MSIAC
Munitions Safety Information Analysis Center

Supporting Munitions Safety

May 2023

Bulletin

In This Issue

PM's Perspective

As we move into the 2nd quarter of 2023, I wanted to take a few minutes to highlight some of our planned activities for MSIAC in 2023 and beyond. MSIAC recently conducted its 37th Steering Committee Meeting in March in Seoul, South Korea. Our host, the Ammunition and Transport Management Division Director, Col. Taejin Song, Dr Seungho Han and Dr Kieun Lee did an outstanding job hosting a very successful Steering Committee meeting. In addition, Dr. Jin Gyo Sin, the Vice President for the Agency for Defense Development (ADD), hosted a one day tour of the ADD facility for all of the MSIAC Steering Committee (SC) participants.


Welcome to Agency for Defense Development (March 29, 2023)

I would also like to mention that the SC approved the 2023 programme of work to include some new work elements that will be of interest to the technical community. New work starting in 2023 will include:

Flow Synthesis: The initial focus will be on the impact on Safety & Suitability for Service (S3) qualification, the impact on logistics & storage, and the supply chain security and integration with other novel processing technologies. MSIAC is hoping to provide a presentation on this at Europyro 2023 in September.

Surrogate Materials: This work element will review the use of surrogate materials in the development of energetic materials processing and in the qualification munitions.

Review of Cost Benefit Models: The aim of this effort is to review a tool developed by the Insensitive Munitions European Manufacturers Group (IMEMG), Cost & Benefit Analysis Working Group with the MSIAC CBAM tool by running test cases and comparing the output of the tools.

Loitering Munitions: The aim of this work element is to highlight the various challenges associated with the S3 assessment of loitering munitions and make recommendations as to areas which warrant particular attention.

Electromagnetic Environmental Effects & Munition Safety: A more general support effort, the aim of this work element is to support the development of related STANAGs, coordinate and participate in technical meetings, interface with National Technical Authorities and the professional community of interest, present papers and provide presentations, answer technical questions related to Hazards of Electromagnetic Radiation to Ordnance (HERO), continue the development of the HERO webinar, develop technical reports, and continue to better understand the LCEP for the various nations.

Small Scale Testing of Energetic Materials: Small scale testing typically focusses on hazard testing as relates to impact, friction and electrostatic discharge. It is well known amongst the energetic community that the many different test apparatus and test set-ups are not directly comparable, and many factors can influence the test results. MSIAC will review the current test apparatus for Small Scale Impact and ESD testing, including positives and negatives of a given test. Furthermore, improvements in the quantitative nature of the tests will be explored.

In addition to our new work elements, MSIAC is planning a number of country visits this year to include visits to Poland, France, Sweden, Finland, Germany, and the USA. In addition, MSIAC will be offering its next AASTP-1 & -5 course in Berlin in May and has others scheduled for Kirtland AFB in the USA, in late August; Ramstein AFB in September; and one in Versailles, FRA in November. The demand for this lecture series continues to grow. MSIAC continues to try and accommodate all of the requests and the schedule for 2024 is already filling up.

Our ongoing series of technical workshops is one of MSIAC's core outputs and gives subject matter experts from across the technical community the chance to collectively discuss matters of mutual importance, and to cooperate on developing solutions to common problems. For 2023 and 2024, we have a number of planned technical meetings to include an *Energetic Materials Qualification* meeting (end of 2023), a *Small Scale Testing* meeting (later in 2024) to review improvements for impact, friction and ESD testing, and a *Non-Destructive Testing of Munitions* meeting (2024 alongside the EMTWG) to follow-up on the Defects Workshop to include topics on Calibration & Standards, Imaging Challenges, Defect Acceptance, and Emerging Technologies in Non-Destructive Testing. And finally, MSIAC is planning its next Workshop on the topic of *Pushing the Limits – Performance and Safety* (late 2024 in the USA) that will investigate the relationship between the desire to push performance and lethality and the impact/influence on safety. As time draws near, please check the MSIAC website for details.

