MSIAC
Munitions Safety Information Analysis Center

Supporting Munitions Safety

December 2022

Bulletin

In This Issue

Insensitive Munitions & Energetic Materials Technical Symposium 2022

Christelle Collet, Kevin Jaansalu and Ernie Baker represented MSIAC at the IMEMTS 2022 held in Indianapolis, IN, USA on 18-20 October 2022. This IMEMTS was the first in-person one after the pandemic crisis and after a virtual symposium in April 2021, with about 125 attendees. MSIAC provided eight technical presentations during the symposium.

Dr. Brian Fuchs (Senior Research Scientist, Insensitive Munitions, US Army Picatinny Arsenal) provided the keynote presentation that outlined current trends in munitions technology and the applicability of IM. With a current focus on improved performance, there is still a great need to provide safety for both storage and transport of munitions, as well as to address munitions vulnerability. Ernie Baker provided a presentation entitled “Recent Vulnerability Events due to Non-IM Munitions”. Munitions depot explosions that are related to the violent response of munitions have been recently observed and reported in the Ukraine and Russia. These recent events indicate that the violent response of munitions is an extreme vulnerability that is essential to address for our warfighters.

For many years, MSIAC has sponsored Munition Safety Awards for individuals who have made consistent contributions in research, engineering, production, procurement, fielding, standardization, policy, etc. related to munition safety over an extended period (Award for Career Achievement) and to teams of individuals having made a significant contribution in research and/or engineering related to the field of munition safety (Award for Technical Achievement).

This year, Christelle Collet presented the **Award for Career Achievement to Mr. Ken Tomasello**. Ken was the Program Manager of the Insensitive Munitions Advanced Development research and development program. He retired in December 2021 from the United States Naval Ordnance Safety and Security Activity after 43 years of exemplary and dedicated service to explosives safety.

Christelle also presented **the Award for Technical Achievement to the team responsible for “Development of an IM aircraft bomb model MK82 General Purpose (Emploi Général) Reduced Vulnerability (Vulnérabilité Réduite)”, represented by M. Joffrey Duchon from DGA**. The team was comprised of experts from RWMI, Eurenco, DGA and the IM Committee. The MK82 EG VR is manufactured by Rheinmetall Waffe Munition GmbH Italia (RWMI). Eurenco is the subcontractor of RWMI and the manufacturer of the whole loading (main loading, booster and thermal protection). This MURAT ** qualified bomb is dedicated for use by Navy forces.

A complete list of previous award recipients can be found on our website !

Christelle Collet and Ken Tomasello, the recipient of the MSIAC Award for Career Achievement.

Joffrey Duchon accepting the MSIAC Award for Technical Achievement from Christelle Collet

Ernie Baker
TSO Warhead Technology

A 'Safe' Retreat

Dear colleagues and friends,

After 7 years, my time at MSIAC as the Munitions Transport and Storage Safety TSO has come to an end! It was a privilege to work in this great team of experts, and I would like to thank all of you for the great cooperation during these years. It was a pleasure to answer technical questions from all over the world, support NATO policy development, organize AASTP-1 and AASTP-5 courses and maintain our explosives safety databases and tools. Also on a personal level, I very much enjoyed the time spent with you on different events and trips. Thanks for that!

I started the job in 2015, still at the old NATO HQ in the basement of Bâtiment Z, as some of you may remember. My time at MSIAC coincided with the development of AASTP-1 Edition C Version 1 (2015-2022), and I'm glad I could support this activity until completion. Since 2015, the move to the new HQ, Covid, the Ukraine war and personnel changes at MSIAC of course had a significant influence on the work environment and experience. To my opinion MSIAC is in good shape for the future.

I will continue my career as a Senior Project Manager at the research organization TNO in the Netherlands. This new challenge will also be related to explosives safety, so we will definitely stay in touch. You can reach me on my new email address martijn.vandervoort@tno.nl.

With that I would like to wish you all the best on a personal and professional level! And of course looking forward to meet you soon!

