



Bulletin

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150 YEARS OF THE PERIODIC TABLE

In every chemistry classroom and laboratory you will find a Periodic Table hanging on the wall. It is the ultimate reference document for chemists providing information on how the elements are related, their atomic structure, their physical properties and reactivity (to name but a few). But its influence extends beyond the chemistry classroom having broad implications in astronomy, physics, biology and other natural sciences. This year the United Nations proclaimed 2019 as the "International Year of the Periodic Table of Chemical Elements" (IYPT 2019).

Chemists are celebrating the 150th anniversary of Dmitri Mendeleev's (1834-1907) structuring of the then known elements. His work (1869), and vision, was to place the elements in a table structure with those having similar properties adjacent, and potentially more importantly was that he left spaces for elements yet to be discovered; Figure 1.

Reihen	Gruppe I R ² O	Gruppe II RO	Gruppe III R ² O ³	Gruppe IV RO ²	Gruppe V R ² O ⁵	Gruppe VI RH ² RO ³	Gruppe VII RH R ² O ⁷	Gruppe VIII RO ⁴
1	H=1							
2	Li=7	Be=94	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	Sc=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59 Ni=59, Cu=63
5	(Cu=63)	Zn=65	Ga=68	--72	As=75	Se=79	Br=80	
6	Rb=85	Sr=87	Yt=88	Zr=90	Nb=94	Mo=96	--100	Ru=104, Rh=104 Pd=106, Ag=108
7	(Ag=108)	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	Ce=137	La=139	--	Di=145?	--	
9	(-)	--	--	--	--	--	--	
10	-- 165 --	169	Er=170	--173	Ta=182	W=184	--	Pt=194, Os=195(?) Ir=193, Au=196
11	(Au=196)	Hg=200	Tl=204	Pb=208	Bi=210	--	--	
12	--	--	--	Th=231	--	U=240	--	

Figure 1: Oldest known periodic table circa 1879-1886 [1]

It is table that is still being revised, with the most recent elements gaining official status in 2016: nihonium (Nh, Z = 113), moscovium (Mc, Z = 115), tennessine (Ts, Z = 117) and oganesson (Og, Z = 118) [2]. Both physicists and chemists are responsible for the discovery of the newest elements. These new synthetic elements are not naturally occurring and require bombardment of heavy elements containing nuclei with large numbers of neutrons; Figure 2.

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CONTACT INFORMATION

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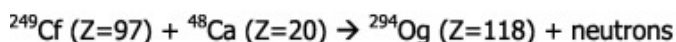
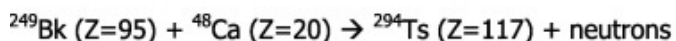
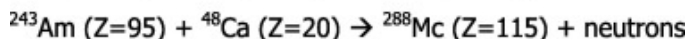
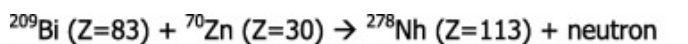


Figure 2: Examples of reaction equations for the synthesis of the four new elements [2]



What might not be widely known is Mendeleev's connection to energetic materials. At the end of the 19th Century Russia were looking to develop their own smokeless powders, employing the services of Mendeleev [3]. After visiting both Abel and Dewar in the United Kingdom, and Sarrau in France, Mendeleev returned to Russia with samples of Cordite and French powder.

His subsequent work and research focussed on forming nitrocellulose with performance suitable for large calibre gun propellant. In January 1891 he had synthesised nitrocellulose with a nitrogen content of 12.44 % and called it pyrocollodion.

According to Dobrotin, Mendeleev wrote that "the heart of the matter in obtaining pyrocollodion is the amount of water for dilution must be equal to the amount of water of hydration" [3]. Mendeleev published a three-part report on pyrocollodion (1895-96) which was subsequently translated into English. Although he won't be singled out for his work on nitrocellulose, the research he carried out influenced the work of other researchers in their pursuit of improved smokeless propellants.

You can find out more information regarding IYPT 2019 events happening in your country through the following link: <https://www.iypt2019.org/>.

An interactive periodic table is also available here: www.rsc.org/periodic-table.

Enjoy!

