SAFEX NEWSLETTER

No. 45, 2nd Qtr. 2013

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This is your Captain Speaking

David Overall (Downer Mining)

David Overall is the CEO of Downer Mining – one of Australia's Tier 1 mining contractors, with over 5,000 employees working across more than 50 sites in Australia, New Zealand, Papua New Guinea, South America and Southern Africa. He has worked in the global infrastructure, engineering and resources industries for almost 30 years, holding senior management roles and directorships around the world. David has managed a diverse range of major projects and operations in Australia, New Zealand, United States of America, Russia and South East Asia – including the NZ Steel Cogeneration project and the Ok Tedi Stage II copper phase in Papua New Guinea .

At Downer Mining, we are committed to a goal of Zero Harm, based on a belief that all incidents, injuries, occupational illnesses and diseases are preventable, as long as there are effective systems in place and an engaged workforce to implement and improve them.

We are always looking for innovative ways to improve safety at our workplaces – not just relying on the current controls to keep us safe, but actively improving our processes for both Downer Mining and the wider industry.

The following is a particular example of where we are taking our risk management controls to the next level within one of our mining services businesses – Downer Blasting Services (DBS).

DBS is one of the largest blasting services providers in the Australian mining industry. It provides innovative blasting solutions to over 20 projects across Australia with a fleet of over 50 Mobile Processing Units, four state-of-the-art emulsion-manufacturing facilities and 400 employees. As a complete blasting services provider, DBS handles large amounts of Ammonium Nitrate Emulsions (ANE) – a product, which if heated under confinement could cause an explosion. To improve its controls in relation to this serious risk, DBS has initiated a project to develop a new international Code of Practice for the safe storage and handling of the product.

Current industry-wide controls for ANE

ANE is classified as UN3375, 5.1 Dangerous Goods, as it complies with the United Nations Test Series 8 (a, b and c).

However, the international acceptance of this classification varies, with some countries (including some states in Australia) erring on the side of caution and are instead classifying the product as a 1.5 explosive – a stricter classification that places restrictions on the quantity of emulsion stored and the safety distances imposed around the manufacturing/storage facilities.

Proposed Code of Practice

Regardless of how ANE is classified, its classification does not reduce the hazards associated with the storage of large quantities, which is why DBS is developing an international Code of Practice that details additional engineering controls to help minimise the associated risk. The most robust control is a storage tank designed to fail-safe by allowing the product to be released if it reaches a specified temperature – a temperature set well below that where it reacts to heat. This would eliminate the potential for the generation of pressure and confinement, which are the primary contributors to explosions.

The code will also detail an alternative control – a blast barrier that can be positioned between storage tanks to eliminate the potential 'domino effect' of equipment failure.

Although the primary purpose of introducing this code is to protect our workforce, it also has the additional benefit of potentially reducing restrictions in relation to the placement and licensing of blasting operations on a mine site. This is due to the fact that licensing would be based on a single tank quantity as opposed to aggregate totals because the engineering controls would ensure that any incident would be isolated to one tank.

This Code of Practice is an example of how our business is constantly looking for ways to improve its risk controls and keep our people safe, and we're confident the wider blasting industry will also recognise its value.

Know the Expert Panel

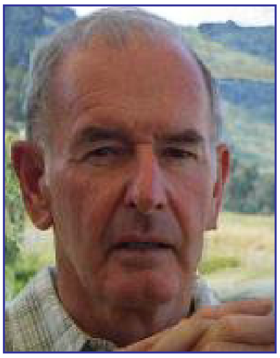
The **Expert Panel** comprises individuals who were nominated by members and approved by the Board. Such an individual must be associated with the explosives industry and possess expertise in specific fields. He must also be willing to make his expertise available to SAFEX members on a commercial basis which is agreed between the expert and the member. SAFEX does not get involved in the detailed arrangements but merely "connects" the Expert and the Member with the need.

To access the services of a SAFEX Expert, a client Member accurately defines the need it wishes the Expert to address. This requirement is captured in a Brief which is e-mailed or faxed to the Secretary General. The Member will be notified of the details of Experts that specialize in the fields of expertise designated by the client Member. It is then up to the Member to select an Expert and enter into an agreement directly with him.

STUART TOUGH

PERSONAL

Position: Secretary
Company: NIXT
Location: South Africa
Education: BSc Cape Town
Affiliations: NIXT; SAFEX
Languages: English; Afrikaans



CAREER OUTLINE

AE&CI Ltd (now AELMS) 1961 to 1996

- Manufacture of
  - Blasting Explosives and Accessories
  - Acids and Chemicals including Agricultural Chemicals
  - Polythene, Chlorine etc.
  - Propellants, TNT and RDX
- SHE Management
- Remediation of manufacturing sites

EXPERTISE

- Safety review of explosives operations and risk management
- Auditing
- Incident investigation
- Remediation

TYPICAL ASSIGNMENTS

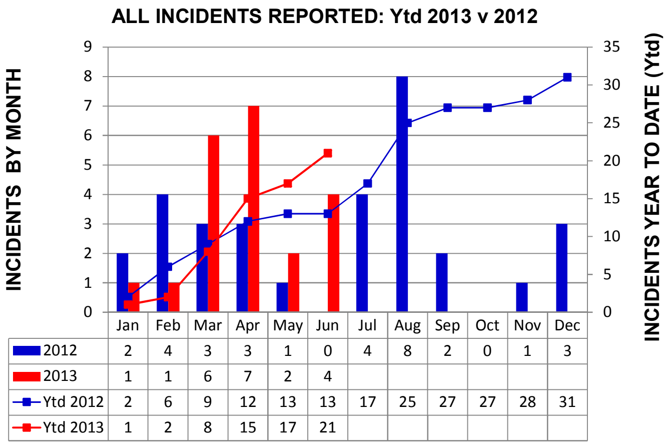
- Review and audit of Explosives Manufacture
- Demolition and Remediation of Explosives Factories
- Nitroglycerine Decontamination
- Incident Investigation

Incident Reporting

Monitoring our Reporting Performance

"Every incident that is reported may prevent another from occurring. You can save a life by reporting an incident - including a near-event."

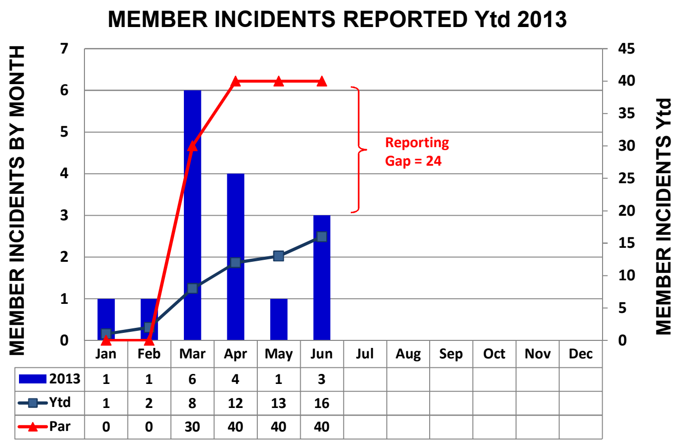
SAFEX learns from its members' experiences through the incident reports we receive. By applying these lessons we can prevent similar incidents recurring. That is why we track our incident reporting performance as follows:



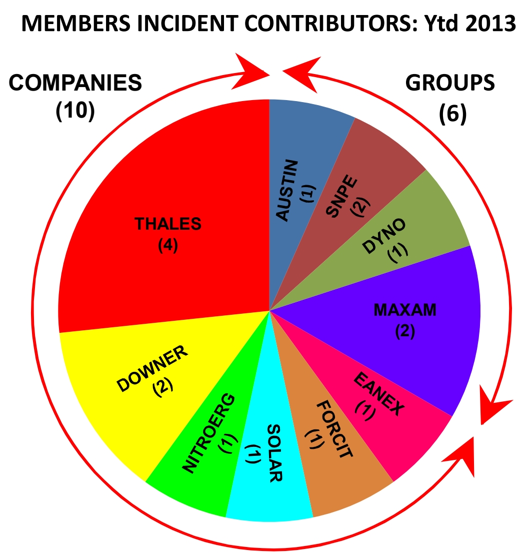
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	2	4	3	3	1	0	4	8	2	0	1	3
2013	1	1	6	7	2	4						
Ytd 2012	2	6	9	12	13	13	17	25	27	27	28	31
Ytd 2013	1	2	8	15	17	21						

All incidents reported. This chart compares the sum of non-member and member incidents reported to SAFEX every month this year to the previous year. We have reported 60% more incidents than for the same period in 2012. If we assume we aren't having more incidents, it means members are being more diligent than last year. In that case our members should be recognised and thanked for their efforts. It will be interesting to see if we can maintain this reporting trend.

Member incidents reported. Because they give us the best learning opportunities, we track member incidents (MI's) separately in the chart on the right. PAR is an estimate of how many MI's are occurring based on the severity of the MI's that have been reported this year. The gap between the number of MI's reported and PAR is our Reporting Gap. The Reporting Gap suggests that only 40% of our MI's are being reported.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	1	1	6	4	1	3						
Ytd	1	2	8	12	13	16						
Par	0	0	30	40	40	40						



Contributors of member incidents. This chart identifies those members who reported incidents. It shows the number of incidents each of these members reported relative to the total number of MI's received. The chart distinguishes between Groups and Companies merely to indicate the performance of the two membership categories. There are about twice as many operating units in the Groups than single Companies. So far this year Companies have reported almost twice the number of incidents Groups have reported.

Stop Press — *just confirmed*

- SAFEX EMULSION CLASS -
Emulsion Supply Chain

SAFEX Emulsion Explosives Workgroup Presents Unique Training Opportunity

"Running safe and sustainable operations throughout the supply chain of the manufacturing of emulsion explosives requires skilled leadership that can make effective management and technical decisions as part of their everyday life".

This is how Dawie Mynhardt, Leader of the SAFEX Emulsion Workgroup, explains the rationale for this unique training opportunity. The SAFEX Emulsion Workgroup plans to conduct a series of Emulsion Classes that address critical safety aspects of various stages of the supply chain of the manufacturing and handling of emulsion explosives, from raw material handling, to manufacturing, final usage and destruction.

The aim is to teach and coach over a period of time technical leaders, and other first line managers who may be new to the manufacture of emulsion explosives, so that they can identify, understand and address all hazards that exist along the total emulsion supply chain. It is further envisaged that these training interventions, together with the establishment of Good Practice Guidelines, would create and maintain long term sustainable capability to the benefit of all SAFEX members.

The introductory Emulsion Class module reviews learning points from significant incidents that occurred along the supply chain of emulsion explosives. It is then followed by a series of modules that address good practice principles of various operational and safety aspects that can assist technical leadership in preventing safety incidents or fatal injuries. Each module is presented by experts of that particular discipline.

You don't want to miss it.