Martijn van der Voort
TSO Munitions Transport and Storage Safety

Munitions Transport & Storage News

Before my departure from MSIAC two big activities were finalized:

- First of all, we published **Edition 2 of L229 "Experimental and Theoretical Basis of NATO Standards for Safe Storage of Ammunition and Explosives".**

  This 2nd edition contains more than 200 pages and 140 references with analysis of NATO Quantity Distances and comparisons with explosives testing. It contains new input on ECM design criteria, barricade design criteria, and a revised chapter on HD 1.3 QD following the two MSIAC technical meetings on this topic.

  L229 Ed 2 is fully in line with the new AASTP-1 Ed C V1 which is expected to be ratified very soon.

- Secondly **a new version of the MSIAC QD Consequence Analysis Tool (MQDCAT) was released**.

  MQDCAT v2.6 is available as one of our web based tools and has implemented a number of new features following a testing period and feedback given by MSIAC nations.

  The most striking new feature is the calculation of Individual Risk and Group Risk, which required new input on probability of event and exposure.

  MQDCAT v2.6 release notes will soon be published; look out for report L289 on our website!

Martijn van der Voort
TSO Munitions Transport and Storage Safety

In Memoriam

It is with great sadness we report the passing of Ed Daugherty who died on 16 June 2022 at 92 years old.

Ed, working with Michel Thevenin and Dr. Ron Derr, was a principal contributor to the creation of the Pilot NIMIC that ultimately became NIMIC and later MSIAC. While helping develop the concept of NIMIC, Ed served as Project Manager and directed the transfer of Pilot NIMIC to NATO Headquarters in May 1991. After NIMIC was established, he continued to support and promote NIMIC and later MSIAC.

Before his activities in NIMIC, Ed was Chairman of the U.S. Navy Weapons Systems Explosives Safety Review Board for fourteen years. In this capacity, he headed the Navy's independent oversight for safety compliance of all Departments of the Navy military munitions. This included energetic systems, weapons, weapon devices, and those systems that manage and control weapons used, handled, stored, or tested on Navy ships and aircrafts.

In 1982, working with Mr. Ray Beauregard and a team of Navy explosives formulation and detonation physics experts, Ed helped conceive the U.S. Navy Insensitive Munitions Program. This program was envisioned to be a structured, disciplined engineering process for the development of new energetic materials that would be less sensitive to unplanned stimuli than materials used at that time. Without Mr. Daugherty's vision, first-hand knowledge, and understanding of weapon safety issues, based on his WSESRB experience, the Navy's insensitive munitions program may never have reached fruition. He was the behind-the-scenes, driving force promoting this initiative.

In 2019, Ed received the MSIAC Munitions Safety Award for Career Achievement .

Ed is survived by his wife of 55 years, Judith Daugherty and his twin sons: Michael and Brian Daugherty.

Norway Country Visit

MSIAC conducted the Norway country visit in September 2022. The visit was hosted by Gunnar Nevstad (FFI). Chuck Denham, Chris Hollands and Ernie Baker from MSIAC visited and toured the Chemring-Nobel AS production facility on Monday 26 Sep, visited FFI on 27 Sep, and visited Nammo AS on 28 Sep. Chris and Ernie toured the Nammo AS rocket motor production facility during the morning of 29 Sep and met with FMA in the late morning and afternoon. MSIAC provided many technical presentations during the visit.

The Chemring Nobel facility is a stunningly beautiful location on a forested peninsula bounded by the Oslo Fjord. The Chemring Nobel tour consisted viewing the large HMX/RDX synthesis facility, followed by the pressed explosives formulation production. Below the synthesis and formulation facilities is a fairly new biologic waste water treatment facility that leads to the fjord. The formulated explosive storage facility, the nitramine drying facility, and the fluidized grinding and mixing facilities, the melt-pour formulation facility, and the pilot plant operations were also visited.

The Nammo rocket motor production facility is also a stunningly beautiful location in forested mountain terrain. The tour consisted viewing the rocket motor hardware production facility, propellant mechanical characterization facility, small cast cure mixing and pouring facility, large cast cure mixing facility, large cast cure casting facility, rocket motor visual inspection station, rocket motor bore machining station, rocket motor x-ray inspection facility, rocket motor painting facility, and the final rocket motor packaging facility.

Gunnar Nevstad & Chris Hollands at the Nammo AS Raufoss facility.

Chemring-Nobel Sætre production facility.