Dr Matthew Andrews
Energetic Materials TSO

References

- 1 N. Bilyeau, "Oldest Periodic Table," 22 January 2019. [Online]. Available: <https://www.thevintagenews.com/2019/01/22/oldest-periodic-table/>. [Accessed 20 February 2019]
- 2 J. Reedijk, "Row 7 of the periodic table complete: Can we expect more new elements; and if so, when?," *Polyhedron*, vol. 121, pp. 1-4, 2018.
- 3 R. E. Rice, "Smokeless Powder: Scientific and Institutional Context at the End of the Nineteenth Century," in *Gunpowder, Explosives and the State: A Technological History*, Abingdon, Oxon, Routledge, 2006.

QUESTIONNAIRE ON IM AND HC TESTS

MSIAC will start two new projects in 2019 that are related to **data collection during Insensitive Munition (IM) and Hazard Classification (HC) tests**:

- ⊕ Guidance on Instrumentation for IM and HC Tests. This project will review the use of existing instrumentation and will seek to share and develop best practice.
- ⊕ Collation and Analysis of IM and HC Test Data. This project will analyse existing IM blast, thermal and fragmentation test data to gain a better understanding of the explosive effects for sub-detonative munition responses. The output from this study will be used to inform on reduced consequences from accidents involving IM, which could be taken into account in quantitative risk assessments.

We need your input to help us gather available information and we therefore kindly ask you to contribute to a **new MSIAC questionnaire**.

Benefits of contributing are that your test procedures and data will be included in the analysis. Also we will make recommendations for improved and harmonized test procedures as well as recommendations for the characterization of the munition responses and their use for safety distances and risk analysis.

Please follow the hyperlink below to access the questionnaire: <https://www.msiac.nato.int/questionnaire-on-data-collection-in-imhc-tests> !

We will close this survey on **May 31st, 2019**.

Many thanks to those that already made a contribution. We hope to receive more input soon!

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

12TH INTERNATIONAL ARMAMENT CONFERENCE

The 12th International Armament Conference on "Scientific Aspects of Armament & Safety Technology" was held from September 17th to 20th 2018 at the Hotel WINDSOR in Jachranka, Poland. The conference was organized by the Institute of Armament Technology in the Military University of Technology (Warsaw, Poland) and the Military Institute of Armament Technology (Zielonka, Poland).

This conference brought together scientists of different research fields sharing and discussing current research and advances in armament and safety technology. A Keynote Address was presented by Dr. Baker from MSIAC: "NATO Standards and Practice for Munitions



Safety (MS) and Insensitive Munitions (IM)". The presentation outlined the MSIAC organization, NATO MS policy, a comparison to Poland MS and NATO IM policy. Poland became a new member of MSIAC in 2018.

IMPORTANT REMINDER



Dr Ernie Baker
TSO Warheads Technology

ACCIDENT REPORTING MADX COMMUNITY MEETING

On 6 and 7 February we hosted an accident reporting meeting at our NATO Headquarters. This was a joint initiative from Canada (Mr. Gilles Belley and Mr. Alain Roy) and MSIAC, with 17 participants from Australia, Belgium, Canada, France, Germany, The Netherlands and UK. These nations currently contribute or are planning to contribute to the MSIAC Accident Database Exchange.

The aim of the meeting was to gain an appreciation for the explosives safety programs of participating nations, to standardize information shared by nations, to harmonize terminology, and to explore tools, training, opportunities and initiatives in support of multinational operations. A number of challenges were identified in relation to differences in terminology, level of detail and frequency of input to the database.

Each nation came well prepared to the meeting and briefed on their national safety program, accident reporting tools and an overview of a number of recent accidents. Plans were made to establish a permanent working group on this topic. We would like to thank all participants for their valuable contributions.

Martijn van der Voort
TSO Safety of Storage and Transport

Check out all reported **ACCIDENTS** via this [hyperlink](#) .

You can find all Technical **PUBLICATIONS** via this [hyperlink](#) .

MSIAC produced products and services are to be used by individuals within MSIAC member nations on activities supporting these nations. Information available from MSIAC will be marked appropriately to ensure that it is protected appropriately.