Finally, I would also mention that MSIAC has recently finalized three recruitment activities for the Munitions Transport & Storage Safety and the Warheads TSO positions and for the Information Analyst & Data Manager position. All of the candidates that were selected are expected to arrive this summer and we hope to announce their names soon.

That said, Dr Ernie Baker, our Warheads TSO, who joined MSIAC in 2016, will be leaving MSIAC at the end of May and we would like to wish him the best in his planned retirement. For those who know him or have had the pleasure to work with him know that he has been an integral part of MSIAC's success over the last seven years and his expertise will be missed.

A very young Dr. Ernest Baker, a former Senior Research Scientist, Insensitive Munitions, in the U.S. Army, at Picatinny Arsenal, NJ.

As always, I would like to encourage you to get involved in our program of work during 2023 and to have a look at our website for details on our activities. Please feel free to send us an e-mail to request more information or to be kept informed or involved on any of our work elements.

Chuck Denham
MSIAC Project Manager

MCYCLEX: MSIAC CYLINDER EXPANSION TOOL

The new MSIAC CYLinder Expansion database (MCYLEX) version 1.1 has been released and is now available for use by the MSIAC member nations.

MCYLEX is a database of high explosive cylinder expansion test setups and test results, as well as a collection of Jones-Wilkins-Lee (JWL) equation of state parameters. It has been designed to provide scientists and engineers with a comparison and analysis tool.

MCYLEX has been designed to provide:

- Scientists and engineers with a tool that is easy to use and up to date.
- A listing and descriptions of cylinder expansion test geometries and setups.
- A database of high explosive cylinder expansion experimental test results with source references that include comparisons and analysis.
- A database of JWL equation of state parameters along with references that can be used for modelling of high explosives.

The MSIAC report O-222: MCYLEX Introduction (MSIAC CYLinder EXpansion database) provides a complete description of the new capabilities and data included in MCYLEX v1.0. MCYLEX v1.1 can be found on the MSIAC Weblink in the MSIAC > MSIAC Member Nations > MSIAC Software Tools > MCYLEX – MSIAC CYLinder EXpansion database subdirectory.

Ernie Baker
TSO Warhead Technology

A New IM/HC Test Facility at Bofors Test Center

It is not every day that a brand new test range dedicated to IM and HC testing is made available, so when it happens, it is worth mentioning!

The new facility in question is in the well-known Bofors Test Center (BTC), located in Karlskoga, Sweden. It consists of a clean, flat, and circular testing area with a diameter of 100 m covered with hard packed gravel and surrounded by sand walls with a height of 2 m. The main idea of this design is to facilitate fragment recovery as much as absolutely possible. As we all know, this is one of the most important criteria when assessing the results of an IM or an HC test. Other important features are four well protected and fixed electrical connection points on the testing area. This makes it far less time consuming and, therefore, more cost-effective to build up and take down a test setup. For fast heating testing with propane, the propane tank of BTC's Dahlgren burner, which is considered to be the state-of-the-art burner, is installed in a protected area right outside the sand walls and to setup such a test is now easily done within a short period of time.

This new facility entered into service last year and several tests have already been conducted. Test items with a total NEQ of up to approximately 20 kg TNT are allowed to be tested. It is mainly dedicated to IM testing (bullet impact, fragment impact, fast heating, slow heating, shaped charge jet impact and sympathetic reaction tests) and HC testing on munitions but arena tests and other static detonation tests can also be conducted.

For further information, please contact Jon Toreheim (jon.toreheim@testcenter.se).

Christelle Collet
TSO Propulsion Technology

MSIAC Insensitive Munitions Design Tools Lecture and Webinar

On 24 January 2023, Ernie Baker provided a lecture on IM Design for the Design for Vulnerability Course at Cranfield University, Shrivenham, UK campus. The lecture outlines the IM design processes for energetic selection, munition design for reduced response, and packaging design for reduced response and protection.