Ernie Baker
TSO Warhead Technology

MSIAC S3 Seminar Norway

On 30th Nov and 1st Dec 2022, MSIAC TSOs Matt Ferran and Kevin Jaansalu visited Olso, NOR to deliver the inaugural Safety & Suitability for Service (S3) Seminar. This 1.5 day course provided an introduction to the various elements of the S3 assessment process as described by AOP -15, with twelve detailed presentations on topics including:

- Definition of life cycle events and the life cycle environmental profile, including the various damaging effects of mechanical, climatic and electromagnetic environments on munitions
- The identification, assessment and control of hazards

- S3 assessment testing, and
- Assessing the condition of the munition population

We would like to extend our thanks to Karl Erik Jarnæs of the NDMA for inviting us to present to the Norwegian munition safety community, as well as his kind hospitality.

Should your nation also be interested in benefiting from this new seminar, please get in touch with us via the email address info@msiac.nato.int.

Matt Ferran & Kevin Jaansalu
TSO Munition Systems & TSO Materials Technology

PARARI 2022 & MSIAC Australia Country Visit

The Australians have a phrase – "the tyranny of distance" – which refers to the role that geographic remoteness has played in shaping their country's history and identity. That same distance means that, as the MSIAC member nation most remote from our offices in Brussels, we have to try and pack in as many activities as possible during our (infrequent) visits; 2022 was no exception!

MSIAC TSOs Matt Ferran (Munition Systems), Christelle Collet (Propulsion Technology) and Kevin Jaansalu (Materials Technology) spent two weeks "down under", first participating in the 2022 PARARI EO Safety Symposium, and then visiting various Australian defence establishments to discuss their munitions safety interests and concerns.

This year marked the 15th edition of the PARARI symposium, and was the most ambitious yet: over 500 delegates from across Australia and the world gathered at the National Convention Center in Canberra for three days of presentations and plenary discussions. Much of the focus was on recent developments in the Guided Weapons and Explosive Ordnance (GWEO) Enterprise, a program designed to enhance Australia's self-reliance and supply chain resilience for these critical commodities. The enterprise comprises multiple capability elements, including manufacturing, R&D, education & training, test & evaluation and so on.

The MSIAC TSOs provided presentations on "Lifing Approaches & Ageing Algorithms", "The Influence of Risk Tolerability on Approaches to S3 Assessment", "The Status of International and National IM Policies across the Nations" and "Comparison of IM Threats versus the Real World".

The symposium also posed a fantastic networking opportunity, allowing MSIAC to advertise our capabilities and services; we also had the unique opportunity to gather for a group photo with four former MSIAC TSOs who are currently working in Australia: Duncan Watt, Michael Sharp, Martin Pope and Ian Powell, all of whom continue to be enthusiastic promoters of munitions safety.

We would like to extend our thanks to the organisers of the symposium, the Directorate of Ordnance Safety (DOS), for inviting MSIAC to participate in this highly successful event; we look forward to the next edition.

After the symposium had concluded, the MSIAC TSOs hit the road, visiting the Directorate of Ordnance Safety (Canberra, ACT), Explosive Materiel Branch (Penrith, NSW and Canberra, ACT), Thales/Australian Munitions (Mulwala, NSW and Benalla, VIC), and Defence Science & Technology Group (Edinburgh, SA). At each location, we delivered presentations on topics of interest and recent MSIAC workstreams; more importantly, these visits gave us the opportunity to learn first-hand the munitions safety concerns of the Australian defence community as well as their recent innovations and successes. The MSIAC TSOs were accompanied on this tour by Major Roger Brinkworth (DOS TSO-A), to whom we would like to extend our thanks for his excellent company and generosity.

MSIAC TSOs with Major Roger Brinkworth.

Statue of Ned Kelly at Glenrowan, VIC

HMAS Otway at Holbrook, NSW: a submarine in a town several hundred kilometres inland!

MSIAC TSOs with Ian Powell at the Thales / Australian Munitions facility in Mulwala, NSW.