We are looking forward to see you there

MODULE 1

WHEN: 24 and 25 October 2013

WHERE: Crowne Plaza London Heathrow Hotel

COST OF CLASS: EUR 200.00 for 2 days

WHO SHOULD ATTEND Experienced plant managers and 1st line process managers; SHEQ managers who are supporting manufacturing processes; Research and Development managers at middle management level who are responsible for development of emulsion explosives; and technical managers and specialists who may be new to emulsion explosives

ACCOMMODATION: Participants will be responsible for their own hotel accommodation. Hotel accommodation is available at the special SAFEX rate of GBP 119 per person per night and includes full English breakfast

AIRFARE: Participants are responsible for their own airfares

PROGRAMME:

Day 1: (Incident Review and Learning Points)

- Raw Material Handling
- Manufacturing
- Waste Management

Day 2: (Raw Materials and Additives)

- Identification of Critical Materials
- Physical and Chemical Properties of Materials
- Hazards and Risks Associated with Handling and Storage of Materials
- Principles and Best Practices

CONTACT: If you are interested or want more information please contact the secretariat@safex-international.org right away. Space is limited to 30 participants

Meet our Workgroups and their Leaders

The SAFEX Workgroups are an integral part of SAFEX's service offering. One can describe them as the engine room of SAFEX's efforts to identify good explosives practices. They focus on specific areas where members have common health, safety or environmental (HS&E) concerns. In the Workgroups members pool experiences and resources to produce an outcome that reflects their collective knowledge for that area of concern. Typical outcomes include a standard, guideline or good practice that promotes ongoing safe operation in the area concerned. The Board of Governors has established the following Workgroups with the designated Workgroup Leaders. Piet Halliday is the Governor responsible for overseeing the performance of the Workgroups:

Good Explosives Practice (GEP) (Dr Martin Held – Austin International)
Explosives Traceability - Track and Trace (Dr Noel Hsu – Orica Mining Services)
Safe Technical Grade Ammonium Nitrate (TGAN) Storage (Dr Noel Hsu – Orica Mining Services)
Explosives Transport (Henry Merrick – AEL Mining Services)
Explosives Emulsion Manufacture (Dawie Mynhardt – BME South Africa)
Explosives Remediation/Decontamination (Mervyn Traut – Expert Panel Member)

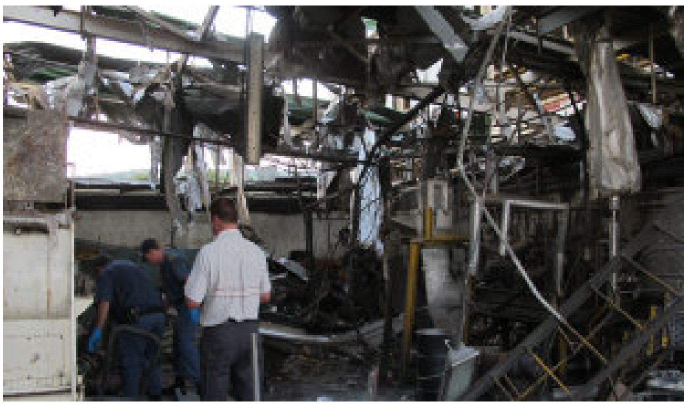
Given the importance of the Workgroups, SAFEX Newsletter is introducing our Workgroups and their Leaders to you in each edition. We have done so in alphabetical order of the Leaders and it is now the turn of Dawie Mynhardt

Dawie Mynhardt – Explosives Emulsion Manufacture

We do not need accidents to learn the hard lessons

When I arrived late in the afternoon after hearing about an explosion in our plant, I was greeted by the scene in the picture below. It was only in the early hours of the next morning that I managed to get back home for a quick shower and a few hours rest - grateful to find my family safely home and peacefully asleep. Meanwhile, three people who reported for duty at the start of their shift never returned home to their families. Incidents like these cut through the hearts of the families of the deceased. It cut through the hearts of colleagues, management and the community. It is a challenging time for companies. Don't we all expect to return home safely after a day's work? We surely do.

The question that will always remain is why is it that we are so often not able to spot and react to early warning signs? Most accidents are preventable. We do not need these accidents to learn the hard lessons, do we?



This is where the SAFEX Emulsion Workgroup stands to play a vitally important role. The Workgroup provides a neutral platform that can draw on the expertise and experiences of the SAFEX membership. In this way it can create awareness and increase the collective technical knowledge within the global emulsion supply chain. The purpose is simply to identify and address safety hazards that are normally encountered during the processing and handling of emulsion explosives.

We all have a duty to find ways to plough back the knowledge that we have acquired over the years. It is therefore an honour to be afforded the opportunity to play an active role in the SAFEX Emulsion Workgroup. I was privileged to have had great coaches and mentors throughout my career of over 25 years in the explosives industry. These "masters of the trade" had a sincere drive to instil the underlying principles and strict discipline that is required for working in an explosives environment. It became part of my value system. For this, I will forever be grateful to my mentors as I was able to employ the lessons learnt throughout my career. Having started as an inexperienced graduate I moved through process and product development to production management. In my current position as director at BME I oversee manufacturing, research and development, engineering and technical support services.

Workgroup Leadership

My first task as the newly appointed Emulsion Workgroup leader was to identify and approach emulsion experts who can participate as core members in the provision of leadership. The core members are a balanced pool of experts with extensive experience in all the critical aspects of the total emulsion supply chain. It will be a privilege and honour to work with the following seasoned experts who have pledged their availability as core members in our endeavours to make a difference in the safety of emulsion workplaces:

- Bill Evans (Orica)
- Clark Bonner (Dyno Nobel)
- Denny Schulz (Austin Powder)
- Fernando Beitia (Maxam)
- Larry Wilson (AELMS)

Emulsion experts from other organisations are requested to please consider their availability to join the Workgroup as core members. Please contact Dawie Mynhardt (dmynhardt@bme.co.za) if you are interested.

Workgroup Deliverables

Many training organisations and consultancy groups provide important system training on general safety principles. However, they avoid addressing operational hazards and safety principles that pertain specifically to the emulsion supply chain as these key competencies fall mostly outside their scope of expertise. The latest operational know-how and best practices are normally invested within organisations that own and manage emulsion operations as part of their business. It is here where the SAFEX Emulsion Workgroup has the capability to play the vital role of improving the collective 'operational safety know-how' of its members in order to avoid incidents and fatal injuries.

The main deliverables of the Emulsion Workgroup can be summarised as follows:

- Sharing of experiences and learning points. Workgroup sessions at SAFEX Congresses and interim Emulsion Class sessions provide for these interventions. It is envisaged to establish a Workgroup communication platform through the SAFEX website where registered members can participate
- Develop and publish Good Practice Guides (GPG's) that cover the total supply chain of emulsion explosives
- Develop and publish a qualitative risk register for the manufacturing and handling of emulsion explosives
- Facilitation of Emulsion Classes. Experts from emulsion manufacturing organisations will teach and coach plant management and technical personnel during various Emulsion Classes that are aimed at refining their skills in the identification and mitigation of operational hazards, which occur throughout the emulsion supply chain

It is the intention of the Workgroup to establish a data base that contains the listings of all emulsion manufacturers, including the contact detail of plant management, R&D management, Safety & Health management, and engineering management of each operation. The operational leadership from each area would form part of future Workgroup communication. The SAFEX contact person or responsible manager at each emulsion manufacturing site is kindly requested to furnish the respective contact details to Dawie Mynhardt. (dmynhardt@bme.co.za).

Workgroup Diary

Although the workgroup is at the initial organisational stage, it has already identified specific interventions and will therefore not wait until the 2014 SAFEX Congress to kick off with its activities:

- A Core group of emulsion experts have been approached and they have made themselves available to participate in the Emulsion Workgroup.
- A draft Workgroup Charter has been established and will be finalised by the Core members during 2013
- The first 2 day emulsion supply chain Class is planned for 24 and 25 October 2013
- The Core group will identify and prioritise the establishment and publication of Good Practise Guides (GPG's). Detailed information will be available during the 2014 SAFEX Congress.

Conclusion

The Emulsion Workgroup is set to add exciting and significant value in contributing to the safety of our emulsion explosives industry. Every emulsion manufacturer and their respective teams are emulsion experts in their own right. Let's use this Emulsion Workgroup as our platform to share our experiences and knowledge; to update and refine our skills; to benchmark our safety practices - and above all prevent nasty incidents that cause harm.

Explosives Eco-talk

The impact explosives and explosives manufacture has on the Environment fall squarely in the SAFEX domain. We are committed to publish the experiences members of the SAFEX community (Members, Associates and Expert Panel) have in minimising explosives' environmental impact. While most of our explosives incidents concern the safety and health impact, we are eager to learn about the environmental side of our activities. By way of this Feature we want to encourage readers to let us have contributions which create awareness of this facet of our operations as well as assist our industry to behave with environmental sensitivity and responsibility.

It is with regret that SAFEX is unable to provide an article for this Feature. We urge any readers who are able and willing to contribute appropriate material for this Feature to contact the Secretariat.

QRA Corner

Welcome to another instalment of the SAFEX Newsletter series called the QRA Corner. Each column will examine a particular aspect of state-of-the-art applications, large-scale testing, and algorithms associated with Quantitative Risk Analysis (QRA) models. Your authors will rotate between Lon Santis, Manager of Technical Services of the Institute of Makers of Explosives; John Tatom, Manager, Explosives Safety Group at APT Research, Inc; and Mike Swisdak, creator of the US Department of Defense' ESKIMORE large scale test program and currently a senior scientist at APT Research. Our previous instalments comprised a series of questions and answers that often come up when the issue of QRA is first raised and the issue of large scale testing to enhance the algorithms used. In this instalment Lon uses an allegory to highlight some of the distinctions between QRA and Q/D.

The Logistician and the Engineer

by

Lon Santis (Manager, Technical Services, Institute of Makers of Explosives)

Sometimes, when reading a series of articles, assumptions listed in an earlier article, and/or acknowledgements previously made, can be forgotten by the time several articles have been published. If someone has not read the previous articles, such notes will be missed entirely. In consideration of this, the authors would like to reiterate their gratitude for all those in the worldwide explosives safety community who are promoting QRA and advancing the associated science and regulations. In particular, the authors would like to thank the United States Department of Defense Explosives Safety Board, especially for their sponsorship of the test programs described in the QRA Corner articles and the Institute of Makers of Explosives. Naturally, the authors would also like to encourage readers to review earlier articles that they may have missed.

A logistician and an engineer were building bridges side-by-side across a river. The logistician asked the engineer, "Why are you building that bridge?" The engineer replied, "Because the people I work for want to connect both sides of the river. Boats cannot handle the traffic back and forth, which should not decrease in the foreseeable future." "How long is it going to take you?" asks the logistician? "About five years" says the engineer. The engineer then asks the logistician, "Why are you building that bridge?" The logistician says "You just answered that question."

So the logistician built his bridge in six months by copying a bridge that had stood for 100 years just down the river while the engineer toiled away. A year later, the engineer had still not broken ground when the logistician noticed he was packing up and moving up the river. "What's the matter, afraid to go up against my bridge, engineer?" mocked the logistician. "No," replied the engineer, "We determined this is not the best place to build a bridge, so we're going to build it upstream. Logistically, it is not as ideal a location as your bridge, but overall we like it better. Good luck with your bridge."

The logistician could not understand it. Why would the engineer delay his project another year and half and build his bridge upstream where the hills made getting to the banks of the river very difficult? Didn't the engineer understand that the bridge was just one link in the chain to get from A to B? The logistician was even more confused when seven years later the engineer opened the bridge, and it looked just like his bridge! What is wrong with the engineer, thought the logistician; it took him eight years longer than me to build a bridge just like mine in a place that is harder to get to. "I'll never understand engineers," said the logistician.

A few years later a huge rainstorm swelled the river and washed away the river bank under the logistician's bridge. The logistician watched in horror as his bridge was swept downstream. Later he found out it smashed into the 100-yr old bridge he copied and destroyed it, too. Sheepishly he approached the engineer. "I'd like to use your bridge to get from A to B, if that's ok?" "Sure," replied the engineer, "We're just lucky the water did not get a little higher, or we would have lost our bridge, too." The logistician could not help asking, "If you could have lost the bridge up here, too, why did you decide not to build the bridge where you started?"

The engineer replied, "We really wanted to build the bridge there, but after looking at all the geologic and weather data, we discovered that the cost to anchor the bridge abutments to the river bank was intolerable. And it would have taken three more years. So we moved upstream where bedrock is closer to the surface. We used 100-year flood data with a safety margin to figure how high above the water the bridge needed to be, and it was just enough. It cost us more to build and maintain, and everyone was disappointed in the delays, but we built this bridge to last 100 years so in the end, we were glad to know. Aren't you?"

The allegory to QRA and Q/D in the parable above comes from my experience with people's realization that QRA may not always allow relief from Q/D standards. The bridges represent risk from an explosives activity and the route from A to B represents risk from all things. The combined use of geology and meteorology data to look at one element of the explosive activity risk represents QRA and blindly copying what worked elsewhere represents Q/D. The role of the logistician and the engineer are played by themselves.