For example:

- ⊕ Information limited to MSIAC member nations (e.g. MSIAC limited reports and tools) will be marked with the dissemination limitation: **"MSIAC UNCLASSIFIED"**.
- ⊕ It can be combined with more restrictive markings such as **"MSIAC UNCLASSIFIED – For Government Agencies Only"**.

Please ensure that you respect these markings and if you have any questions please do not hesitate to contact your NFPO or the MSIAC staff directly.

WELCOME MATTHEW FERRAN !



Matt Ferran joined MSIAC on the 5th November 2018 as the **Technical Specialist Officer for Munitions Systems**. He holds Master's Degrees in Chemistry (from University of Nottingham, UK) and Explosive Ordnance Engineering (from Cranfield University, UK).

Prior to joining MSIAC Matt worked for the UK Ministry of Defence for 10 years in the Defence Equipment & Support organization (DE&S), working in a variety of posts related to munitions safety. From 2012 to 2018 Matt worked in the Defence Ordnance Safety Group (DOSG) as a Weapon Systems Safety Advisor, providing advice and guidance to procurement project teams on munitions safety issues. Initially this was for a range of complex weapon systems (including surface-to-surface guided weapons, lightweight torpedoes and various countermeasure systems), and later for medium caliber ordnance and ammunition (including aircraft cannons and naval close-in weapon systems).

Between 2014 and 2017 Matt was seconded to the Australian Department of Defence, working for their Directorate of Ordnance Safety (DOS). During this time he led the development of the new suite of Explosive Ordnance Materiel Safety Regulations.



... AND GREETINGS FROM AURIHONA WOLFF !



I am a civilian student at ENSTA Bretagne, a French engineering school specialized in pyrotechnics and detonics.

After one year in Germany, studying Aerospace Engineering in Universität der Bundeswehr in Munich, I am taking a gap year in between my second and my third year.

I currently work at the Munitions Safety Information Analysis Center (MSIAC) in the NATO headquarters in Brussels. My project concerns "Novel Properties enabled by new technologies" under the supervision of Matthew Andrews (TSO in Energetic Materials), Wade Babcock (TSO in Material Technology) and Christelle Collet (TSO in propulsion). It is a fascinating subject in which I get the opportunity to work on common manufacturing processes for explosives and propellants, and new processing techniques such as additive manufacturing and resonant acoustic mixing. I will try to summarize all the common processes used for fabricating energetic materials in my report. It is not an easy task since they have been evolving a lot since the end of the Second World War.

I will also write a report to gather all our current data on resonant acoustic manufacturing and additive manufacturing. It is evolving very quickly so this task is challenging. But thanks to the TSOs and the incredible Laserfiche database, I have all the information I need within easy reach.

It is definitively a very interesting experience in which I get the opportunity to attend meetings, have access to an impressively complete database of technical documents, visit companies and work with experts.

Moreover the life in Brussels is extremely enjoyable and the city hosts many cultural events. I probably learnt more in two months time here than in one year at university. I would definitely recommend this internship in MSIAC!

AASTP-1 AND AASTP-5 LECTURE SERIES

We are about to kick off the 2019 course program for the AASTP-1 and AASTP-5 Lecture Series. From 25 to 29 March, instructors Johnny de Roos (ex BEL MoD) and Eric Deschambault (ex US DDESB) will start the year at the Camp de Matelots in Versailles. The week thereafter, Johnny will be accompanied by Matt Wingrave (DOSR, UK) to teach at the Julius Leber Kaserne in Berlin.

Due to a good cooperation with Capt. Sylvain Souday in Versailles and Lt. Col Sascha Decker in Berlin, the preparation of the courses is going smoothly. Both events will host 9 visiting students from other (MSIAC) nations.

The course program for the rest of 2019 is shown below. Unfortunately we cannot except new students for this year, all events are fully booked. Please let us know if you're interested in attending and we will include you in the mailing list for 2020.

Country	Location	Date
FRA	Versailles	25-29 March
DEU	Berlin	1-5 April
US/CAN	Quantico,	23-27 September
AUS	Canberra	11-15 November
NZ	Wellington	18-22 November
US	Ramstein, DEU	2-6 December

Martijn van der Voort
TSO Safety of Storage and Transport

ESMRM TRAIN THE TRAINER (T3) COURSE

We are currently considering options to develop a new course in relation to Explosives Safety Munitions Risk Management (ESMRM). This is the overarching NATO policy (ALP-16) that defines roles and responsibilities with respect to risk management on NATO missions, and describes the risk management process to be followed if criteria provided in AASTP-1 and AASTP-5 cannot be met. Two videos are available on the MSIAC website that illustrate risk management in a port situation and on a military base.