Matt Ferran, Christelle Collet & Kevin Jaansalu
TSOs Munition Systems, Propulsion Technology & Materials Technology

AASTP-1 & AASTP-5 COURSE

In the previous newsletter you may have read about the courses we held in the beginning of the year; Wrocław (14-18 March), Versailles (21-25 March), RAF Cosford, UK (3-6 May) and Brussels (16-20 May). In the meantime we have planned and conducted the remaining two courses of the year, in Rome (24-28 October) and Canberra (14-18 November). These courses were fully booked. We have also established the **course program for 2023**:

- **Versailles (FRA), 20-24 March 2023**

PoC: Pierre Villeneuve, Instructors: Johnny de Roos and Evelyn Conradi

- **Versailles (FRA) 2nd course, Fall 2023 (TBD)**

PoC: Pierre Villeneuve, Instructors: Johnny de Roos and Matt Wingrave

- **Berlin (DEU), 8-12 May 2023**

PoC: Roland Stern, Instructors: Johnny de Roos and Roland Stern

- **Kirtland Airforce Base (USA), 28 Aug. – 1 Sept. 2023**

PoC: Lon Moyer, Instructors: Johnny de Roos and Dr. Josephine Covino (pending)

- **Ramstein Airforce Base, 12-16 September 2023**

PoC: Philip Thompson, Instructors: Johnny de Roos and Sean Gardner

We are very pleased with the continued availability of all instructors, many thanks for that! We still have some available seats on some of these courses. Please let us know if you or colleagues have an interest to join one of these courses. Please note that the MSIAC PoC for the courses has changed. As I will move on to another position, we would ask you to forward any queries to our MSIAC office manager Mrs. Diane Vanoverstraeten: d.vanoverstraeten@msiac.nato.int.

It was a pleasure to organize and conduct the courses over the last 7 years!

Good memories: Matt Wingrave, Eric Deschambault, Martijn van der Voort and Johnny de Roos with their AASTP 2018 world tour shirts!

Martijn van der Voort
TSO Munitions Transport and Storage Safety

MSIAC Canada Country Visit

Matt Ferran and Kevin Jaansalu attended the Canadian Ammunition Practitioner Training Symposium from 31 May to 2 June and were hosted by Pierre-Luc Bellanger and Paul Walsh. This was a great opportunity to learn of Canadian interests and concerns with respect to munitions safety. During the symposium, Matt presented on IM Benefits and Policy, IM Design Considerations, and IM Benefits across the LifeCycle; Kevin presented on IM EOD Challenges. On Friday, Matt and Kevin visited with DAEME staff, hosted by Jean Bergeron. Matt presented on Ageing and Life Extension Challenges and on Life Assessment of NC Based Energetic Materials, and Kevin presented on Lifing Algorithms and on IM EOD Challenges. As this was a smaller group, there were many points of discussion during the presentations.

Kevin couldn't let Matt leave Canada without experiencing the Canadian institution that is Tim Horton's. Matt could not decide which Timbit was the best (they were all good) but we both agreed that the dark roast is much preferred.

MSIAC and DAEME Staff: James Sauvé, Kevin Jaansalu, Matt Ferran, Jean Bergeron, Rachel Collier, and Jean-Francois Fournier.

Kevin Jaansalu
TSO Materials Technology

MSIAC Poland Country Visit

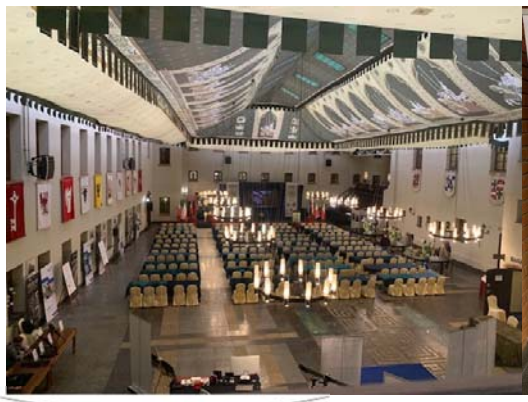
MSIAC was very pleased to be invited to the 14th International Armament Conference that was held 19th – 22nd September 2022 in Ryn, Poland. This major event gathered about 260 attendees from industrial armament stakeholders and key government representatives.

A dedicated MSIAC session was organized by Dr Agata Kamienska-Duda (WITU), the Steering Committee Member for Poland. This session provided fruitful exchanges on topics related to insensitive energetic materials, 3D printing, S3 assessment, aspects of MHM, and recent developments of AASTP-1.

