LEMS JOURNAL

LAND EQUIPMENT MANAGEMENT SYSTEM JOURNAL

ISSUE 9
MARCH · 2022

IN THIS ISSUE

National Defence | Défense nationale

Canada

M777 HOWITZER TRIALS

Members of the 1st Regiment, Royal Canadian Horse Artillery (1 RCHA) hold a M777 Howitzer shooting range practice during a trial for Canadian Army Trial and Evaluation Unit, Gagetown (CATEU) at Canadian Forces Base Shilo, Manitoba on February 8, 2022.

Read more about the M777 on Page 18.

Photo credit: Cpl Stéphanie Labossière, Canadian Armed Forces

Cover Photo: Cpl Oscar Fernandez, a Vehicle Technician with the 1 Battalion, Royal 22e Régiment, attaches a chain to a wrecked vehicle as part of the towing procedure during Exercise REMORQUEUR TACTIQUE on October 21, 2021 in Valcartier, Québec.

Photo credit: Cpl Hugo Montpetit, Canadian Forces Combat Camera, Canadian Armed Forces

Director General
Land Equipment Program Management

Brigadier-General
Rob Dundon

Send articles and comments to:
LEMSJournalSGET@forces.gc.ca

Coordinating Editor
Tom Douglas
thomasmdouglas@gmail.com
Tel. (289) 837-3168

Graphic Design and Project Management
d2k Graphic Design & Web
www.d2k.ca
Tel. (819) 771-5710

LEMS JOURNAL

LAND EQUIPMENT MANAGEMENT SYSTEM JOURNAL

DIRECTOR GENERAL'S COMMENTS

HISTORY AND PROJECT UPDATES

SUPPORT TO TRAINING AND OPERATIONS

FUTURE CAPABILITIES

ISSN Number: 2561-5882 English Version online

DIRECTOR GENERAL'S COMMENTS

LEMS has a vital role to play in maintaining European and global security

By BGen Rob Dundon

There is an ancient apocryphal curse that goes: "May you live in interesting times." The irony should not be lost on any of us as we find ourselves experiencing world events that are increasingly shocking. Just when we were emerging from the pandemic, on February 24, 2022, we all witnessed the return of state-on-state warfare. What does it mean for LEMS? What does it mean for us as a community? The conflict is giving us a glimpse of how future peer-on-peer conflicts may be fought, in Europe at least, and I would suggest that three observations can be drawn out, one strategic, one tactical, and one doctrinal.

First, technological overmatch remains a valid equipment strategy. Democracies are sensitive to casualties in war and consequently we have opted to maintain military power with advanced technologies, or more simply put: technological overmatch. Ukraine has a defender's advantage, but the country is resisting the invaders with donated Western weapons systems such as the Stinger, Javelin and NLAW – and they are proving, to date, to be massively successful. Technological overmatch works. Collectively, we need to accelerate the adoption of advanced technology, and LEMS has a role in leading this. We need to embrace it.

Second, our tactical concept of Levels of Repair needs to be challenged. We have to determine how to affect repairs within a much faster targeting cycle. During the Cold War, the targeting cycle for various Soviet artillery echelons was hours, and that drove the calculus of labour we could perform at various levels. Targeting is now cycling in minutes, as proven not just in Ukraine but additionally in the Nagorno-Karabakh conflict. We need to find a way to cope – and may have to turn to first principle analysis to do so.

Third, the LEMS Tenets contain distilled wisdom that will shape how we realize LEMS during peer-on-peer conflict. Our doctrine has changed considerably since World War II, but when we examine the doctrine's evolution, one thing has remained consistent: our Tenets. You can call these axioms, or first principles, but they are at their essence nuggets of truth passed from those who last experienced state-on-state warfare to those of us in the future. It is time to look profoundly to them again as we deal with equipment support in this new world.

Crises are the catalyst for change, and this one, the invasion of Ukraine, is pointing to what we need to look at to modernize LEMS. I don't know how this will end, but the articles you will find in this issue of LEMS Journal give me confidence that the Corps of RCEME remains ready to contribute to Canada's response to this crisis specifically, and to the cause of European and global security more broadly.

NEXT EDITION

LEMS Journal is your forum for putting forward ideas, commenting on current or past articles, and sharing related experiences. The next edition of the *LEMS Journal* will be published in the summer of 2022. If you want to be a part of the next edition, please send your articles – or your ideas for articles – to LEMSJournalSGET@Forces.gc.ca no later than **May 16, 2022**.