In most cases QRA will show that Q/D compliant situations are extremely low risk, with the risk of fatality less than 1 in 10 billion. But sometimes, QRA will show that the risk allowed by Q/D is above generally tolerable levels. Engineers tend to meet this realization with inquisitiveness, a desire to learn more about why the unintuitive is happening and take appropriate action. Logisticians see many apple carts being overturned.

Being an engineer, I have difficulty understanding the "head-in-the-sand" reaction. Except of course if the intent is to make some quick cash and then close up shop like a roadside fireworks stand after the holiday. (A tradition in the U.S. around July 4th and I suppose at other times around the world.) I have nothing against these patriotic entrepreneurs but I do not think many of them are reading the SAFEX newsletter. I am sure that readers of the SAFEX newsletter are in this profession for the long haul and nothing screams UNSUSTAINABILITY like causing mass casualties while using century-old technology.

SAFEX readers want to know the truth, even if it is so-called "bad news;" because they know that ignoring "bad news" will eventually lead to "worse news." This is essentially SAFEX's founding principle; to suffer the consequences of sharing "bad news" about incidents so that similar incidents might be prevented elsewhere, even if it is at your competitors'. Are you the logistician or the engineer in the parable?

In future columns, we will talk about the kinds of situations where Q/D might not provide the degree of protection we envision. These include large and relatively weak exposed buildings such as concrete tilt-ups near NEWs over about 50,000 kilograms (kg), relatively unprotected exposed sites on the normal to donor walls that create large amounts of horizontal secondary debris, exposed sites with large amounts of glass, and exposed sites with a high density of people

Putting Science to Work

In this Newsletter Feature we try to publish articles with a technical bias that illustrate how our industry is putting science to work in the interests of explosives health and safety. We want to recognise those who are involved in research and development as well as encourage them to continue improving our understanding of the behaviour of explosives. While explosives have been around for millennia there are still big gaps in our understanding of how and why they sometimes behave the way they do. As long as those gaps exist we are vulnerable.

The article we publish in this edition differs from previous articles in that it concerns a survey conducted within the explosives industry to assess issues regarding the UN Test Manual, the basis of the scientific tests we conduct.

Results of Survey on Test Series 6 of the UN Test Manual

by

David Boston

(Acting on behalf of the IME Technical Committee's UN Subcommittee)

In August last year SAFEX Members were invited by the IME to participate in a Survey to obtain comments, observations, and experiences in performing Test Series 6 (TS6) of the UN Manual of Tests and Criteria (Test Manual). The IME indicated that an update based on the survey results will be prepared for presentation at the 43rd Session of the UN TDG Subcommittee in June 2013.

David Boston is the United Nations Safety Consultant of the Institute of Makers of Explosives (IME) and chairs the UN Subcommittee of the IME Technical Committee who conducted the Survey. He submitted the following report on the results of the Survey to the IME Technical Committee on 13 May 2013. Because of the participation of SAFEX Members, SAFEX Newsletter is happy to provide this feedback with the IME's thanks to those who contributed to the Survey.

Introduction

At the thirty-ninth session of the UN TDG Sub-committee (TDG), the TDG working group on explosives (EWG) discussed issues of difficulty in conducting tests outlined in the UN Manual of Tests and Criteria (Test Manual), and recommended to the TDG sub-committee that the EWG conduct a review of the tests mentioned in Parts I and II of the manual with a view to:

a. Better defining the specifications of the tests,
b. Better defining the tolerances associated with those specifications, and
c. To remove any unnecessary or over-specifications.

Australia offered to coordinate a survey of experts on the basis of permitted variations to Test Series 8 and IME offered to coordinate the work, along with USA and Canada, on Test Series 6 (TS6). The TDG Sub-committee agreed that this work should be carried out.

As a first step in the review of TS6, IME, along with USA and Canada, conducted a survey to obtain comments, observations, and experiences in performing TS6. At the 41st session of the TDG, IME reported initial results of this survey in UN/SCETDG/41/INF.33.

The TDG welcomed the report from IME and requested that it expand the distribution of the survey and to report back at its 43rd session. (Editor: If any reader wishes to obtain a copy of the survey questions please contact me)

Discussion

The survey was initially distributed to: All participants at the June, 2012 EWG meeting: CERL; USA explosives testing & classification laboratories; BAM; TNO; INERIS; HSL; IME members; SAAMI; FEEM; AEISG; US Department of Defense; and US Department of Energy

After the 41st session, the survey was subsequently distributed to: Participants at the IGUS/EPP 2012 meeting in Berlin; Participants at the 2012 meeting of the Chief Inspectors of Explosives in Berlin; IGUS/EOS; CEFIC; ICCA and SAFEX

In total, 31 replies (22 initial replies and 9 replies to the second distribution) were received from: National defense ministries; National and independent explosives testing laboratories; Explosives, fireworks, and automobile supply industry members; Explosives and pyrotechnics associations; and NATO. In addition to the 31 survey replies, a comprehensive set of comments addressing the subject of improving the test series was received from the Alliance of Special Effects and Pyrotechnic Operators, Inc. (AESPO).

Survey Results

General comments. The respondents provided numerous comments regarding Test Series 6. Many concerned confusion of:

- the meaning of terms,
- when to use a detonator and when to use an igniter,
- when to use equipment mentioned in test specifications, and
- how to interpret test results.

All of the comments have been summarised in this document. Please note:

- There is no correlation between the positions of comments from question-to-question. In other words, the first comment in Test 6(a) question 1 may not be from the same respondent as the first comment in question 2.
- The comments are presented in no particular order.
- A tally of responses is included, along with percentages. You will note that not every respondent replied to every question.
- The source of comments is not identified.

Section 16.2.2. This section describes the order of test performance and the conditions under which tests may be waived. This section does not address the potential waiver of the 6(a) and 6(b) tests if the 6(d), when required, has been passed. This waiver was discussed by the EWG and endorsed by the TDG at its 35th Session (ref 3). Additionally, the structure of the section makes it difficult to determine what order changes and/or waivers may be appropriate. Finally, for the 6(a), 6(b) and 6(d) tests, some commenters questioned why the test is required of articles that are shipped without a means for initiation or ignition or otherwise designed such that functioning within the transport package is prevented. This is an issue that has been considered by TDG and its EWG, yet the question continues to arise. Currently, no guidance on this topic is provided in the Test Manual and IME believes that it would be helpful to the users if such guidance were provided to help in understanding these tests.

The IME recommends:

a. Section 16.2.2 should be revised to indicate that, if 6(d) is required, it should be performed first.
b. Section 16.2.2 should be revised to indicate that, if 6(d) has been passed, 6(a) and 6(b) may be waived.
c. Section 16.2.2 should be restructured to make its reading and interpretation easier.
d. The sub-committee should consider whether some guidance should be provided, in reference to the 6 (a), (b), and (d) tests, to applicability of the tests regardless of whether the products can function in the transport packaging.

TEST 6(a).

Purpose of the test. 73% responded that the purpose of the test was adequately defined. Section 16.4.1.1 of the Test Manual clearly states that the purpose of the test is to determine if there is mass explosion of the contents; however, there is some confusion as to the meaning of the term “mass explosion”.

Comments indicated that some are unsure if testing explosives shipped singly under Test 6(a) was necessary, since all the contents will explode. This issue is adequately addressed in Section 16.2.2 of the Test Manual, which states that, for articles packaged singly, the 6(a) test can be waived.

The IME recommends:

a. Revise the heading of Section 16.4.1.1 to read “Purpose”. This revision is also suggested for Sections 16.5.1.1, 16.6.1.1 and 16.7.1.1.
b. Insert the following sentence at the end of Section 16.4.1.1 of the Test Manual:
See Appendix B of the Model Regulations for the definition of “mass explosion”.
a. Review the definition of “mass explosion” in Appendix B of the Mod-

el Regulations to ensure that it is still appropriate and clear in its meaning.

Test materials. 62% responded that the materials required to perform the test were adequately described. One significant issue that was called to attention was that of the "standard detonator" described in Section 16.4.1.2, which, as several respondents noted, is not available as specified. A quick survey by IME of several test agencies revealed that, when a test specifies use of a "standard detonator", a commercially available detonator believed to provide equivalent results is used. The table in Annex 3 provides specifications of detonators identified to IME as being used in place of the "standard detonator" referred to in the Test Manual.

The list in Section 16.4.1.2 appears to imply that both a detonator and an igniter are required. Based upon the guidance given in Sections 16.4.1.3.2 and 16.4.1.3.3, IME does not believe that this is the case, and that this should be clarified.

Suggestions were received to include more sophisticated means of blast characterization such as the effect of donor action on receptors, projection hazards, etc. IME disagrees with these recommendations as it understands that the 6 (a) test is intended to be a relatively basic, simple mechanism for determining if there is a mass explosion hazard. Other blast characteristics are not examined by the 6(a) test.

The IME recommends:

a. The sub-committee should revise Appendix 1 of the Test Manual to specify broader criteria for detonators that can be used as a "standard detonator" pending a more detailed study on more appropriate criteria, and should commence such a study.
b. Revise the list in Section 16.4.1.2(b) as follows:
   i. *A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.4.1.3.2 and 16.4.1.3.3);*
   ii. *Suitable confining materials (see 16.4.1.3.4); and*
   iii. *A sheet of 3.0 mm thick mild steel (or equivalent mild steel such as 11 gauge or CR4 grade) to act as a witness plate.*
c. Reword the comment at the end of Section 16.4.1.2 to read as follows: *Note: In some cases, blast measuring equipment may be necessary*.
d. Revisions similar to those in ii) and iii) above should also be made to Sections 16.5.1.2 and 16.7.1.2.

Detonator vs. igniter. IME asked if it was clear when to use a detonator and when to use an igniter. 68% of the respondents felt that the procedure was clear on this issue. As noted above, IME believes that Section 16.1.4.2 implies that both are required and has provided a recommendation regarding correcting this implication.

The witness plate. When asked if a tolerance should be provided for the 3.0 mm specification contained in Section 16.4.1.2, 64% of the respondents responded, "no". Since the purpose of this test is to determine if a mass explosion has occurred, it does not appear that the thickness of the witness plate is that significant. However, 3.0 mm thick mild steel may be difficult to obtain in some parts of the world and alternatives should be provided for. IME has suggested a revision above that would address this problem.

The survey also asked if alternative materials for the witness plate should be considered and 79% of the respondents replied, "No". IME agrees with this assessment since the purpose of the test is to determine if there is a mass explosion hazard. The witness plate serves no other purpose than to provide an indication that a mass explosion may have occurred. Mild steel is inexpensive and readily available throughout the world and specification of alternative materials doesn't seem necessary. It should be noted that the Competent Authority always has the prerogative to substitute materials used in the test if it deems such substitution appropriate.

Test specifications. 63% of the respondents indicated that the test specifications were adequately defined. Many of the comments received indicate that the respondent may think that there is some other purpose to the 6(a) test other than determining if mass explosion occurs. IME believes that this is adequately addressed in Section 16.4.1.1. Some suggestions that would lead to better clarity were received. For example, in Section 16.4.1.3.2(c), "—" is used to indicate "negative". It was suggested that the use of the minus sign might not be clear to some, especially non-English speaking users. Also, it was also pointed out that the wording Section 16.4.1.3.2(c) is cumbersome and difficult to read.

The IME recommends:

a. In 16.4.1.3.2(c), replace occurrences of "—" with "*negative (—)".*
b. Review 16.4.1.3.2(c) to try to improve readability and understanding of the section.

Tolerances. 64% of the respondents indicated that tolerances weren't of particular use in the specification of the 6(a) test. IME's comments regarding tolerances are discussed above.

Over-specifications. 78% of the respondents replied that there were no over-specifications in the 6(a) test. Most of the comments received in reply to this query have been addressed above.