The week ended with a memorable tour of WITU facilities and equipment in Zielonka: shooting range, chemical analysis lab, 3D printing lab, X-ray detection lab, and shooting simulator.

The week was a great opportunity to strengthen the connection between MSIAC and the Polish community who recently joined MSIAC. On a personal note, I feel particularly grateful and touched by the fantastic welcome of Agata and her colleagues. Thank you so much!

The conference room in the Ryn castle and the conference roll-up:



Just before the MSIAC session:

Christelle Collet
TSO Propulsion Technology

45TH IPS Seminar

11-15 July 2022 - Colorado Springs

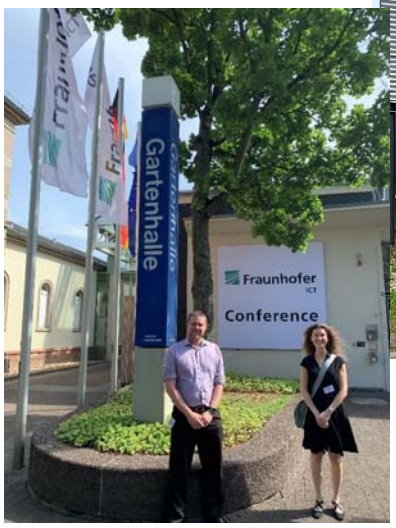
The 45th IPS Seminar was attended by Christelle Collet and Kevin Jaansalu. It consisted of about 70 presentations and posters with over 115 engaged attendees.
Christelle presented on Green Insensitive Munitions, and the 2020 MSIAC Stokes Fellow, Ms Morgan Bolton, presented her work on Influence of Mechanical Properties on the Explosiveness of Energetic Materials. Highlights included the keynote speaker, Homer Hickam, who spoke about his experience with rockets and his latest book, "Don't Blow Yourself Up", and Dr Jesse Sabatini's personal talk where he did everything right, but still nearly blew himself up. Jess's final remarks included the advice "take the extra few minutes to wear the d@^#% PPE". It was a great opportunity to strengthen American and international connections, and for Christelle to karaoke!

Christelle, Kevin, Morgan, and Alexandra Junqua-Moullet walking in the Garden of the Gods Park.

The next IPS will be coupled with the EUROPYRO conference. It will be held in St Malo, France, 11-14 September 2023. The deadline to submit abstracts is 31 December 2022. There will be a special session on correlations between manufacturing processes, microstructure and properties.

Kevin Jaansalu
TSO Materials Technology

The week ended with the traditional BBQ party organized at the ICT site in Pfinztal, located east of Karlsruhe, followed on the Friday by a visit of the ICT installations: Explosive Trace Detection, Manufacturing Lab, Compression Solutions for Hydrogen, and Energy Storage.



Chris Hollands & Christelle Collet
TSO Energetic Materials & Propulsion Technology

Feedback from the 17th WPC & the 51st ICT

In the week of the 27th June to 1st July 2022, two major events in the energetic materials world took place in Karlsruhe, Germany: the 17th Workshop on Pyrotechnic Combustion Mechanisms, on 27 June, and the 51st edition of the International Conference of the German Fraunhofer Institute for Chemical Technologies (ICT) for the remainder of the week.

The 17th WPC was the opportunity to discuss the latest progress and the challenges related to additive manufacturing of energetic materials thanks to eight presentations from TNO, ISL, ICT, UK DOSG/Cranfield University, MSIAC, LLNL, Purdue University and EURENCO Bergerac. This workshop has a unique format for presentations as it allows a 1-hour slot for each (including 15 minutes for questions/discussion). This is ideal to encourage further exchanges on a specific topic.

The 51st edition of the International Conference of ICT was the first one after two years of disruption related to the COVID pandemic. Despite a lower attendance due to the lack of participation from Russia, China and India, the quality of the technical content (both presentations and posters) was back at the same high technical level as before the pandemic. The conference program was split into six sessions which were New Materials & Techniques; Gun Propellants; Mechanics & Safety; Machine Learning & Energetic Materials; Kinetics; and Characterization. MSIAC contributed to the program with a presentation on the additive manufacturing techniques that are best suited for the different categories of energetic materials.