A **History of the Leopard 1** in the Canadian Armed Forces

By Yves Bouffard

When 4 Canadian Mechanized Brigade Group was moved within West Germany from Westphalia to Lahr on the Rhine frontier with France, the decision was made for the brigade to continue using the Centurion tank – which had served well up to that point but could not be used on long road moves. In 1975, this venerable workhorse was replaced by the Leopard 1.

Members of the Royal Canadian Armour Corps who had the privilege of working with the Leopard 1 family of vehicles are now saying farewell to the Leopard 1 fleet. Following its introduction in 1965, the Leopard 1 quickly became the standard for many European militaries and eventually served as the main battle tank (MBT) for more than a dozen countries across the world, including Canada.

The first Leopard 1 MBTs were loaned to the Canadian Armed Forces (CAF) at Lahr by the West German government in 1977. Their superior accuracy, ease of use, and reliability bore fruit early when the Royal Canadian Dragoons (RCD) B Squadron won the NATO tank gunnery competition that year against major allied nations. Canada operated most Leopard 1 variants, including: BEAVER Bridge-layer, TAURUS Armoured Recovery Vehicle, and BADGER Armoured Engineer Vehicle.

The CAF began to receive its full order of 114 Leopard 1 C1 MBTs in 1978. Most of the new Leopard 1s were originally stationed with 4 Canadian Mechanized Brigade Group at Canadian Forces Base (CFB) Lahr and operated by the RCD. The remainder were allocated to Canadian Forces Base Gagetown (now 5 Canadian Division Support Base Gagetown), between C Squadron RCD (known as the "fly-over squadron"), and the armour school (now the Royal Canadian Armoured Corps School).

Leopard 1 C1 MBT with mine rollers, Exercise in LANGENHARD training area, Germany, October 1987.

With the closing of CFB Lahr in 1993, the Leopard 1s were repatriated to Canada and redistributed to armour regiments and engineer squadrons stationed at Brigade Groups in Valcartier, Petawawa, and Edmonton, as well as the Combat Training Centre in CFB Gagetown.

In 1995, the Leopard 1 C1s were upgraded with add-on armour to provide more protection. Two Leopard 1 C1s of this configuration were deployed to Bosnia for use in engineering tasks using mine rollers and mine ploughs.

In 1999, further upgrades to the Leopard 1 MBT included the replacement of welded turrets with cast turrets,

Leopard BADGER Armoured Engineer Vehicle, Operation HARMONY, Sarajevo, Bosnia-Herzegovina, 1992.

a new gun sight, an improved hydraulic turret drive, and new turret armour. These collective upgrades changed the MBT to the Leopard 1 C2, with an acceptance ceremony held at the Cartier Square Drill Hall in Ottawa in September 2001.

In 2006, a 15-tank squadron – with five operational spares, four Armoured Recovery Vehicles (ARV) and four Armoured Engineer Vehicles (AEV) – was deployed to Afghanistan to support operations in the Kandahar area and remained there until the repatriation of the Canadian contingent in 2011.

During this deployment, the Leopard 1 family was further upgraded with mine belly-plates for additional protection from improvised explosive devices (IEDs) and mines, a crew chiller system, and thermal covers to protect the crew from the excessive heat of the south Asian desert. Also during the Afghanistan deployment, the Leopard 1 MBTs were augmented by the Leopard 2 A6M and Leopard 2 A4M.

The Leopard 1 C2 tanks were considered completely obsolete by 2015. With the delivery of the new Leopard 2 Tank Mobility Implements in the fall of 2017, the last Leopard 1 tanks were "parked for good". All variants of the Leopard 1 family of vehicles are being divested now, with estimated completion by the end of 2022.

For 40 years, Canadian soldiers relied on the Leopard 1 to provide direct fire support to manoeuvring forces. They will continue their watch duties in front of many Canadian Army museums, bases and buildings across Canada and abroad.

India Coy 2 RCR BG personnel aboard a Leopard 1 C2 MBT at the conclusion of Operation REAR ENTRANCE, Panjwa'I District, Afghanistan, June 2007.

Yves Bouffard is a former RCEME technician and Armoured Corps Officer who, as a contractor to DND, has been heavily involved in coordinating Leopard 1 disposal.