Acceptance criteria. It appears that the indicators of mass explosion described in 16.4.1.4 are leading some to conclude that any occurrence of any one of them is a failure. IME believes this is not necessarily true and that (a) - (d) of Section 16.4.1.4 are offered to assist in evaluating whether a mass explosion has occurred. For example, if there is damage to the witness plate, yet the package contained 50 items of which 48 were recovered unexploded, clearly, mass explosion has not occurred. However there is a perception that the damaged witness plate is automatically a failure of the 6(a) test and requires assignment to Division 1.1, even though a mass explosion obviously didn't occur.

Some comments were received suggesting that package orientation should be varied in each of the three 6(a) trials. Since the purpose of the 6(a) test is to determine if mass explosion occurs, package orientation seems immaterial. Package orientation would be important if examining projection effects, but this is not the purpose of the 6(a) test.

The IME recommends:

a. Review the criteria to ensure that they don't conflict with the definition of "mass explosion" provided in Appendix B of the Model Regulations.
b. Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/ actuators, small arms ammunition, etc.
c. Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

TEST 6(b).

Most of the discussion above about Test 6(a) is applicable to Test 6(b) as well. Some comments were received that indicate that some parties think that the 6(b) test is used for purposes other than as stated in Section 16.5.1.1, that is, to determine if there is package-to-package propagation.

The IME recommends:

a. Review the criteria to ensure that they don't conflict with, or lead one away from, the stated purpose of the test, that is to determine if there is package-to-package propagation.
b. Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/ actuators, small arms ammunition, etc.
c. Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

TEST 6(c).

Purpose of the test. 90% of the respondents replied that the purpose of the test is adequately defined. Some concern was expressed about the phrase "… or any other dangerous effect …". The concern is that the phrase is ambiguous and could lead to misclassification affected by burning packing material, the fuel itself, etc. Some clarification should be provided. Also, as noted above the heading of this section and comparable sections in 6(b) and 6(d) should be revised to read, "Purpose".

The IME recommends:

a. Revise the heading of Section 16.6.1.1 to read "*Purpose*". This revision is also suggested for Sections 16.4.1.1, 16.5.1.1 and 16.7.1.1.
b. The EWG should discuss the phrase "… or any other dangerous effect …" to determine what those other dangerous effect might be. It may be appropriate to revise the ending of Section 16.6.1.1 to read something like, "*… or any other explosives-caused dangerous effect when involved in a fire.*"

Test materials. 75% of the respondents agreed that the 6(c) test materials were adequately described. A suggestion was received concerning the mesh size of the metal grid. The feeling was that an inappropriate mesh size could, after packaging begins to burn away, result in tested product falling into the fire rather than remaining on grid thus confusing interpretation of the test. Some clarification on this point is recommended.

The IME recommends:

a. Insert a sentence between the first and second sentences of 16.6.1.2 (c) to read as follows: *The upper surface, or mesh, of the grid, upon which the tested explosives are placed, should be of sufficient size to prevent the tested explosives from falling into the fire after any packaging, if present, begins burning away.*
b. Reword the comment at the end of Section 16.6.1.2 by inserting "*Note*:" at the beginning of the statement.

Witness panels. 56% of respondents indicated no support for tolerances to be quoted for witness panel size. Additionally, 75% of respondents agreed that alternative materials for witness panel construction should be allowed. IME agrees and suggests that the EWG review witness panel specifications, with the goal of providing some guidance regarding acceptable alternatives.

Test specifications. In response to the question, "Are there any 6(c) test specifications that could be better defined?", 70% of respondents answered, "no".

The main issues identified in this portion of the survey were fuel sources and construction of the fire. Of particular concern was the description of a "suitable method" of building a wood fire that is found in Section 16.6.1.3.2. It appears that some take this very expensive method as the only way to build a wood fire and that fires build of other lumber or wooden pallets are unacceptable. IME recalls discussions at recent EWG meetings where it was generally agreed that other methods, such as wooden pallet fires, are also acceptable, so long as the desired fire characteristics and duration are obtained.

Additionally, several comments were received that the procedure seemed less organized than those for 6(a), 6(b), and 6(c).

The IME recommends:

a. The EWG should review fuel sources for the test to determine if other methods are available that will serve the purpose, be readily available, and more environmentally friendly.

b. Revise Section 16.6.1.3.2 by adding the following sentence to the end of the section:
   Other methods of building a wood fire, such as using wooden pallets and/or scrap lumber, may also be used, so long as the desired fire is obtained for an appropriate duration of time (see 16.6.1.2(e) and 16.6.1.3.1).
c. The EWG should review the structure of the procedure to improve its readability and comprehension.

Unnecessary or over-specifications. 63% responded "no" to the question, "Are there any unnecessary or over-specifications in the 6(c) test?" Most of the comments received under this question have been addressed above, and where appropriate, IME has recommended some courses of action.

Assessment criteria. Slightly more than half (53%) responded that the 6(c) assessment criteria contained in Section 16.6.1.4 were adequate. Some of the questions concerned the definition of "mass explosion" (see discussion above), assessing fireballs and jets of flame, calculating burning time, assessing witness panel dent depth, and calculating mass-distance relationship when trying to evaluate energy of metallic projections.

It was observed that the second sentence in Section 16.6.1.4.2 is inconsistent with the definition of "mass explosion" as provided in Appendix B of the Model Regulations.

A suggestion was received that terms such as "fireball", "jet of flame", "fiery projection", and "metallic projections" be defined so that there will be more consistent interpretation and application of the 6(c) acceptance criteria.

It was observed that the concluding phrase of Section 16.6.1.4.6, which addresses hazardous effects being confined within the package, is not an evaluation possible in the 6(c) test, since the package has most likely been consumed in the fire. Commenters questioned why this statement is in the assessment criterion that leads to 1.4S. IME agrees that this is an inappropriate 6(c) assessment criterion and has confirmed that the statement was added during the development of the 6(d) test, which is used to evaluate hazardous effects that result from accidental function of an explosive within its transport package.

There seemed to be general confusion and lack of understanding of the significance of certain criteria, such as the energy level limits (8J and 20J) for metallic projections, the thermal flux and burning time criteria, dent depth limits, and so forth. Much of this information is contained in discussion documents that were developed during the review of the 6(c) test by the EWG in the 1990s. IME is in possession of most, if not all, of these historical discussion documents and suggests that it might be worthwhile to include some of this information in an introductory paragraph to the procedure so that users will understand their significance. Since IME has already recommended revising the heading of Section 16.6.1.1 to read "Purpose", perhaps a new "Introduction" section could be added.

Validity of the points on the curve and the data in the table in Figure 16.6.1.1 was questioned. Some observed that the data presented has not been borne out in their practical test experience.

The IME recommends:

a. Review Section 16.6.1.4.2 and ensure that the assessment provided is consistent with the definition of "mass explosion" as provided in Appendix B of the Model Regulations.
b. Develop definitions for the terms "fireball", "jet of flame", "fiery projection", and "metallic projections".
c. Revise Section 16.6.1.4.6 as follows:
   If none of the events occur which would require the product to be assigned to Division 1.1, 1.2, 1.3 or 1.4 other than Compatibility Group S, ~~the thermal, blast, or projection effects would not significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity, and if hazardous effects are confined within the package~~, then the product is assigned to Division 1.4 Compatibility Group S.
d. Add a new introduction section that discusses the theories, meanings, and significance of the various acceptance criteria.
e. Review the graph and data in Figure 16.6.1.1.

TEST 6(d).

Most of the discussion above about Test 6(a) is applicable to Test 6(d) as well. Some issues specific to 6(d) are reviewed below.

Acceptance criteria. 85% of the respondents indicated that the 6(d) acceptance criteria are well defined. Concern was expressed that minor nicks and scratches might be interpreted as a "dent" as described in Section 16.7.1.4 (a). This has been discussed in past meetings of the TDG's explosives working group, and IME recalls that this is not the case. Some guidance to this effect should be provided in Section 16.7.1.4.

Also of concern was the wording of the criterion provided in Section 16.7.1.4(b). The feeling is that the words "capable of" are too vague. IME agrees and suggests that a revision of this criterion be considered.

Section 16.7.1.4(c) describes disruption of the packaging causing projection of the explosive contents. If this occurs, assignment to 1.4S is not possible. The question has been posed that, if the entire outer package is blown away, yet all of the contents remained in the area of the confines of the package, would this be considered a pass or a fail? IME believes that, in this example, since the explosive contents were not projected, that this would be a pass. However, discussions at a past meeting of the IGUS/EPP and at a past Chief Inspectors of Explosives conference indicate that there is not a consensus of agreement on this interpretation. Some clarification is needed and this could possibly be assisted by inclusion of some additional specific examples.

IME recommends:

a. Provide some guidance regarding what a dent is and what it is not.
b. Revise Section 16.7.1.4(b) as indicated below:
A flash or flame ~~capable of igniting~~ that ignites an adjacent material such as a sheet of 80 ± 3 g/m² paper at a distance of 25 cm from the package.
c. Consider providing some guidance regarding the issue described above concerning the outer package being blown away.
d. Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/ actuators, small arms ammunition, etc.
e. Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

Consideration

The IME recommendations above are not intended to be formal proposals for consideration by the TDG or EWG. They are intended as IME's suggestions for further discussion beginning at the 43rd Session.

The issues above are those that IME has identified as the most significant. In total, more than 400 comments were received in response to the survey, and the TDG and EWG may wish to conduct a more thorough review of those comments

IME remains at the service of the TDG and the EWG to continue to coordinate any future work on the review of Test Series 6 subject to those groups' desires and instructions.

References

1. UN/SCETDG/39/INF.58, para. 13
2. ST/SG/AC.10/C.3/78, paras. 24 - 25
3. ST/SG/AC.10/C.3/70, para. 18 and UN/SCETDG/35/INF.57, para. 11(a)

Our Explosives Regulatory World

Manual of Tests and Criteria: Recommendations for improvement of Series 1(a) and 2 (a) Gap Tests and Series 1(c) and 2 (c) Time/Pressure Tests

by

David Boston

(Acting on behalf of the IME Technical Committee's UN Subcommittee)

David Boston is the United Nations Safety Consultant of the Institute of Makers of Explosives (IME) and chairs the UN Subcommittee of the IME Technical Committee. He submitted the following report to the IME Technical Committee on 13 May 2013.

Introduction

At the 39th session of the UN TDG Subcommittee (TDG), the TDG working group on explosives (EWG) discussed issues of difficulty in conducting tests outlined in the UN Manual of Tests and Criteria (Test Manual), and recommended to the TDG sub-committee (ref 1) that the EWG conduct a review of the tests mentioned in Parts I and II of the manual with a view to:

a. Better defining the specifications of the tests,
b. Better defining the tolerances associated with those specifications, and
c. To remove any unnecessary or over -specifications.

The TDG Sub-committee agreed that this work should be carried out (ref 2).

As a first step in this review of the Test Manual, IME carried out a review of Test Series 1 and 2 focusing on the materials specified for carrying out these Tests, since it was shown earlier that some of the materials were difficult to obtain (ref 3).

Discussion

The 1 (a) and 2(a) Gap Tests and the 1 (c) and 2 (c) Time/Pressure tests were considered as pairs since for both Test Series 1 and 2 the materials required are the same.

Gap Tests

The steel specification in 11.4.1.2.1 and 12.4.1.2 is: cold-drawn seamless, carbon steel tube with an external diameter of 48 ± 2 mm, a wall thickness of 4.0 ± 0.1 mm and a length of 400 ± 5 mm. The cold-drawn seamless steel is not commonly manufactured, and if available is at a premium over, for example, an ANSI Schedule 40 steel tubing that is commonly and readily available. Schedule 40 steel has the following dimensions (ref 4) (converted from the table): external diameter 48.3 mm and a nominal thickness of 3.8 mm. The diameter fits within the current specification of 48 ± 2 mm while the nominal tubing thickness is 0.1mm less. Wall thicknesses are 'nominal' to account for manufacturing tolerances. For the test criterion of fragmentation a thinner walled steel tube would give a conservative result. Conversely, a thicker wall would be conservative for the criterion of puncture of the witness plate. In a survey carried out by IGUS EPP in 2010 and 2011 respondents questioned

the need for the narrow specification on tube thickness in view of the comparatively loose OD specification (ref 5). To enable easier sourcing for this material it is proposed that the steel tubing specified should be carbon steel with a diameter of 48 ± 2 mm and a nominal thickness of 4 mm.