<https://www.msiac.nato.int/news/explosives-safety-munitions-risk-management>

The course has yet to be approved but would be aimed at students that have previously followed the AASTP-1 and AASTP-5 lecture series or already have a significant experience in explosive safety siting and risk management. The course would take three days:

- ⊕ Day 1 (explosives safety basics. e.g. hazard classification, QD)
- ⊕ Day 2 (ESMRM focus, theory of ALP-16 and risk analysis methods)
- ⊕ Day 3 (ESMRM group exercise)

We are very keen to hear about your interest for this course starting in 2020. Can you please help us by indicating your nation's interest? How many students would you expect per year?

Please email your reply to M.vandervoort@msiac.nato.int!

Many thanks for your response!

Martijn van der Voort
TSO Safety of Storage and Transport



GUN LAUNCH SETBACK IGNITION STUDY WG

The 2nd Gun Launch Setback Ignition Study Working Group meeting was held 9 October 2018 at the new NATO Headquarters. This was initiated by the NATO AC/326 SG/A – Energetic Materials and is being led by the USA, with Sean Swaszek from US Army ARDEC overseeing the process. The goal of the working group is to develop a new Allied Ordnance Publication for standardizing the approach to testing and evaluating the safety of energetic materials and munitions to setback loading. The meeting was attended by 19 subject matter experts representing USA, Norway, Sweden, Netherlands, United Kingdom, and Germany. Dr. Ernie Baker from MSIAC has been providing technical support to the group, and he provided a presentation of results from the recent MSIAC Gun Launch Setback Survey. It was distributed to member nations and 15 responses were received from government (87%) and commercial (13%) test centers from 7 nations. The major items listed in the survey were the principal topics for discussion. They included; energetics under gun launch, defects requirements, defects inspection and identification, laboratory testing, standardization, and gaps identification. Technical presentations were also provided by Swedish and German representatives. Lively technical discussions resulted in significant consensus and a recommended path forward for the development of standard assessment protocols for: acceptability of explosive for gun launch; acceptable defect types, sizes, distributions; and acceptable defect identification methods. The 3rd Gun Launch Setback Ignition Study Working Group meeting is planned for 12 March 2019 at the US Naval Surface Warfare Center Indian Head.

New MSIAC report: O194 - An International Review of Gun Launch Explosive Setback. It includes the survey results, analysis and recommendations.

by 19 subject matter experts representing Canada, France, Netherlands, Norway, South Africa, Sweden, UK, and USA. Dr. Baker from MSIAC has been providing technical support to the group. Dr. David Hubble of the US Naval Surface Warfare Center Dahlgren Division provided presentations of work by Dr. Baker and himself on required heat soak durations to achieve thermal equilibrium. Dr. Baker had conducted analytical calculations, whereas Dr. Hubble had conducted finite element calculations. The two approaches provided confirmation and agreement for the calculated heat soak durations. Based on the previous working group meeting discussions and updated information, national positions were presented and discussed. Lively technical discussions resulted in consensus. Full agreement was reached for this important topic with details provided in the new draft STANAG 4382 and AOP-4382 for IM and HC assessments.

Dr Ernie Baker
TSO Warheads Technology

SYMPATHETIC REACTION CUSTODIAL WG MEETING

The STANAG 4396 Sympathetic Reaction (SR CWG) Meeting was held on 17-18 September 2018 at the Kromhout Kazerne, Utrecht, Netherlands. France is the custodian, with Christophe Jacq leading the process. This was the second meeting of the group held in order to review STANAG 4396, make recommendations and provide a draft STANAG update for review by the NATO AC326 CNAD Ammunition Safety Group. The meeting was attended by 20 subject matter experts representing Canada, France, Netherlands, Norway, South Africa, Sweden, UK, and USA. Dr. Ernie Baker from MSIAC has been providing technical support to the group. MSIAC previously conducted a survey among member NATO nations requesting feedback related to sympathetic reaction testing described in STANAG 4396. The survey results will be published in a future MSIAC report. The results of the survey were sent to the custodian nation and were the focus of this meeting. Agenda topics for this meeting are based on the issues cited in the MSIAC survey and other related topics brought forth by the subject matter experts.