Leopard 1 C2 monument located at NDHQ Carling Campus, Ottawa, taken by author Aug 2020.

Commissioning of the Headquarters Shelter System by **Equipment Fielding Detachment Valcartier**

By Cpl Alexandre Dame

It takes experience and organization to receive and distribute a large project such as the Headquarters Shelter System (HQSS).

As with all new equipment received, the HQSS is inspected before being distributed to the various units, which ensures that it is functional and compliant. This equipment-commissioning process has the advantage of not adding additional tasks to the maintenance organizations of the various units – which already have to deal with carrying out their respective maintenance plans, collective training support, and operational deployments. Therefore, this major task falls to the 2nd Canadian Division's (2 Cdn Div) Equipment Fielding Detachment (EFD), which is the cornerstone for receiving, inspecting, completing the technical testing of, and distributing the equipment to the various units.

The commissioning of this new equipment is a complex task, considering the potential range of components and configurations of the HQSS – which has four main components, thus allowing it to be assembled into nine different configurations as required.

Also to be considered are maritime containers, whose contents differ from one complex to another and contain a wide variety of equipment, such as:

- 60 000-BTU/h environmental control units (ECUs), which are air conditioners and heaters that control the modules' indoor air temperature up until the outside temperature falls below -7°C;
- 130,000-BTU/h portable heaters for cold weather; and
- three different types of semi-rigid floors for safely inserting the various electrical wires.

To date, EFD Valcartier has received approximately 30,000 flooring sections, 176 ECUs, 176 heaters, and 47 out of the 122 maritime containers. This project is much more complex and far-reaching than it first appeared.

The EFD, however, was up to the task and managed to take full advantage of the skills it has acquired over the years – as well as the expertise of its technicians.

Although delivery of the floors, heating modules, and heat pumps began in January 2020, the current pandemic situation caused by COVID-19 has disrupted the manufacturer's equipment delivery schedule. This particular situation required adapting and thorough planning, while demonstrating the professionalism and dedication of the EFD members who were able to receive the equipment at any time of the day or night. Everything was delivered by more than 30 tractor-trailer trips (excluding maritime containers).

Once all the equipment was received, inspections were conducted that uncovered problems with the ECUs. One of the complications proved significant because the foam insulation inside the units was peeling off under the heat. When the ECU was used, that insulation turned into a cloud of foam that got shredded by the fans, and then came out the ventilation ducts. Technicians from the design firm DEW Engineering and Development went on site to make the necessary adjustments before the equipment was delivered to the various units. Inspections once again proved to be an essential step in the commissioning, as they allowed problems to be identified before the equipment was put into operation.

The complexity of commissioning the HQSS will again put the team to the test with the arrival of the remaining 75 maritime containers. This daunting task will require receiving major equipment parts, and a thorough inventory has to be conducted with a large number of parts and accessories to ensure that all systems are working properly. They are made up of six different tent modules and include the necessary accessories for deployment and a surplus of repair parts to keep the equipment operational for 90 days. This is a challenge that the EFD team and its technicians are prepared to take on.

Cpl Dame, EFD V-Tech, performs the inspection upon reception and the testing needed to ensure a high level of quality control.

Considering that these complexes vary in size and composition, some are complete with a single container, and others may require up to nine containers. It is obvious that they offer flexibility and adaptability that will be exploited by the various units. For example, the 2E medical role complex consists of nine containers, 27 ECUs, 27 heaters, and approximately 3,800 sections of semi-rigid flooring. Once assembled, it forms a field hospital that is 93 metres long by 68.4 metres wide.

These impressive complexes will definitely redefine the way the CAF operates in a tactical environment, on top of significantly increasing the quality of work and the comfort of the military personnel working there, thanks to a comfortable temperature in both summer and winter.

Cpl Dame is a vehicle technician at EFD Valcartier, Maint Coy 5 Service Battalion, 5 CMBG, 2 Cnd Div.