The booster charge is specified to consist of 160g RDX/Wax (95/5) or PETN/TNT (50/50). The commercially and readily available Pentolite boosters are typically PETN/TNT (60/40). The higher PETN content will be more conservative. It is proposed that the specification be changed to require a minimum of 50% PETN in the PETN/TNT booster.

Time/Pressure tests

For the time/pressure test a lead washer is specified in 11.6.1.2.2 and 12.6.1.2.2. The purpose of this washer is to ensure a good seal. Lead is a highly toxic metal and since its sole function is to ensure a good seal, alternate materials available today can be used. The requirement in effect is for a washer made from a deformable material that will provide the required seal.

The ignition system for the time/pressure test consists of an electric fusehead together with a 13mm square piece of primed cambric, as specified in paragraphs 11.6.1.2.5 and 12.6.1.2.5. Primed cambric is only available from the UK. Some test laboratories manufacture their own. It is recommended that an equivalent material to primed cambric be identified, just as the Test Manual states "that fuseheads with equivalent properties may be used."

Proposals

Section 11

a. Amend 11.4.1.2.1 of the 1(a) test procedure to read:
   1. *The test sample is contained in carbon steel tube with an external diameter of 48 ± 2 mm, a nominal wall thickness of 4 mm and a length of 400 ± 5 mm. For example Schedule 40 steel with a Nominal Diameter of 38 mm (1.5 inches) will be suitable;*
   2. *The booster consists of 160 g RDX/Wax (95/5) or PETN/TNT that has a minimum of 50% PETN in the mixture,*

b. Amend 11.6.1.2.2 of the 1(c) test procedure to read:
   1. *A washer of a deformable material is used with both plugs to ensure a good seal.*

Section 12

a. Amend 12.4.1.2 of the 1(a) test procedure to read:
   1. *The test sample is contained in carbon steel tube with an external diameter of 48 ± 2 mm, a nominal wall thickness of 4 mm and a length of 400 ± 5 mm. For example Schedule 40 steel with a Nominal Diameter of 38 mm (1.5 inches) will be suitable;*
   2. *The booster consists of 160 g RDX/Wax (95/5) or PETN/TNT that has a minimum of 50% PETN in the mixture,*

b. Amend 12.6.1.2.2 of the 1(c) test procedure to read:
   1. *A washer of a deformable material is used with both plugs to ensure a good seal.*

Consideration

IME recommends that an alternate to primed cambric be sought and welcomes further discussion on this topic at the EWG.

IME remains at the service of the TDG and the EWG to continue to coordinate any future work on the review of Test Series 1 and 2 subject to those groups' desires and instructions.

References

1. UN/SCETDG/39/INF.58, para. 13
2. ST/SG/AC.10/C.3/78, paras. 24 - 25
3. UN/SCETDG/39/INF.25
4. http://www.engineeringtoolbox.com/ansi-steel-pipes-d_305.html
5. UN/SCETDG/39/INF.25

Improving Explosives Competence

All explosives manufacturers recognise the importance of training and developing people who work in and are responsible for explosives operations. SAFEX recently responded to a perceived need to develop leaders of explosives operations by embarking on the development of the *SAFEXplosives Management Course* in an e-learning format. We are not alone in trying to support SAFEX members in their quest for improved workplace competence. SAFEX is willing to partner with anyone or use any technology that can contribute to the competence of people working with explosives and thereby make our workplaces safer.

In this Newsletter feature we propose to present a series of articles that explain the UK's National Occupational Standards (NOS) in Explosive Substances and Articles (ESA). In the coming editions of the Newsletter, each article will examine a different aspect of the ESA standards and explain how they can be used for a range of purposes.

The coverage and construction of the Explosive Substances and Articles (ESA) National Occupational Standards (NOS)

by

Denise Clarke (Managing Director, Homelands Security Qualifications)

Homeland Security Qualifications (HSQ) is a British-based awarding body that specializes in the award of explosives-related qualifications. Denise has spent the last twenty years specializing in the specification and measurement of competence, working in a wide range of industries. Working with the industry, she has developed UK National Occupational Standards in Munition Clearance and Search and in Explosive Substances and Articles, creating qualifications and supporting assessment materials. HSQ now has five qualifications assessment centres, delivering a range of bespoke, industry-recognized and nationally regulated competence-based qualifications. Please visit www.homelandsecurityqualifications.co.uk for more information

The first article in this series introduced the UK's Explosive Substances and Articles (ESA) National Occupational Standards (NOS). In this article, we look more closely at what the standards cover and how they are constructed.

What do the ESA NOS cover?

The ESA standards were written to cover all the uses of explosives for everyone who works with them so they are as applicable to the commercial and private sectors as they are to the civilian defence world and military forces. The suite of ESA standards was developed in and by the UK but it is also applicable beyond the shores of the UK. Indeed, the EU ExCert project validated the relevance of the standards across Europe between 2006 and 2008. The participating countries were Sweden, Norway, Finland, Estonia, Lithuania, Italy, the Czech Republic, Germany, Portugal, the European Federation of Explosives Engineers and the UK. The outcome of that project was that the standards were found to be valid and relevant in all the participating countries and, since there is nothing either UK-centric or European-centric in them, there is no reason why they should not be equally as applicable beyond Europe.

The ESA standards were derived from a systematic process of functional analysis which identified the standards. They were organized into thirteen groups (known as "key roles"). To give them their abbreviated names, these are:

1. Research, design and development
2. Safety management
3. Test and evaluation
4. Manufacture
5. Maintenance (processing)
6. Procurement
7. Storage
8. Transport
9. Facilities management
10. Engineering and entertainment purposes
11. Disposal
12. Munition clearance and search
13. Generic (i.e. explosives-related standards that might apply to all key roles).

Key role 10 is the only area that is unfinished as there was insufficient industry input to be able to complete work on the engineering aspects of the use of explosives.

Please note that the ESA suite covers only the use of explosives so, for example, key role 9 only contains five standards as it relates only to the explosives aspects of facilities management and not to civil engineering in general.

Explosives roles covered by the ESA standards

The ESA standards were written to cover everyone who works with explosives. Consequently, they do not cover strategic roles or other roles that, whilst they might be employed by the explosives industry, do not have hands-on responsibility for working with explosives. So, in broad terms, they cover roles relating to explosives:

- Basic support (UK level 1)
- Operators (UK level 2)
- Supervisors/Technicians (UK level 3)
- Managers (UK level 4).

The exception to this pattern is that the Research and Development standards (key role 1) which include ESA standards for people who work at level 5. Conversely, there are no ESA standards for people who work as Explosives Transport Managers as it is usual in the UK for the explosives elements of the Transport function to be delegated to explosives experts who work at level 3.

Typically, the sorts of job titles that the ESA standards cover are as follows:

Key role (ref 2)	**Typical job titles**
1 Research, design and development	Research Project Leader, Research Leader, Research Project Manager, Senior Scientist Design Manager, Design Engineer, Weapon Designer, Development Manager, Project Leader/Manager, Engineering Manager Researcher, Designer, Development Scientist, Explosives Technologist, Design/Development Engineer
2 Safety management	Explosives Safety Manager, Explosives Safety Adviser, Inspector, Weapons Safety Manager, Weapons Safety Officer Magazine Manager, Police Explosives Liaison Officer
3 Test and evaluation	Trials Manager, Trials Conducting Manager, Range Manager, Range Safety Officer, Test Manager, Test Engineer, Firing Officer Trials Conducting Officer, Test Officer, Leading Hand, Prover, Test Department Manager Range Worker, Junior Laboratory Technician
4 Manufacture	Manufacturing Manager Manufacturing Supervisor, Process Supervisor, Chargehand Process Workers, Process Operators
5 Maintenance	Explosives Maintenance Manager, Weapons Engineer Officer Explosives Maintenance Supervisor, Weapons/Armaments Technician Explosives Maintenance Operator, Weapons Assembly Technician
6 Procurement	Explosives Procurement Manager, Procurement Manager Explosives Procurement Officer, Purchasing Officer
7 Storage	Explosive Storage Manager, Explosives Logistics Manager, Jetty Manager Explosive Storage Supervisor, Magazine Supervisor, Jetty Supervisor Magazine Attendant, Warehouse Operator, Storeman, Stevedore, Docker, Ammunition Worker
8 Transport	Explosives Transport Supervisor, Explosives Logistics Officer Driver, Lorry Driver, Van Driver
9 Facilities management	Explosives Facilities Manager Explosives Facilities Technician
10 Entertainment and engineering purposes	Special Effects Technician, Theatre/Film Armourer, Fireworks Display Designers, Re-enactors
11 Disposal	Explosives Disposals Manager, Demolition Manager, Demolition Safety Officer Explosives Disposals Officer, Explosives Disposals Supervisor Disposals Operator, Process Worker
12 Munition clearance and search	Ammunition Technical Officer, Bomb Disposal Officer, Search Adviser, Number 1 Ammunition Technician, Number 2, EOD Operator, Search Team Member, Support worker

In addition to the roles listed on the previous page, a further role was identified, namely, the General Explosives Operator whose responsibilities include aspects of test and evaluation, manufacture, maintenance, storage, transport and disposal.

The structure of the ESA standards

All the ESA standards are structured in the same way. They comprise three components:

1. Performance criteria
2. Knowledge requirements
3. Contexts.

Performance criteria

The performance criteria are the outcomes against which someone's performance would be measured. Because they are written as outcomes, they can be assessed and the assessment judgments that result should be fair and unequivocal. The ESA standards were written to describe competence in the workplace so it follows that the performance criteria must be evidenced by real work. People cannot prove their competence against the performance criteria by sitting an examination or writing a report and only in very rare situations is evidence from simulated activities acceptable.

As each ESA standard is designed to be a stand-alone specification of competence, any requirement that is relevant to that standard must be included in it. So, all the ESA standards begin with the same performance criterion [you need to]: *work safely at all times, complying with health and safety, environmental and other relevant regulations, legislation and guidelines.*

How you do this and the applicable legislation will vary according to the standard to which someone is working. For example, what is required to *Supervise the selection, preparation and despatch of explosive substances and/or articles* (ESA standard 7.9) might be quite different from *Dispose of explosive substances and/or articles by function as intended procedures* (ESA standard 11.17).

Sample ESA Standard

7.9 Supervise the selection, preparation and despatch of explosive substances and/or articles

Contexts

1. Orders: single; mixed
2. Consignments: single; multiple
3. Fulfilment of orders: in part; in full
4. Resources: full; limited

Criteria

You need to:

a. work safely at all times, complying with health and safety, environmental and other relevant regulations, legislation and guidelines

b. ensure that the correct items are selected, prepared and despatched in accordance with the order

c. report any shortfalls in the order to the right person

d. ensure that sufficient manpower and equipment are available to enable the goods to selected and despatched on time

e. determine accurately any requirements for pre-issue inspection, fractioning, rework and repackaging

f. ensure that any pre-issue activity is completed to meet pipeline times

g. ensure that appropriate action is taken in accordance with organizational procedures where explosive substances and/or articles are reported to be in a suspect or damaged state

h. ensure that all documentation is fully and accurately completed

i. ensure that the order is correctly packaged and labelled to comply with relevant legislation

j. resolve any problems within your level of authority

Knowledge

You need to know and understand:

i. health, safety and environmental and other statutory legislation, regulations and safe working practices and procedures governing explosives and their implications for your area of work

ii. the relevance of PPE

iii. the nature, characteristics, hazards and risks of the explosive substance and/or article

iv. the actions to be taken in response to an unplanned event

v. how to identify alternative sources of supply to accommodate any potential shortfalls

vi. the importance of fulfilling orders accurately and on time

vii. how long it takes to assemble orders

viii. how to identify if pre-issue activity is required

ix. how to progress pre-issue activity

x. the procedure to follow if an order cannot be fulfilled or discrepancies exist

xi. the rules governing mixing hazard divisions and compatibility groups

xii. the staff and resource requirements for the task and the information they need to perform effectively

xiii. how to implement contingency plans

xiv. how to give and receive constructive feedback

xv. your level of authority and to whom to refer for advice or decisions

In the examples identified above, the expectation for despatching explosives would need the demonstration of an understanding of ADR (ref 3), but for disposal, this would be the Explosives Industry Group 'Guidance for the Safe Management of the Disposal of Explosives'. Both these meet the same outcome performance criteria of working safely, but are only appropriate for the standard to which they apply.