National positions were presented by the national representatives. Lively technical discussions resulted in significant consensus. The plan of action for the SR CWG is to resolve technical issues, to offer recommendations for the updated SR test requirements and to hand-off the findings to the AOP-4396 document custodian who will share this information with AC/326 Subgroups B. The next Sympathetic Reaction Custodian Working Group Meeting (SR CWG III) was planned to take advantage of the occasion of the Spring Subgroup B meeting where many of the national representatives participate in both meetings. The follow-up meeting for this Working Group will precede the AC/326 Subgroup B meeting and is planned for Monday-Tuesday, 8-9 April 2019, at the new NATO Headquarters facility in Brussels, Belgium.

Dr Ernie Baker
TSO Warheads Technology

SLOW HEATING CUSTODIAL WG MEETING

The STANAG 4382 Slow Heating Custodial Working Group (SH CWG) Meeting was held on 18-19 September 2018 at the Kromhout Kazerne, Utrecht, Netherlands. The USA is the custodian, with Stephen Struck from the U.S. Air Force Research Laboratory overseeing the process. This was the fourth and final meeting of the group held in order to review STANAG 4382, make recommendations and provide a draft STANAG update for review by the NATO AC326 CNAD Ammunition Safety Group. The meeting was attended



Artillery Projectile Gun Launch

Dr Ernie Baker
TSO Warheads Technology



THE FRENCH CHRONICLE

Working at MSIAC is not only about technical matters, it also usually deals with communication issues, misunderstandings and philosophical conversations on word meanings and their etymology in the different spoken languages. As a French member in a mostly English-spoken team, this happens to be a daily topic of discussion. A relevant and recent example was provided by the search of a hotel room in London for a mission. Oddly, English hotel owners are proud to mention the fact that they propose “ensuite rooms”. This makes no sense for a French speaker even if the word “ensuite” obviously comes from the other side of the Channel and actually means “afterward”. So now the question is: what would be an “afterward room”? A room that you would use for the night coming after your day? Or something to place in a conversation, like: “May I offer you a drink?” “yes please, and afterward a room”! And of course, nothing to do with the French word “suite” which, when used in the context of hotel vocabulary, means a sort of apartment with kitchen, living room, etc. As usual in this typical situation, I then discovered the total discrepancy with the English meaning of this poor originally French word, literally kidnapped from its initial land and friends and family and sent to a foreign language just to be misused. Indeed, for those of you like me before who do not know what an “ensuite room” is: it is a room with a private bathroom! In opposition with a “non-ensuite” room that does not have any bathroom I presume? My advice of the day for those of you who are not super familiar with English language particularities: make sure you pick an “ensuite room” the next time you book a hotel in the UK!

Christelle Collet
TSO Propulsion Technology



The Insensitive Munitions European Manufacturers Group (IMEMG), the US National Defense Industrial Association (NDIA) and the Munitions Safety Information and Analysis Center (MSIAC), are sponsoring a joint industry/government symposium on Insensitive Munitions (IM) and Energetic Materials (EM) at the Silken Al-Andalus Palace Hotel, Seville, Spain on 21 – 24 October 2019. The 2019 theme is Innovative IM&EM Solutions for Safer Operations in More Demanding Environments

CALL FOR PAPERS ANNOUNCED

We invite high-quality professional presentations for the 2019 Insensitive Munitions & Energetic Materials Technology Symposium.

To view the complete Call for Papers instructions, please visit: NDIA.org/imemts.

Deadline to submit abstracts is March 22, 2019.

[Submit your abstracts.](#)

For more symposium information and to register please visit: www.imemts2019.com.

Questions? Contact: imemts2019@cwtme-ormes.com.

Date: October 21-24, 2019

Location: Silken Al-Andalus Palace Hotel | Av. de la Palmera | Sevilla, Spain 41012

Contact: Loey Bleich | Program Manager | (703) 247-2575 | lbleich@ndia.org