USA East Coast Country Visit

MSIAC conducted a USA east coast country visit in November 2022. The visit included the US Navy Naval Surface Warfare Center – Dahlgren Division (NSWC-DD), US DOD Office of the Under Secretary of Defense (OUSD), US Army Combat Capabilities Development Command – Army Research Laboratory (CCDC ARL), the Department of Defense Explosives Safety Board (DDESB), the US Navy Naval Surface Warfare Center sites at Dahlgren, VA (NSWC-DD), and the US Naval Ordnance Safety and Security Activity (NOSSA). The MSIAC delegation consisted of Chuck Denham, Chris Hollands, and Ernie Baker.

Robert Bozarth hosted Chuck and Ernie for the visit to the NSWC-DD. MSIAC presented an MSIAC Overview, a HERO Overview, and Recent Vulnerability due to Non-IM Munitions. Dr. Dion Serben, (Deputy Director, Munitions) hosted the OUSD visit. The visit consisted of MSIAC, CCDC AC (Dr. Brian Fuchs), and NOSSA participation. MSIAC presented Recent Vulnerability due to Non-IM Munitions and a discussion on the importance of IM for warfighter survivability followed. It is increasingly apparent that munitions vulnerability is extremely detrimental in real world war-fighting. Dr. Nirupam Trivedi hosted the CCDC ARL visit. The morning consisted of MSIAC and ARL presentations at the Detonation Science & Modeling section of the Weapons Sciences Division. The afternoon consisted of a tour of the energetics facilities. The Small Scale Advanced Energetic Material Characterization Testing Facility make extensive use of lasers for initiation and photography of very small laboratory scale (mg) highly quantita-

tive energetic materials testing. The ARL Synthesis and Formulation Facilities include small scale (mg), scale-up (up to a kg) and larger scale (10s of kg) facilities. Formulation capabilities include melt pour, pressed, cast cure and extruded (gun propellant) facilities. The Detonation Testing Facility includes a fairly large detonation chamber that is well instrumented with high speed cameras, Photo-Doppler Velocimetry (PDV) capabilities and x-ray capabilities. Thierry Chiapello hosted the DDESB visit. Andy Rash hosted the NOSSA visit.

CCDC-ARL, Aberdeen Proving Ground, MD, USA

Ernie Baker
TSO Warhead Technology

MSIAC Reports Published in 2022 (Open and Limited Distribution)

L-291 IM Threats vs Real World Threats - Dec. 2022
Christelle Collet; Martijn van der Voort; Dr Ernest L. Baker

This report demonstrates the applicability of the six standardized IM threats (FH, SH, BI, FI, SCJI and SR) to other credible aggressions that may occur during the life cycle of munitions. By comparing the standardized energy loading provided to the munition in IM tests with other credible threats that may occur in the "real world", it shows to what extent IM threats can be considered conservative. This analysis is based on the most recent IM-related NATO standards.

L-287 Mixing Rules for Energetic Materials Elastic Constants - Sept. 2022 - *Victor der Weduwen (NLDA); Dr. Kevin M. Jaansalu*

Many properties of energetic composite materials are rarely experimentally determined and instead estimated through the use of models established in the technical literature. Schrama and Jaansalu examined the electrical properties of composite energetic materials and their models. This report continues this line of research, examining the elastic constants of composite energetic materials and assessing the models available within the technical literature for these properties.

L-286 Thermomechanical Fatigue an Introduction - Sept. 2022 - *Dr. Kevin M. Jaansalu*
The purpose of this report is to present an introduction to thermomechanical fatigue and how this applies to energetic materials. This topic is seldom, if ever, treated in materials science textbooks.

L-229 Experimental and Theoretical Basis of NATO Standards for Safe Storage of Ammunition and Explosives - Sept. 2022 - *Martijn van der Voort; Matt Ferran; Eric J. Deschambault (DDESB ret.); Dr. Sean Donahue (NAFVAC EXWC); Johan A.J. de Roos (ESSINT)*

NATO standards for the safe storage of ammunition and explosives (AE) contain tables with Quantity Distances (QD). These distances are intended to provide an acceptable protection level to surrounding Exposed Sites (ES) in the event of an accidental explosion at a Potential Explosion Site (PES). MSIAC has conducted an in-depth study to assess and document the basis of NATO QD criteria, and to compare them with additional testing and analysis accomplished in recent years for validation purposes.