One size no longer fits all:
DSSPM to update the 2012 Canadian Forces Anthropometric Survey

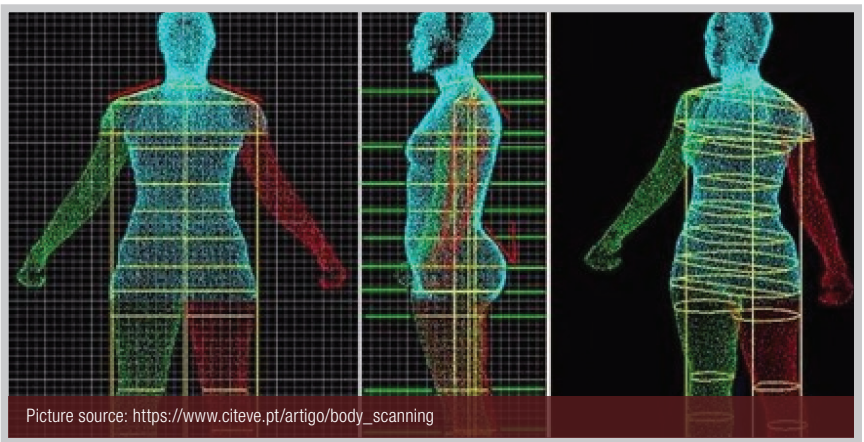
By Emma Moon

People come in a variety of shapes and sizes and it is simply not feasible for the Department of National Defence (DND) to customize clothing and equipment for each individual operator.

What is possible, however, is for DND to understand the size and shape of the Canadian Armed Forces (CAF) membership in order to optimize the sizing and fit of individual equipment and clothing. This is not an easy task – as CAF membership evolves over time, so do the body measurements of each individual member.

In 2019, under Operation GENERATION, the Assistant Deputy Minister (Materiel) (ADM(Mat)) was tasked to lead the requirements definition process for a program to modernize and maintain the database – which informs the procurement of individual clothing and equipment, to ensure all body types and gender considerations are included. This task was delegated to the Human Factors Support Cell (HFSC) within Director Soldier System Program Management (DSSPM). In October 2021 ADM(Mat) approved the CAF Anthropometric Program for Soldier System Acquisition (CAPSSA).

Anthropometry is a science that deals with the standardized measurement of the human body. Anthropometric data can be used to better understand the target population under consideration and can be applied to ensure appropriate fit of equipment, clothing, and workstations.



Picture source: https://www.citeve.pt/artigo/body_scanning

In DSSPM, the HFSC applies anthropometric data in a number of different ways to support the procurement of equipment and clothing. Anthropometrics are applied to answer questions about fit and form such as: "Where should we place pant pockets, and at what angle, so that the highest number of members will be able to comfortably access them?"

Anthropometrics are also used to inform sizing tariffs – which is the range of sizes available – as well as the dimensions and the quantity of stock required for each size. Anthropometric data can also be released to industry in order to ensure its designs align to the needs of the CAF population.

The aim of CAPSSA is to introduce a fleet of 3D scanning technology to systematically capture the body morphology of CAF members and provide key measurements to DSSPM for sizing and fit decisions. Currently, the procurement of individual equipment and clothing is informed using a database of anthropometric measurements generated in 2012.

These measurements do not adequately represent all members. As the CAF continues to evolve under *Strong, Secure, Engaged: Canada's Defence Policy* to recruit more women and members of visible minority groups, the existing anthropometric data becomes more obsolete and less reliable for acquisition decision-making.

CAPSSA will generate a more inclusive database and ensure the continued relevance of the data by enabling

portable scanning technology deployed across Canada and systematic scans offered as part of the Force Test. Deployable scanners will also be held within the HFSC to support targeted efforts for anthropometric data gathering in specific under-represented populations, such as the Canadian Rangers.

CAPSSA execution involves the collaboration of many stakeholders. Scan implementation will take place via Personnel Support Programs (PSP) in conjunction with Force Test evaluations. Due to the sensitive nature of the data being collected under this program, multiple privacy, security, and legal entities within DND are involved to approve and advise project documentation and decisions.

Assistant Deputy Minister (Information Management) will also play a role in facilitating network linkages to Defence Wide Area Network (DWAN) for the CAPSSA database software application. Lastly, the HFSC will be working in conjunction with Defence Research and Development Canada to develop an evaluation strategy for scanning technologies as part of the solicitation package for CAPSSA.

CAPSSA expects to be running at Full Operating Capacity by March 2024. The next milestones for CAPSSA are to develop a Statement of Work (SOW) and to officially release the Defence Administrative Orders and Directive (DAOD), which governs the administration of the CAPSSA program.

Once CAPSSA is established and an ever-green database of representative anthropometric data is readily available, the HFSC expects to see a) a drop in special sizing requests, b) supply chain management improvements concerning forecasting and availability of correct sizes, and c) an increase in member satisfaction with respect to fit of issued clothing and equipment.