Knowledge requirements

Some of the knowledge that is needed to fulfil the performance criteria can be inferred from competent performance. For example, if you *adhere to reporting procedures at all times* (and this would be assessed over a period of time), then it follows that you know what those procedures are. However, some knowledge cannot be inferred from competent performance. This is specified in the Knowledge requirements.

The intention of all these standards is that competence would be measured in the workplace. However, for some points of knowledge, this could be taught off the job in a training module. For example, a training course could cover the legislative and regulatory requirements of health and safety and *the rules governing mixing hazard divisions and compatibility groups*. On the other hand, it might be more appropriate to assess whether someone knows *how long it takes to assemble orders* in the workplace because this will vary from one organization to another and indeed, between different production areas.

Contexts

The Contexts describe the critical parameters of competent performance which may include internal and external factors, options or situations. Someone cannot be deemed to be competent unless they can meet the performance criteria in all the situations describe by the contexts. So, looking at ESA standard 7.9 *Supervise the selection, preparation and despatch of explosive substances and/or articles* (see previous page), a Storage Supervisor could not be competent if he or she could only deal with single orders, single consignments that were fulfilled in part with full resources. A competent Storage Supervisor can also deal with mixed order, multiple consignments that were fulfilled in full with limited resources. Achievement of the contexts shows the breadth of someone's competence and the fact that they can deal with the non-routine and unpredictable as well as the full range of expected situations.

A sample ESA standard is shown on the previous page.

Let us take an example we can all understand of what all this would mean – that of driving a car. If you were to write a standard about driving a car, the performance criteria might include *control the speed and direction of the vehicle*; *comply with the requirements of legislation, codes and guides*; *maintain lane discipline*; *take all reasonable actions to maintain the health and safety of self and others* etc.

The knowledge requirements might include the *requirements of the Highway Code*; *the location and functioning of the controls*; *when it is safe to overtake vehicles* etc. Fortunately, it is not necessary to know and understand the workings of an internal combustion engine to be able to drive safely!

The contexts might include *different weather conditions*; *day and night*; *hazards (e.g. road conditions, traffic conditions, road layout, road users*); *changes in direction* etc.

Readers might like to consider the case of the lady who was not confident in dealing with all the contexts when driving her car. Apparently, when she did the school run in the mornings, the journey took ten minutes. However, on the return journey in the afternoons, because she was not confident about dealing with right hand turns (remember – we drive on the left in the UK) the journey took 45 minutes so that she could avoid as many right hand turns as possible!

Nowadays, in the UK, prospective drivers' knowledge of the knowledge requirements (the Highway Code) is tested in exam conditions using a touch screen. However, the competence element, (the performance criteria in all the relevant contexts) is tested by independent assessors at a range of government test centres across the UK.

We hope that this article has demystified some aspects of the ESA suite of standards. In the next article, we will look at some of the practical applications of the standards.

References

1. www.euexcert.org
2. Note: the ESA standards in key role 13 do not contain any qualifications in themselves but the standards are used in combination with other key roles to form qualifications designs
3. http://www.unece.org/trans/danger/publi/adr/adr2013/13contentse.html

Pondering the Profession

This column is devoted to our 'Safety Professionals' in recognition of the important role they play in the explosive industry's health, safety and environment efforts. It is intended to be a forum in which we can talk about the Profession. Our aim is that this column will be read by all but that the Safety Professionals in our industry will make it their own.

Profile of a Safety Professional / Coordinator

by

Maurice Bourgeois (General Dynamics- OTS, Canada)

Maurice is a graduated industrial engineer with vast experience in managing maintenance groups (millwrights, electricians, pipefitters, machinists, carpenters) in paper and shingle mills as well as in copper rod rolling mills. He joined General Dynamics OTS Canada (formerly Canadian Arsenals and SNC Technologies Inc) in 1983 as maintenance and industrial engineering manager. As maintenance manager he was deeply involved with industrial and explosive safety. Because of his process experience and knowledge he was asked to take charge of licenses and permits which involved explosive safety and the environment. He has an obsession with explosive safety as result of an incident that almost cost the life of a millwright on his watch. While the millwright was working on a bolt, the explosives in the threads detonated and projected the bolt like a bullet. It shot through the millwright's hand and just missed his head. As the munitions business covers a wide variety of explosives and processes governed by many military standards he has gained considerable experience in diverse explosive processes and their safety issues.

SAFEX Newsletter asked me to share some thoughts on the role of the safety professional or coordinator based on my thirty years' experience in the military explosives sector. It is with pleasure that I list them in no particular order:

1. The safety coordinator should be humble; he can't know everything and is not infallible. He must encourage team work. What he missed may be picked up by other members of the team (safety inspectors, operators, maintenance personnel, process engineers and R&D). The most important thing is that no significant safety issue should be overlooked.

2. He must identify where the knowledge resources are and not be be afraid to use them. Typical internal resources include: R&D, Engineering, Maintenance, and Production, etc. Consultants and the SAFEX community are typical external resources he can use.

3. Active participation of operators and trades personnel in a safety programme are of the utmost importance. These people are in the front line and it is crucial that they buy into the safety programmes and procedures.

4. Don't be afraid to ask questions and challenge existing or proposed practices even if at times it seems unpopular or an irritation. Just recently, I was involved in the commissioning for a new pellet collection system off a press. I asked the technicians if all the safety switches had been checked and were fully functioning. The answer was yes. I asked the 'inquisitive commissioning' question: Is the system fail safe? If a switch is faulty or a connection cable is broken, how does the system react? They weren't sure. After verification, they discovered that the Zener barrier used to make the system intrinsically safe outputted a ''1'' instead of a ''0'' under those circumstances. They had to reprogram the Zener barriers to output ''0''. The engineer asked to redo the commissioning for all switches using the ''what if'' approach even though the technicians felt it wasn't necessary. Lo and behold they found several logic faults in the process.

5. Risk analysis involves a creative brainstorming process (either using well structured and systematic procedure such as HAZOP or a more informal procedure such as "What If"). You have to be creative and imaginative to discover failure modes and human errors. Fukushima is a good example. Who would have thought that a Tsunami could flood the reactor cooling pumps that allowed the reactor to overheat and cause an explosion? This illustrates the need for creative imagination during risk analysis sessions. I personally prefer the "What If" method for our assembly processes because of the processes' vulnerability to human error. For chemical processes HAZOP seems the most efficient tool.

6. People become complacent with explosives because they are exposed to them day in and day out without any mishaps occurring. Demonstrations at the burning ground once a year, or even once every two years, can drive home the effects of the explosives people handle daily. This should help to bring them back to earth. These demos should not only be a firework demo. People should be briefed on the do's and don'ts, near-events, lessons learned and good record keeping to prevent explosives ending-up where they shouldn't be.

7. Management of Change (MOC) is another issue the safety coordinator should keep close tabs on. Everyone in the organization should endorse MOC procedures particularly shop floor people. Every change must be scrutinized to make sure they don't produce hidden dangers. The best way to convince people is to demonstrate with lessons learned from near-events or accidents that occurred following a change that was identified as a root cause or a contributing condition to the event.

This column exists for safety professionals to share their ideas so that we can become more effective in our role. I look forward to the comments of other safety professionals and learn from their experiences as well.

Safety Snippets

Product Stewardship: Check before you push the Plunger

by

Mine Safety and Health Administration (MSHA), US Department of Labor

Paul Clark, Factory Manager of Arabian Explosives Company came across this incident and thought readers may wish to bring it to the attention of customers who operate open cast mines or quarries. SAFEX certainly does not claim any blasting expertise but is concerned about the safe use of explosives given its commitment to Product Stewardship. Details of this MSHA Fatal Report can be found at http://www.msha.gov/fatals/2013/FAB13m03.asp

On March 27, 2013, a 61-year old loader operator with 24 years of experience was killed at a crushed stone operation. The victim was in a front-end loader about 50 feet from the base of a highwall when a blast was initiated. Broken rock struck the front-end loader and covered it. The rock was removed from the front-end loader and the victim was recovered about 10 hours after the blast occurred.

Best Practices

- Do not initiate a blast until it has been determined that all persons have been evacuated from the blast area.
- Establish and discuss safe work procedures. Identify and control all hazards associated with the work to be performed along with the methods to properly protect persons.
- Task train all persons to recognize all potential hazardous conditions, to ensure all persons have left the blast area, and to understand safe job procedures for elimination of the hazards before beginning work.
- Maintain and use all available methods of communication, such as sirens and radios, to warn persons of an impending blast. Establish methods to ensure that all persons are out of the blast area.
- Before firing a blast give ample warning to allow all persons to be evacuated.
- Guard or barricade all access routes to the blast area to prevent the passage of persons or vehicles.
- Verify that the blasting procedures are effective and being followed at all times.

This is the 3rd fatality reported in calendar year 2013 in the metal and non-metal mining industries. As of this date in 2012, there were 2 fatalities reported in these industries. This is the 1st Explosives and Breaking Agents fatality in 2013. There were 0 Explosives and Breaking Agents fatalities in the same period in 2012

FIBC Selection and Safe Use

by

Dr. Muhammad M. Rafique Qureshi (Safety Consulting Engineers Inc—SCE)

Muhammad Qureshi, Ph.D., is a Process Safety Specialist in SCE which is part of the Dekra Group. He provides consulting services in dust explosion and electrostatic hazard assessment and is also responsible for standard and customized electrostatic testing at Chilworth labs in Princeton, NJ. He received his Ph.D. degree in mechanical engineering from the New Jersey Institute of Technology (NJIT) in 2006.

He has been involved in investigating numerous fire and explosion incidents, conducting on-site process safety reviews and audits, and providing training on combustible dust and electrostatic hazards. He has been working for company in a wide range of industries including pharmaceuticals, chemical, petrochemical, and food industries. He has also been involved in developing interactive Computer Based Training (CBT) modules for combustible dust. He has published a number of articles related to combustible dust and electrostatic hazards.

This article appeared in the February edition of “Safety Watch”, a Dekra Newsletter, and is published with the kind permission of Safety Consulting Engineers Inc.

Flexible Intermediate Bulk Containers (FIBCs) are extensively used for packing, storing and transporting a variety of materials (chemicals, minerals, food products, agricultural products, fertilisers, plastics, cement, etc) in fine dust, powder, granular or flake form. The use of FIBCs in industrial applications is ever-growing as they are a cost-effective packaging and transportation means; however, there are associated electrostatic ignition hazards that one should be aware of when using FIBCs for packaging and transporting combustible/ explosible materials and/or when flammable gases and vapour atmospheres are present in the solid media.

Electrostatic Discharges

Electrostatic charge generation normally occurs due to the process of contact and separation which takes place between individual powder particles and the conveying equipment upstream of the FIBC during filling and between the powder particles and the internal surfaces of the FIBC during emptying.

The types of discharges that may occur due to the buildup of electrostatic charge on the FIBC include:

- Brush Discharges from the surfaces of standard insulating FIBCs and liners. Brush discharges can ignite flammable atmospheres requiring a Minimum Ignition Energy (MIE) of up to approximately 4mJ.
- Propagating Brush Discharges from the surfaces of insulating FIBCs and liners, which have electrical breakdown voltage greater than 6,000 volts. Propagating brush discharges can ignite flammable vapor, gas and dust cloud atmospheres.
- Spark Discharges from conductive parts of groundable bags and conductive liners if left ungrounded.

Types of FIBC and Selection Criterion

There are currently four types of FIBCs; namely Type A, B, C and D. Table 1 provides the features of the various FIBC types and the testing requirements for each FIBC.