L-281 Lifing Approaches and Ageing Algorithms - Aug. 2022 - *Dr. Kevin M. Jaansalu; Matthew Ferran*

An algorithm describes a process within a system. For lifing algorithms, the system is defined by the national approach to munition life management. From different national approaches, four different lifing systems are proposed and each system is described along with the level of information required for the algorithm to function.

L-285 MSIAC Technical Questions Annual Summary Report 2021 - Aug. 2022– *Chuck Denham*

This report presents a summary of each Technical Question (TQ) answered by MSIAC during 2021.

L-284 Critical Diameter and Shaped Charge Jet Impact - August 2022 - *Dr. Ernest L. Baker*

This report provides supporting data and references for the 50 mm critical diameter engineering "rule-of-thumb" applicable to passing the shaped charge jet impact (SCJI) Insensitive Munitions (IM) threat test defined in AOP-4526. In addition, information is provided on a critical diameter/gap test result correlation that can be used to estimate critical diameters if NOL LSGT or IHEGT data is available.

L-283 Recent Vulnerability Events due to Non-IM Munitions - Aug. 2022 - *Dr. Ernest L. Baker*

The violent response of munitions due to attacks, accidents or fire events has long been known to be a large vulnerability for munitions during storage, transport and warfighting. The USA, NATO and NATO partner nations have addressed these concerns through development of IM technology and implementation of Insensitive Munitions (IM) policy. This report provides a review of recent vulnerability events due to munitions that are not IM compliant, observed in Ukraine and Russia during 2022.

L-280 Mixing Rules for Energetic Materials: Transport Properties - April 2022 - *Paul Schrama (NLDA); Dr Kevin M. Jaansalu*

In great many cases the properties of energetic materials have not been obtained by measurement. Therefore they have to be estimated by mixing rules for the technical literature, which are often not validated and it is often unknown which mixing rule works best. This study provides insight and recommendations of the usage of the mixing rules for a selection of these composite properties, consisting of electric conductivity, dielectric constant and thermal conductivity.

L-150 MSIAC Self-Audit Procedure of IM/HC Test Organizations' Competences and Capabilities Edition 4 - April 2022 - *Christelle Collet*

The MSIAC self-audit procedure provides IM/HC test organizations with a useful tool for assessing their capabilities and competences in conducting IM/HC tests. It helps address the mutual need for munition developpers and IM/HC test organizations to have a common understanding on the way IM/HC tests are conducted.

O-221 Defects Lexicon Survey Results & Agreed Terms - April 2022 - *Dr Matthew Andrews; Dr Kevin M. Jaansalu; Matt Ferran; Aurihona Wolff (ENSTA Bretagne)*

Defects in energetic materials are relatively common and can have a significant impact on the safety and reliability of munitions, yet there is a lack of clarity in the use of terminology for describing and classifying these defects. The munitions safety community had recognized this problem and approached MSIAC for assistance. The result is a standardised and consistent defect language for the benefit of the munitions community to enable users to describe what they are observing with clarity, precision, and most importantly, commonality.

O-220 A Taxonomy for the Classification of Defects in Energetic Materials - April 2022 - *Matt Ferran; Dr. Matt Andrews; Dr. Kevin M. Jaansalu; Aurihona Wolff (ENSTA Bretagne)*

Following many discussions and multiple iterations over two years, MSIAC has produced a largely self-consistent taxonomy and lexicon of terms related to defects in energetic materials and munition systems, based on the paradigm of materials science and engineering. This report discusses the methodology employed by MSIAC in developing a model for classification of material performance, and subsequent development of the taxonomy and lexicon.

L-279 MSIAC Technical Meeting HD 1.3 Issues - Feb. 2022 - *Martijn van der Voort; Matt Ferran; Christelle Collet; Dr. Ernest Baker; Chris Hollands; Dr. Kevin M. Jaansalu*

MSIAC organised a virtual technical meeting about HD 1.3 issues on 7 and 8 December 2021. The meeting objectives were to improve Quantity Distance (QD) and risk analysis for HD 1.3, to generate input for future editions of NATO standards AASTP-1 and AASTP-3, and to harmonize the approaches in NATO. A way forward was defined which will be presented to the CNAD Ammunition Safety Group AC/326 SG/C.