Emma Moon is the Human Factors Support Cell section head in DSSPM. She is a professional engineer and holds a Masters in Human Systems Integration.

The end of one era and the start of another: **Extending the life of an old warhorse**

By Lt Lucas Giannotti

The 202 Workshop Depot (202 WD) in Montreal specializes in third- and fourth-line support for the Canadian Armed Forces. With this in mind, in the early 2000s and with the armed conflict in Afghanistan, 202 WD was assigned a major project that would directly support the war effort and the troops on the ground. It was with pride and dedication that more than 60 technicians, both civilian and military, executed an operation that would last nearly 20 years, namely the M113/M577 (Armoured Personnel Carrier/Armoured Command Vehicle) life extension project.

First, it is important to understand the history of the project. The converting of M113s into M113 A3s for greater life span began in the late 1990s. It had two parts – refurbishing the M113 A3 models and extending the Tracked Light Armoured Vehicle (TLAV) family.

For the M113 A3s, the procedure was simple. The vehicles arrived in Montreal with kits containing all the parts to be replaced and installed. Technicians disassembled the entire vehicle, recovering parts that could be reused and performing repair, painting, reassembly, and inspection tasks. The vehicle would often be at its destination within a week after the inspection.

For extending the TLAV family, the process was more complicated. The project involved lengthening the M113 by four feet. To do so, the vehicle's chassis and body were separated. In the meantime, a new, longer chassis was delivered, and the employees looked after preparing it (additions, painting, and so on).

The next step involved cutting the body in half in the middle in order to weld the four-foot extension onto it. This was a huge challenge because the standards for welding ballistic steel are extremely restrictive. Once the vehicle was back together, it continued down the production line.

The undertaking then evolved into an Inspect and Repair Only As Necessary (IROAN) project, continuing in the footsteps of the M113 A3s. However, since the nature of the task had changed, the work method had to be adjusted as well. The production line remained in place, but the vehicle did not necessarily go through all the steps.

Challenges occur in any project at some point. In this case, two major quality-related issues were significant. The first was vehicle standardization. Although all vehicles appear to be the same, items such as brackets and wire runs are not exactly in the corresponding location. Creating positioning tools as well as work done on a prototype became less realistic because each vehicle was unique. Another challenge involved the variability in the quality of parts. By dealing with many suppliers, it was harder to control the quality of the components, with the part sometimes having very different assembly qualities. The lack of standardization in the parts resulted in additional unplanned work on the vehicles.

The M113/M577 project had beneficial and lasting effects on 202 WD as one of the unit's most extensive projects in recent decades. The expertise gained, the depth of experience exploited, and the challenges that arose enabled 202 WD and its staff to develop, to learn new machining techniques, and to gain expertise in undertaking large-scale projects.

Lt Lucas Giannotti is the Operations Officer at 202 Workshop Depot.

Production line in 2012.

Ready for a New Assignment: **HLVW Wrecker Comes Home to Canada**

By MCpl Craig Dottermann

The time finally arrived to send one particular Heavy Logistics Vehicle Wheeled (HLVW) Wrecker back to Canada.

Located at the International Peacekeeping and Security Centre (IPSC) about an hour west of the city of Lviv, Ukraine, this vehicle was an integral part of the capacity building mission in Ukraine since 2015.

From recovering broken US equipment, to demonstrating to partner nations how the Canadian Armed Forces (CAF) conducts various rollover recovery techniques, the vehicle remained an important piece of the support provided to Operation UNIFIER.

As the mission evolved, the Task Force became highly dispersed in order to conduct Security Force Capacity Building activities at many outstations spread throughout Ukraine that were no longer reliant on the CAF Standard Military Pattern (SMP) fleet. What this evolution meant was that the need for the SMP fleet in support of the mission had come to an end.

After one last demonstration – extracting and recovering a rollover – conducted by the Rotation 11 wrecker crew consisting of myself, MCpl David Deblois, and Cpl Jacob Arseneau Hillier, the wrecker was packed and cleaned for shipment back to Canada in order to await a new future unit to support.

MCpl (Craig) Dottermann is a vehicle technician at 2 CER Maintenance troop.

The Challenges of RCEME Officer Training **in a COVID Environment**

By 2Lt Pamela Reed

"No plan survives first contact," as Course Supervising Officer Captain (now Major) Doucet would say.