Table 1: - Features and Testing Requirements for Various FIBC Types

FIBC Type	Features	Testing Requirements
Type A FIBC	• No protection from static discharge • May be used when transporting non-combustible solids or solids with MIE > 1000 mJ	• None
Type B FIBC	• Provides Protection from Propagating Brush Discharge • Use when transporting combustible solids with MIE > 3 mJ • When loading and unloading in the absence of flammable vapours and gasses	• Breakdown Voltage and Propagating Brush Discharges
Type C FIBC	• Uses inter-connected conductive threads or conductive coatings to dissipate the charges • Must be grounded • Provides Protection from Propagating Brush Discharges and Brush Discharges • Use when transporting combustible solids with MIE > 3 mJ and/or when loading and unloading in the presence of certain flammable vapours and gasses	• Breakdown Voltage and Propagating Brush Discharges • Resistance to Groundable Point
Type D FIBC	• Incorporates interwoven specialist antistatic threads and/or specialist antistatic coatings • Does not require Grounding • Provides Protection from Propagating Brush Discharges and Brush Discharges • Use when transporting combustible solids with MIE < 3 mJ and/or when loading and unloading in the presence of flammable vapours and gasses with MIE > 0.14 mJ	• Breakdown Voltage and Propagating Brush Discharges • Discharge Incendivity Test

The use of liners in any type of FIBC can increase the risk of an electrostatically initiated flash fire or explosion. There are three types of liners that are permitted to be used in a particular type of FIBC depending on the electrostatic properties of the liner material (see Table 2). Depending on the liner type, the following electrostatic properties may need to be determined for liners:

- Surface Resistivity,
- Breakdown Voltage,
- Liner Thickness,
- Resistance to Groundable Point

These tests results provide valuable information that will be utilized to determine the safe use of a particular type of liner with a specific type of FIBC.

Table 2: - Features of Various Types of Liners for use in FIBC

Liner Type	Features
Type L1 Liner	• Made from materials with "*Surface Resistivity*" on at least one surface < 1.0x107 Ohm per Square, • If the material is multi-layered, or if the material has outer surface with Surface Resistivity > 1.0x1012 Ohm per Square, "*Breakdown Voltage*" through the material shall be < 4KV • If the material is multi-layered, or if the material has inner surface with Surface Resistivity > 1.0x1012 Ohm per Square, "*Breakdown Voltage*" through the material shall be < 4KV and Thickness shall be < 700 micrometre
Type L2 Liner	• Made from materials with "*Surface Resistivity*" on at least one surface between 1.0x109 and 1.0x1012 Ohm per Square. • If the material is multi-layered, or if the material has outer surface with Surface Resistivity > 1.0x1012 Ohm per Square, "*Breakdown Voltage*" through the material shall be < 4KV • If the material is multi-layered, or if the material has inner surface with Surface Resistivity > 1.0x1012 Ohm per Square, "*Breakdown Voltage*" through the material shall be < 4KV and Thickness shall be < 700 micrometre
Type L3 Liner	• Made from materials with "*Surface Resistivity*" greater than 1.0x1012 Ohm per Square, • "Breakdown Voltage" through the material shall be less than 4KV

Selection of a Particular FIBC and Liner Combination

It is very important and safety critical to ensure that:

- A suitable FIBC is selected for a particular application,
- Both liner and the FIBC meet the specifications of the testing requirements per the international standards,
- A permissible combination of a qualified liner and a particular FIBC is used,

References

IEC 61340-4-4 Edition 2.0: Standard test methods for specific applications – Electrostatic classification of flexible intermediate bulk containers (FIBC)

Company sentenced for control failings

UK Health and Safety Executive Press release no. SE/13 dated 28 May 2013

This release is published with the permission of the HM CIE, Neil Morton whose support we gratefully acknowledge. The UK Health and Safety Executive is Britain's national regulator for workplace health and safety. It aims to reduce work-related death, injury and ill health. It does so through research, information and advice; promoting training; new or revised regulations and codes of practice; and working with local authority partners by inspection, investigation and enforcement.

Paul Clark, Factory Manager of Arabian Explosives Company also brought this case to the attention of SAFEX Newsletter. We publish it to remind readers of the consequences being found guilty of violations of explosives regulations. Besides the fine that the court imposed the company concerned had to pay costs and compensation to the injured employee. This release can be accessed at http://www.hse.gov.uk/press/2013/rnn-se-13-awe.htm?ebul=hsegen&cr=3/3-june-13

The Atomic Weapons Establishment PLC (AWE PLC) has been ordered to pay more than £280,000 in fines and costs for significant failings relating to its use and control of explosive materials after a worker was injured when a fire broke out in an explosives processing building.

Ashley Emery, 29, from Basingstoke, burnt his left arm and face in the incident at the company's Aldermaston base in Berkshire on 3 August 2010. Reading Crown Court heard today (28 May) that he was breaking dry nitrocellulose (NC) into a plastic bucket which contained methyl ethyl ketone (MEK) - both volatile agents - as part of the process of producing a lacquer. Mr Emery moved away from the mixture, removed his respirator, and returned to have a better look at things, at which point the contents of the bucket ignited and produced a fireball. He managed to flee before the fire took hold, spread and seriously damaged the building.

The Health and Safety Executive (HSE) investigated the fire and established that had AWE Plc recognised all the hazards of working with dry NC, and implemented appropriate safeguards, then the incident could have been avoided. The company possessed data sheets identifying the potential risks associated with the use of NC and MEK. These provided direct guidance about situations to be avoided when using the substances, but insufficient heed was paid to them.

HSE inspectors also identified issues with the storage of unnecessary hazardous materials in the manufacturing area, and the fact a number of explosives processes were taking place at the same time.

AWE Plc, of Aldermaston, near Reading, was fined £200,000, ordered to pay £80,258 in costs, plus £2,500 in compensation to the injured man after pleading guilty to a single breach of the Health and Safety at Work etc. Act 1974.

After sentencing HSE inspector Dave Norman said: "The fire could have caused multiple casualties and it was entirely preventable had better control systems been in place. The failure to instigate such controls was dependent on AWE identifying potential hazards and risks, all of which were well documented, but that simply did not happen. The building and equipment within it did not comply with the-then current standards required for storing and handling explosives, which are potentially sensitive to static electricity, nor for storing and handling extremely flammable liquids. "The risks associated with the lacquer preparation were not fully recognised by the company. This was compounded by a decision to run numerous explosives processes at the same time and in the same building, which is completely unacceptable by industry standards. "We also found that the personal protective equipment (PPE) provided for employees, principally a lack of flame retardant coveralls, was inadequate.

"This collection of shortcomings demonstrates that there were failures of supervision, monitoring and auditing over time, including in relation to the conducting, validating and approval of risk assessments. Companies working with hazardous substances must take extreme care at all times and in all aspects of their operations."

Inbox @ SAFEX-International.org

From time to time we receive e-mails from members of the SAFEX community on a variety of issues. It is important we share such experiences and insights and if necessary debate them. Our quarterly Newsletter may just be the forum for doing so.

We therefore invite ALL readers to drop us a line at secretariat@safex-international.org if they want to raise an explosives health, safety or environmental issue or comment on any of the opinions received from our correspondents.

Clamp bands on vibro energy sieving machines for explosives

Two operators were severely burned (one of them died subsequently) and electrical equipment as well as the roof damaged when ball powder ignited during a sieving operation. The sprinkler system functioned properly but was unable to prevent severe injuries to the workers. The most likely cause was mechanical impact when the clamp bands used to fix the screens onto the machine became undone while the machine was operating. The sieve used was a vibro-energy separator and the member concerned asked for ideas on preventing the accidental disassembling of clamp bands on the separator.

Maurice Bourgeois (General Dynamics-OTS Canada) weighed in with this comment One question that comes to mind is: Why is this type of operation not done remotely? All our sieving operations are done remotely because the shaking in sieves can generate friction points if the powder gets trapped in the interfaces between the screen and sieve body or as in this case something breaks loose creating impact. Other causes can be the inadvertent introduction of a foreign body or failure by the operator to attach the screen properly. While I don’t know the operation concerned, will it be possible to shield the screen in some way and properly vent the shielded area to prevent confinement?

As far as the deluge system is concerned, it will not protect the operators properly because it is highly dependent on detection. If the sieve is enclosed, the fireball forms inside and when the sieve body breaks open detection is too late. If it’s an open sieve and the fire propagates under the screen before it reaches the powder on top, detection will also be too late. Hence the best protection is to operate remotely.

Willie Dalgleish (Chemring Energetics UK) passed on the following comment from one if their plant managers: The plant manager concerned recognised this type of sieve system from an installation on the industrial nitrocellulose plant which previously operated on their site and said. “One of our units went for a walk when the springs burst. We fitted sensors to detect severe movement and cut the power off. However, depending what you are sieving the units can move around a fair bit due to the out of balance drive motor. The big problem is when you replace a torn screen. We used to run the unit with no product for a couple of hours then re-tighten the locking clamps which tend to move after a sieve change. In addition, we had a weekly routine for the fitters to nip-up the clamps."

Claude Modoux (Poudrerie d'Aubonne) reacted as follows: Poudrerie d'Aubonne has been operating for 8 years with a similar type of screening machine (not identical and manufactured by another supplier) for the production of dry black powder. The construction is circular with a central feeding device. The mechanical screening is fully automatic through a gyratory motion with a horizontal motion. Up to 4 different fractions can be obtained. To improve the safety of the equipment we asked the supplier to make some minor design modifications using our long experience of engineering technology and explosives manufacture before delivery of the equipment. The incident demonstrated the hazard generated by the application of the clamp bands, particularly for the manufacturing operations of explosives. Clamp bands can result in each screen being improperly located causing friction in the presence of explosives dust. We have preferred the application of a vertical shaft maintaining all the plates in a correct and fixed position.

Claude then provided some details of their design which were forwarded to Vincent Berton.

John Rathbun (Austin International) wrote saying: I am not sure if I can be of any help but wondered whether a robust, plastic wire harness similar to those used in a car could be made of anti-static materials and be used to hold the clamps in place.

Vincent Berton (PB Clermont) responded to these suggestions and comments in this way: Many thanks for this useful information. I fully agree with Claude's statement that the use of a clamp band is probably not the best system to clamp screens into a sieving machine. A vertical shaft is certainly more reliable in presence of explosive. The feedback SAFEX members have generously provided indicates that a surprising number of the sieving machines using clamp bands are in operation in explosive facilities around the world. I believe the Poudrerie d'Aubonne sieving machine appears safer to me.

Would "inquisitive commissioning" have helped?

A member reported that there were no injuries or damage when a grenade striker pin dislodged during the assembly of a high explosive grenade due to the malfunction of a newly installed pneumatic torque driver.

Maurice Bourgeois (GD-OTS Canada) found the report very interesting with an application close to home. He went on to say: Fortunately the fuze handle was probably held in place by the torque tool. This illustrates the need for what I would call an ''inquisitive commissioning'' with inert components. I think that many times commissioning is limited to test the equipment for its orderly operation and check the safety switches and devices. There should be a phase where we study all possibilities of by-passing safety devices or affecting normal operations such as poor positioning of parts, power failures, dislodged switches etc. to determine their effects on the equipment whenever possible. This phase I would call ''inquisitive commissioning''. It is sort of a brain storming risk analysis with the actual equipment instead of a desktop risk analysis. I don't know if it applies in this case but this is what came to mind while reading this report.

On handling detonators in the field

SAFEX received a report about an explosion that occurred while a truck delivering explosives and detonators was being unloaded at a quarry. The likely cause of the incident that killed 10 people and injured 20 was initiation of the detonators.