The lecture outlines current databases, technology, theory, design tools, and appropriate experimental characterization for each of the IM threats: Shaped Charge Jet Impact (SCJI), Fast Cook-Off (FCO), Slow Cook-Off (SCO), Bullet Impact (BI), Fragment Impact (FI) and Sympathetic Reaction (SR).

An expanded and more comprehensive version of this lecture is available to the MSIAC member nations through the IM Design Tools Webinar. The last webinar was held online on 3 May 2023 (https://msiac.nato.int/workshop) with over 60 participants. The next webinar is planned to be held in 2024.

Ernie Baker
TSO Warhead Technology

Visit to THALES LAS

MSIAC (Christelle Collet) visited Thales LAS in La Ferté Saint-Aubin, France, on 29th November 2022. Thales LAS is the acronym for Thales Land and Air Systems. It is a subsidiary of Thales group created on 1st January 2018. It is one of the major munition stakeholders in France.

The visit was initiated by Christophe Coulouarn (R&D Energetics materials and munition systems manager)

when he met Christelle and Chris at the International Conference of the ICT, in June 2022. This is basically how it went:

Christophe to MSIAC: “Would you be able to come to our site and deliver some of your presentations to my team?”

MSIAC to Christophe: “Yes, of course, let’s define the date and the agenda!”

There you go, as simple as this…

The agenda of the visit covered many aspects including MSIAC tools and products, ResonantAcoustic® Mixing (RAM) qualification challenges, non-destructive methods for detecting munition defects, and energetic binders. The MSIAC presentations triggered a great number of questions and side discussions. From the feedback received, it is believed that this visit has been very valuable for the attendees who, for most of them, were recently hired at Thales LAS or are new to the energetic materials and munitions field.

The day was concluded by a visit to the pilot plant being developed at Thales LAS for R&D activities and production support on melt cast energetic materials, coated energetic materials, and RAM.

Many thanks to everyone for the warm welcome and the interesting exchanges we had during the day!

Christelle Collet
TSO Propulsion Technology

… A New Beginning…

Dear colleagues and friends,

Hard for me to believe that 7 years have passed so quickly and that my time at MSIAC as the Warheads Technology TSO has come to an end! It has been a privilege to work in this great team of experts. I would like to thank all of you for the great support, cooperation and comradery during these years. It was a pleasure to answer technical questions from all over the world, support NATO policy development, provide Insensitive Munitions and Munitions Safety training, and maintain our MSIAC member nation databases and tools. On a personal level, I very much enjoyed the time spent with you on different events and trips. Thank you!

I started the job in 2016, 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 major updates to all of the AC/326 IM STANAGs and their transitions to AOPs. I’m particularly proud to have provided technical support for updating many AOP’s and to have developed AOP appendix historical inclusions. These historical technical explanations of changes in the documents are vital in order to properly maintain the documents so that future subject matter experts can quickly understand the technical basis of the standards. I’m extremely pleased that I was able to support this activity until completion. Since 2016, the move to the new HQ, Covid, the war in the Ukraine, and personnel changes at MSIAC of course had a significant influence on the work environment and experience. I believe that MSIAC is in excellent shape for the future.

I will now start another part of my life; with a concentration on my family, friends, travel, hobbies, and helping others. It is a new beginning of my life and I’m somewhat apprehensive of the great change, but extremely excited for the freedom and upcoming new experiences.

With that, I would like to wish you all the best for both your personal and professional endeavors!

Ernie Baker
TSO Warhead Technology

MSIAC Student Intern Clément Longere

From November 2022 to January 2023, Clément worked at MSIAC for a 10-week internship. Clément is in the 2nd year of engineering classes at ENSTA Bretagne and he will graduate at the end of the 3rd year with a Master’s Degree of Engineering in Mechanics. He is also in an apprenticeship, working as a Test Director for DGA Land Systems (Direction Générale de l’Armement).

