of my failing memory. Somehow during the process, I stumbled across an old clay tablet etched in the ancient Sumerian script. It took a while to decipher and while I’m not absolutely sure, it appeared to describe a product called NNT’s or Noiseless Nonel Trunklines, (later referred to as Noiseless Surface Trunklines). These though are rather part of a system used to initiate bulk explosives and not strictly part of the resulting loud noise debate.

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I seem to recollect that NNT's were simply a shocktube (then Nonel) based system marketed as a replacement for detonating fuse and intended for use in noise-sensitive surface blasting operations. The shock tube component still popped a relatively noisy detonator, an event hopefully followed shortly thereafter by the detonation of the bulk explosive, but NNT's resolved the then overwhelming issue of the noise pollution associated with surface applications of detonating fuse and detonating (dogbone) relays.

Shocktubing remains an all, but silent method of transmitting an energy signal between two points. The signal can and is used to initiate detonators. Shocktube employs just a few milligrams of a suitable explosive mixture per meter. This mixture, often silvery in colour, is caused to cling to the inner walls of a small diameter hollow plastic tube. Some say it is witchcraft, but it is really just the clever harnessing of electrostatic phenomena. The tubing typically has a final outer diameter of about 3mm and an internal diameter of around 1 mm. It can be clear, opaque, translucent or just about any colour. It can even be wrapped in yarns and overextruded with a different polymer, but whatever it looks like, it does pretty much the same thing. Initiation of the tubing results in the propagation of a detonating front advancing at velocities in the region of 2000 meters/second. Although propagation also produces a pressure pulse accompanied by both heat and light, it does so without bursting the tube. It's really quiet too. I know I've seen it being tested. Safety fuse does something similar, it just takes a lot longer.

I also seem to recollect a similar product called Mantinel. It was Brazilian I think. Mantinel used a continuous length of a nitrated fibre as its energy source and not an internal coating. It was contained within the tubing and looked like cotton thread.

There was once even a product that could be charged with an explosive gas mixture immediately before use. Clever stuff. There might also have been a low velocity system based on silicon and red lead. I suspect that one was subsonic. Please bear in mind that I don't guarantee these wild statements, I am old and often have vivid hallucinations especially after sessions involving Deep Heat rub and vintage tonic wine.

Nevertheless, we live in an ever-changing world and it is likely that in the not too distant future, many end-user applications may benefit from the use of electronic detonators. Their precise control over timing may prove to be a useful ally in the control of noise and vibration. For secondary blasting there are alternatives to explosives in the form of expansive grouts and powders and even a few non-detonating CO_2 based systems.

But what about those noiseless blasting explosives? That presents a serious dilemma. Might they implode, not explode? Maybe they'll create a massively intense, but incredibly brief gravity field like those believed to be generated by the black holes found in space. Appearing only briefly, everything around them would be crushed into dust or less. I have no idea whether the crushing process itself would be noisy. I suspect that it would. There might still be a pressure wave and maybe even shrapnel and other flying debris to contend with, perhaps sucking in and not flying out, but the noise hazard would be eliminated.

I've also taken the time to include some especially useless information. Be aware that there may be a test afterwards.

I do not know if the record still holds, but at around 09:30 on the morning of 5th April 1958, what was once and maybe still is the largest intentional non-nuclear, man-made and deliberate explosion ever to happen took place at Ripple Rock in the Seymour Narrows, north of Vancouver in Canada. In this once almost legendary event, some 1250 tonnes of explosive were deliberately popped in a single blast. Its aim was to shear off the twin submerged peaks known as Ripple Rock, a locally notorious shipping hazard. It was successful.

Now that was a proper bang!

It is now time for my afternoon nap, but before Mr. Sleepy comes a-knocking I must make an attempt, however feeble, to raise awareness around the importance of safeguarding all explosive products:

Many criminal incidents and accidents involving energetic materials, the fatal ones as well as those causing injury, are in my opinion, the result of poor security and gross negligence. The importance of safeguarding all explosives, especially detonators, (blasting caps) and scrupulously accounting for them cannot be overstressed. Their security must be paramount. Without explosives and their vital initiators, criminals will no longer be so readily able to inflict their horrors upon society and my petty debate around extremely loud explosives will become utterly superfluous.

I suspect too that criminals are unlikely to be particularly vigilant around the issues of explosives safeguarding either. Whether they're dead, doing time in prison, planning future

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robberies or are merely lying low, they may have chosen to stash their explosives hoards in old buildings, derelict cars or simply bury or abandon them. I know from experience that juveniles, especially boys, (*I was one once, I remember*) tend to be fascinated by explosives. I therefore anticipate that at some indeterminate time in the future – and perhaps years will pass by – that perhaps the perpetrators own children or the children of others may find them.
The consequences are almost as predictable as they will be tragic.

ARTICLES FOR NEWSLETTER

This is a reminder that through the Newsletters we share knowledge in the areas of Safety, Health, Environment and Security pertaining to the Explosives Industry. SAFEX thus call on all members to submit articles on these subjects within their own companies and countries. **The deadline for articles for the June Newsletter is 10 September 2018 and I look forward to your support** .

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