L-278 Injury & Lethality Criteria from Thermal Radiation - Feb. 2022 - *Matt Ferran*

Accidents involving explosive substances and articles belonging to Hazard Division 1.3 may expose involved persons and the public to thermal radiation; depending on the dose received, this may result in burns of varying severity, and even death. When siting explosives facilities, NATO nations implement safety distances to reduce the risk from thermal radiation to tolerable levels. The tolerable injury criteria associated with these safety distances have been investigated; their continued applicability has then been assessed based on an understanding of the mechanism by which thermal radiation causes damage to the human body. Recommendations have subsequently been made for harmonisation between NATO nations, and improvements to the way in which thermal radiation safety distances are determined for accidents involving ammunition and explosives.

L-277 - Tolerability of Risk Part III: Ammunition Storage, Range Safety and Demolition - Feb. 2022 *Martijn van der Voort; Matt Ferran*

This report provides an overview of commonalities and differences of risk tolerability in relation to siting of Ammunition and Explosives (AE) storage, Range Safety (RS) and AE demolition in various nations. AE storage and RS have a number of parallels.

Find all our publications here !

Kevin Jaansalu
TSO Materials Technology

MSIAC Participation to Cuira Test Campaign

Martijn van der Voort and Christelle Collet attended the largest Cuira trial held in Älvdalen, Sweden, between 6 and 10 June 2022. The Älvdalen firing range is a large, unpopulated, test area of 540 km². The most important part of the facility is the hardened target area which is 700 x 1000 m² and has been prepared for the use of live munitions.

During the trial, 2000 kg TNT was detonated in an Earth Covered Magazine (ECM). It was the last in a series of three tests in adjacent ECMs with a common earth cover.

MSIAC was there to support the community with the debris collection. It also provided a unique opportunity to network

with the newest MSIAC member, Switzerland, and five other MSIAC members participating in the Cuira consortium: Germany, Sweden, Norway, UK, and US.

Measurements included blast, high speed video, and LIDAR technology. The data will be used to inform quantity distances and risk analysis (QRA) for the specific Cuira structure.

Before the last test involving the detonation of 2000 kg of TNT:

During the test:

After the test:

Martijn
van der Voort & Christelle Collet
TSO Munitions Transport and Storage Safety & TSO Propulsion Technology

New Student Projects

The list of student projects for 2023 has been updated and is available at:

https://www.msiac.nato.int/products-services/msiac-interns-trainees

If you are (or if you know) a student who would be interested in working for a few months on munition safety-related topics, in a dynamic and international team, in NATO Headquarters located in the beautiful city of Brussels, please contact us!

A new job for Bruno Nouguez!

Bruno Nouguez is well renowned in the IM community and it is not by chance: he has authored about 60 publications on various topics related to explosives and munitions, he contributed to the proceedings of 19 Insensitive Munitions and Energetic Materials Technical Symposia out of 24 editions in total (including the very first edition in 1990), he received five MSIAC Munitions Safety Awards for technical achievements and one for his overall career during which he promoted safer energetic materials and insensitive munitions. After all this hard work, he decided to start a new one this year as "happy retired".

MSIAC wishes him all the best for this new career challenge!

Bruno Nouguez (right) at his farewell party in Avignon, France, on 1st June 2022.

The French Chronicle

The French language can be very misleading for those who want to learn it. The dictionary contains a bunch of homonyms (same pronunciation, same or slightly different spelling, but totally different meanings) that can really puzzle you if the sentence is put out of its original context. A good one is "nous avions…" (meaning "we used to have…", past tense). But "avions" also means "airplanes"! This abundance of homonyms results in many word games and riddles. As an example, to the question "de quelle couleur sont les petits pois ? » (what colour are the peas ?), one should answer : « les petits pois sont rouges » (the peas are red). Why that? Because the answer also means: "les petits poissons rouges" (the little goldfish – which are red in most cases). And I will end this chronicle by a last one which is timely for this season: "cette chronique est un fait divers", which means "this chronicle is a news item" but it could also be understood as "cette chronique est un fait d'hiver", which means "this chronicle is a winter fact"!