During his internship at MSIAC, Clément worked mainly on the creation of a database and computing tool for cylinder expansion test (CYLEX). This test is performed in order to characterize the metal-acceleration capability of an explosive for warhead design.

The work Clément has done first consisted of searching and gathering available CYLEX test results and data from the MSIAC database. He then created an Excel tool that was first called MEWCYLET (MSIAC Excel Worksheet on CYLinder Expansion Test), which is now MCylex v 1.1, containing more than 600 CYLEX test results and 250 JWL equation of state parameters. This allows MSIAC member nations easier access to the information as well as easier comparison between substances thanks to several functions.

Clément also worked on SMILES (Simplified Molecular-Input-Line-Entry System), creating a presentation and a database containing SMILES code of each substance in the EMC (Energetic Materials Compendium) database. He also took part in revising a report studying the effect of ageing on the IM signature, which was initiated by Thibault Balay, a previous MSIAC intern from ENSTA Bretagne, in order to eventually publish it.

This is Clément's quote that summarizes his internship at MSIAC: "Working during three months at MSIAC was a very enjoyable experience where I had the opportunity to learn from the MSIAC database and the TSOs knowledge and expertise. I've really appreciate the diversity of the subjects entrusted to me. I've also find very pleasant to work with people from all around the world in a multicultural organization."

The MSIAC Team

The French Chronicle
American versus British English

As a non-native English speaking individual, it is challenging to remember which term is used in American, British, Canadian, or even Australian, English.

This is why I need to find tricks to remember which word is used in which country, so that I am consistent when I speak or draft texts. For example, a good way to remember which of 'lift' or 'elevator' belongs to US or UK vocabulary is to keep in mind that "Love in an Elevator" is a song by Aerosmith which is an American band. So there you go, an elevator belongs to American vocabulary!

There are many other examples, especially in food vocabulary: the British 'aubergine' is an 'egg-plant' in the US, the British 'courgette' is called a 'zucchini' in the US and, as in France, we use both the British courgette and aubergine, I just need to remember that our UK neighbors align most of the time with the French when speaking about food.

And here is one last example: what do you call those deep-fried potatoes in the shape of long, square cross-sectional sticks? 'Chips', as in the UK? (Note that what the French call 'chips' are actually called 'crisps' in the UK and 'chips' in the US, but I don't want to confuse you). Or 'french fries', as in the US? But then it comes to the endless, highly controversial, and still raging debate on where those 'french fries' originated: Belgium or France*? But this is a totally different story…

Note however that National French Fry Day is celebrated across the US on July 13 every year!

** about 12,000,000 results come up when typing "the origin of French fries" in the Google search engine, including a Canadian thesis on "Measurement of Physical Properties during Processing of French Fries", 239p !*

Christelle Collet
TSO Propulsion Technology

MSIAC Reports Published between Jan & May 2023

- **L-254 Ed.2 Analytical Response Models (ARM) Application Specification -** April 2023
  Dr Ernest L. Baker
- **L-282 Novel S3 Approaches -** March 2023
  Matthew Ferran
- **L-289 Release notes for MQDCAT v2.6 -** February 2023
  Martijn van der Voort
- **L-290 IM Policies across the Nations -** January 2023
  Christelle Collet
- **L-292 MSIAC Technical Questions - Annual Summary Report 2022 -** February 2023
- **L-294 The Effects of Ageing on IM Response -** May 2023
  Thibaut Balay, Clément Longère, Christelle Collet
- **L-295 TNT Equivalence of Black Powder and its Gurney and Mott Constants -** March 2023
  Dr Kevin Jaansalu
- **L-296 An International Review of STANAG 4488 GAP Testing -** April 2023
  Dr Ernest Baker

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- **O-222 MCYCLEX Introduction (MSIAC CYlinder ECpansion Database) -** January 2023
  Clément Longère
- **O-223 An International Review Of STANAG 4488 GAP Testing -** March 2023
  Dr Ernest Baker

Find all our publications here !