Maurice Bourgeois (GD-OTS Canada) indicated that he wasn't a blasting expert but concurred that a mass detonation of detonators would be the number one suspect: There must have been a mishandling of the detonators. I had a quick peak on the net and came across an Orica document with good recommendations on detonator handling that include:

1. Keep detonators away from open flame, sparks, or heat sources. Do not smoke
2. Avoid impact on detonators. Do not attempt to pry detonators open to investigate the contents. Do not attempt to pull the legwires out of the detonators.
3. Wear only natural fibre outer clothing. Synthetics, such as nylon, generate static energy.
4. Ground yourself whenever possible to bleed away static charges prior to handling detonators. Many simple actions such as sliding off a vehicle seat can generate static.

5. Avoid excessive friction with plastics. Do not let legwires slide through your hands. Keep your shunt on
6. Minimize handling of detonators. Leave in containers until required. Do not carry detonators in your pockets.
7. Do not throw legwires through the air.
8. Do not handle detonators during severe dust, snow or electric storms.
9. Do not transmit on any radio when handling detonators. (RF energy can initiate detonators under certain circumstances).
10. Keep legwires close to the ground to minimize any antenna effect for RF pick-up.
11. Avoid any contact between detonators or legwires and any source of power, (electric cables, etc.). Avoid unnecessary contact with any conductor of electricity, (fences, etc.).

MOST IMPORTANT. Never remove the shunt or separate the duplex wires of detonators (electric and electronic) until a primed charge is safely in the hole, or until absolutely necessary. Never make up charges ahead of time

I would add to that you don't open the detonator packaging near large quantities of high explosives whenever possible. If the box is shielded with an aluminium foil it can act as a Faraday cage to prevent RF pick-up in case of an unshunted detonator in the box. Point 6 emphasises that you keep the detonators in the box until you start loading the boosters.

Use of recycled PETN

In a widely publicised incident that was reported to SAFEX, 33 people were killed and 19 injured when 3.7 t of explosives detonated as result of an explosion in the cartridge machine loading seismic charges with recycled PETN mixed into emulsion matrix.

The use of PETN and especially recycled PETN struck Maurice Bourgeois (GD-OTS Canada): In commercial boosters, I have seen CompB used with a detonator sensitive explosive such as PETN which is mid-way in sensitivity between primary and secondary explosives to various stimuli (impact, friction etc.). A key element in this report is that they incorporated recycled PETN in their mixture. How they screened their recycled explosives for foreign bodies may be a major issue in this case. It will be great to get the full report identifying the suspected root causes for lessons learned.

There were no casualties but could the fire have been controlled

An incident in which the design precautions a member took prevented injuries when single base propellant initiated during the drying process attracted attention. The activity was carried out remotely and the building was fitted with an ultra-high speed fire detection and suppression system.

The mitigation measures employed by the member impressed Janusz Drzyzga (Nitroerg SA): I think this is an example of a well-planned safety system using automation to protect people. I know about a very similar incident in Belorussia in 1995 which involved the drying of water wet propellant as in this case. However, the results were completely different with 3 fatalities and 4 injuries. There were no protection systems and housekeeping was a mess with boxes of propellant in many places on the plant. Therefore, I want to extend my compliments to the management and staff of the company concerned.

While Maurice Bourgeois (GD-OTS Canada) was also complimentary about the remote operation that prevented the injuries, he had questions about why the deluge system did not fully control the fire: He asks: Was the fire detector not fast enough? Or, in the case of a UV detector, did the fire go undetected until it expanded out of control because it started in a blind area such as below the surface of the propellant stack? Other questions may be whether there were enough deluge heads; were they oriented properly as it could be that the water spray pattern sprayed half the water outside the bin; or was there insufficient water pressure for the number of heads; or was the system blown away by overpressure? These are issues with which we are confronted when designing a fire extinguishing system. Identifying why the fire was not controlled by the deluge system would provide valuable a lesson.

Don't try and try again (with explosives), if at first you don't succeed

Three people were killed in an explosion on an emulsion explosives production line in an incident that was reported to SAFEX. The incident was characterised by repeated attempts on the part of the operators to rectify a number of abnormalities that occurred in the line prior to the incident. Possible theories as to the cause include: overheating of the emulsifying mixer leading to ammonium nitrate decomposition and ultimately to deflagration / detonation; and thermal decomposition due to blocked lines or other dead heading.

It leads Maurice Bourgeois (GD-OTS Canada) to speculate: Blockage and ingredient feeding problems in this type of process often lead to dangerous situations. If I recall correctly, before the detonation in the Lorena incident in Brazil, the operators had problems feeding aluminium powder. In these types of processes, blockages of feeding systems (HAZOP "not enough" or "too much" criteria) should be a major consideration in the risk analysis. The effect they can have should be well documented and controlled. In this case we can ask, if overheating of ammonium nitrate was an issue, could a heat sensor that trips an alarm and enact an emergency stop not have helped. I guess this is where SAFEX comes in sharing expertise, listing does and don'ts so that its members don't overlook major issues in their risk analysis.

The other surprising issue is the number of attempts to try to get the process back on track. I compare that to someone who keeps trying to reset a tripped overload in an electric motor. If it trips twice or more, obviously there is a short-circuit problem that has to be fixed before trying to reset it again. Operators should be told to stop the process safely and ask for help before resuming.

Finally, blockage problems should be identified and operators provided with proper unblocking procedures that address the risks.

Concentrated forces are like stiletto heels

According to a SAFEX report a detonation occurred while one of the workers was trying to remove the remnants of di/mono PETN with the tip of a metallic screwdriver from a bend in a waste line. As a consequence three people were injured.

Maurice Bourgeois (GD-OTS Canada) has an interesting take on this: We have seen this type of accident in the past. Some operators think that because the screwdriver is non-sparking (in this case I doubt it was a brass screwdriver but may have been stainless steel), there is no risk of ignition. Sharp edges like screwdriver bits concentrate forces of impact and friction in a small area which generates very high pressures. An illustration of this phenomenon is the 250 lb. guy wearing city shoes that steps on one's foot versus a 100 lb. women wearing stiletto heels doing the same. You will feel the stiletto heel as if a nail was driven through your foot.

It's a Strange World

Crazy labels

Seen on a Children's Cough Syrup label:

"Do not drive a car or operate machinery after taking this medication."

(We could do a lot to reduce the rate of construction accidents if we could just get those 5 year-olds with head-colds off those bulldozers!)

Tony's Tale-piece

A tailpiece is something that appears at the end of a publication. I guess it is derived from the tail of an animal which is (normally) fixed to "the end" of it. However, we refer to this feature as a "Tale-piece". It is not a spelling mistake but a different tale. This "tale" is about telling stories. While it appears at the end of our Newsletter, it is also meant to tell a story hence the play on words. Let me tell you what "Tony's Tale-piece" is about.

Tony Rowe, recently retired from AEL Mining Services, kindly agreed to provide a regular feature based on truths he has discovered over many years in his work with explosives. He has a unique style of writing (perhaps "telling stories" may be a better way to describe it) which we hope gets a well-known message across in a new way. This Feature is there to remind readers of some explosive(s) truths in a different way!

It's about time (for me!) and temperature.

by

Tony Rowe (Retired from AEL Mining Services)

(Editor: Tony retired after the last edition of SAFEX Newsletter. On behalf of all our readers we wish him a long and happy retirement and look forward to his reminiscences and ongoing contributions to Tale-piece)

I have reached that moment in life when everything is poised to change. A milestone has been reached. I am alone now in a much smaller world. The final transition step, so long anticipated is at last upon me; or to use a rather more nautical analogy: Once I could see the tips of the awaited one's masts upon the horizon, I knew the end was coming, but it seemed so far away. Later its dreaded hull became visible, dull grey and lifeless, its holds jammed to the hatch covers with the unknown. It was closer now, but still appeared to offer little threat. Before long, I could see a creamy moustache where blunt bow met briny sea. I could hear her drummer beating to quarters. I could only watch in helpless awe as her guns were run out and her great battle flags streamed in the wind. In the final moment I read the name on the hellship's stem. There it was. Written in large black letters it read "YOUR RETIREMENT". Somewhere below decks, I can hear her Captain shouting "No Mercy!" – "Fire as your guns bear!"

Look at the picture below. That's me, the broken hulk on the left. Ripped and torn by shot and shell. I have become one of the condemned. Their future is at least written, their individual fears perhaps leavened by the hope that wherever they are going it's not going to be as bad as their nightmares predict   My future remains much less well defined. I suppose that I should be grateful. At least I still sleep all night.

With the worst of the horrors now over and my battered body firmly consigned to the scrapheap, my fight is over. I am done. Once this was understood and properly internalised I fell into a deep slumber. When I woke up, my eyes came to rest upon a battered old book. It was bound in pale plastic. On the front cover was a logo; one fast vanishing from the world. Three white letters trapped within a thin white circle upon a field of dark blue. Two white wavy lines drawn horizontally, underscored the letters. On the cover of the book, printed in red in both upper and lower case was the legend, "Basis of Safety HANDBOOK". I picked it up reverently. This battered old tome had been my companion, guide and mentor over many years. It was old, but unlike me, not yet done. It will be passed to someone new. Inside its ancient pages we learn that explosives can be initiated through the mechanisms of impact, friction, electrostatic and incendive sparks, fire and heat. It explains the how's and why's. Somehow its teachings must go on. Others must be found to carry the flag. The learning contained within will help prevent injuries and save lives.

I worry though, the faithful are harder to find these days.

The above aside, the principles of ignition aren't like rocket science, it is simple stuff and I can prove it. Here is an example.

When you try to ignite something combustible, we all know on an instinctive level that for ignition to occur, we've simply got to get the stuff hot enough for long enough. We know this. It's built in to the part of our brains called the amygdala, pronounced "AMIGDOOLA" or lizard brain. I don't know why it is spelled so oddly. Maybe the guy who discovered it was dyslexic? Anyway, it is apparently the oldest and most primitive part of the human brain, the bit where gut feelings and instinct lurk, where the sense of danger and the subconscious originate and thrive.

When we light combustibles we apply that knowledge stored in the amygdala so-instinctively that we don't even notice.

Do you want to try? If so, take a suitable piece of dry paper. Strike a match and once the wood is burning cheerily, pass it quickly underneath the paper so that the flame just brushes its surface. Did the paper ignite? Yes or no? If it caught fire then you are passing the match flame too slowly. Do it again, but quicker. If the paper didn't ignite, you have just learned that ignition is a function of both time and applied temperature.

Quickly now, put out the fire! If there is enough paper remaining, wet the same piece again. If it is still burning; wetting it will also assist in quenching the flames. That's right, stick it right under the water. You see most fires won't burn underwater. Isn't science amazing? Now, using a fresh match, repeat the earlier procedure, but this time hold the flame against the wetted paper for a second or two. Did the paper ignite? No, you say - and why not?

Tick one of the following possible answers

1. The match flame is cooler?
2. The ignition temperature of the paper has changed?
3. Something else?

Congratulations if you ticked answer No. 2 you were absolutely wrong. By the way, are you male or female? Have a look further down to find out.

Don't look in the article – Look even lower down.

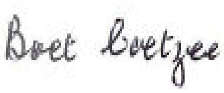
No wonder your Mom worries!

The temperature of most match flames is similar and the ignition temperature of the paper hasn't changed either. What has changed is time to ignition. Before the paper can ignite, the water must change to vapour and disappear. Water boils at around 100 degrees Centigrade at sea level. A Johannesburg it will be less, perhaps as low as 94 degrees Centigrade. The ignition temperature of paper is probably around 600 degrees Centigrade. What happens is that when there is water around, the paper simply can't reach its ignition temperature. The water sucks in the heat and uses it to change phase. The paper can't reach its ignition temperature 'cos it can't get hot enough. The water is stealing the heat so the paper doesn't burn. You see for water to change from a liquid to a gas (steam) takes lots of heat. However, once the water has been boiled off, the paper does its thing and ignites just like before.

So what have we learned and how does this relate to explosives? Well, sometimes when we've done silly things, we get to walk away because the time/temperature relationship worked out in our favour. At another time or in another place we might not be so lucky. Better to rely on knowledge! Lady luck - as an old acquaintance once confided - said, "She mighty pretty, but she fickle too".

Conditions change and with change comes uncertainty. Ask me, I know.

Stay safe. You know it makes sense.



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