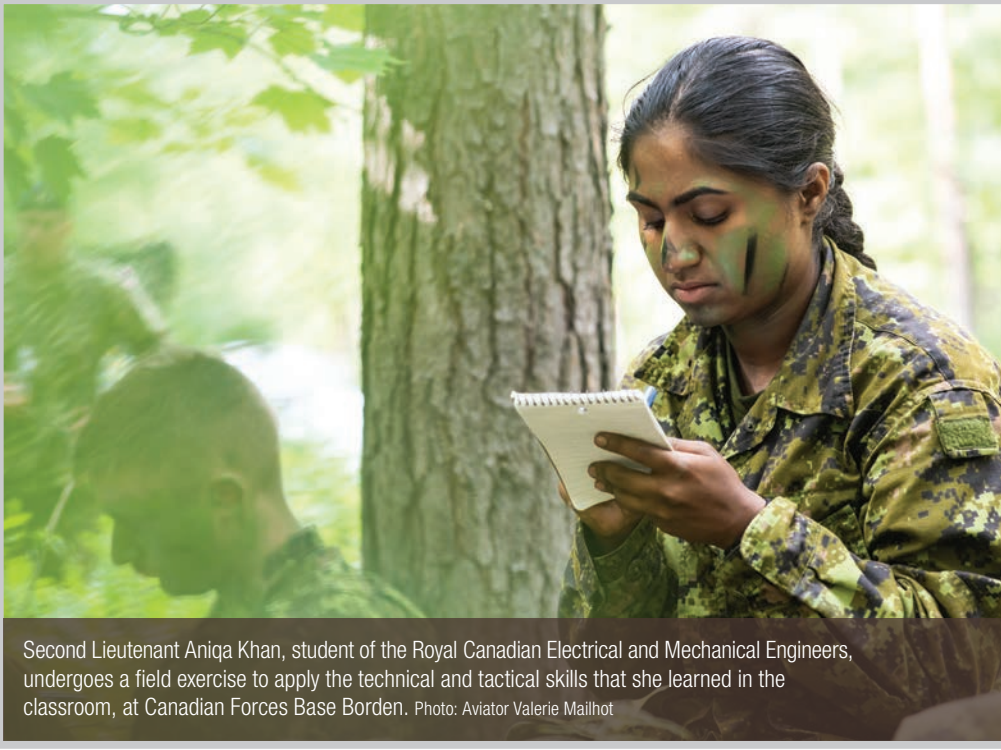
Such was the case for Officer Development Period 1.2 (ODP 1.2). The course was originally scheduled to begin on January 14, 2021 at the RCEME School. However, a provincial lock-down forced the Army to do what it does best – adapt and overcome.

The RCEME School's response to the stay-at-home order meant candidates began the course in a virtual environment. Borrowing technology from civilian workplaces, many of which had been operating remotely since March 2020, the course planners arranged for lectures to be delivered via Office 365 and Microsoft Teams, requiring students to adopt an adult-style learning method of self-directed study.

This invites the question as to whether training needs to be conducted in-person at all. Certainly there are advantages to a virtual approach:

- A reduction in the required budget for the course;
- Reduced impact on members with families; and
- The comforts of home.

But can students be expected to focus entirely on a course that demands their efforts and attention when there are dishes in the sink that need to be washed? How can practical, hands-on fieldcraft skills be taught through a screen?



Second Lieutenant Aniqa Khan, student of the Royal Canadian Electrical and Mechanical Engineers, undergoes a field exercise to apply the technical and tactical skills that she learned in the classroom, at Canadian Forces Base Borden. Photo: Aviator Valerie Mailhot

Ultimately it was decided that the students would resume in-person learning on January 25, 2021. This was no small decision given the state of the provincial lockdown, as the military could not be perceived as disregarding these important health guidelines.

A strict 14-day self-isolation prior to going on course was enforced, and, upon arrival at the RCEME School, students were subjected to another 14-day isolation period where access was granted only to the dining hall, the RCEME School, and individual accommodations. Public health measures also required masks to be worn at all times in any common areas, students were separated into one per room, and they were not allowed to leave the base. Strict mealtime windows were enforced to ensure there was little to no cross-contamination between units at the base.

These public health measures provided a unique challenge to the candidates on ODP 1.2 – how to forge a bond of camaraderie among peers when separated by a wall of plexiglass at mealtimes while also having to maintain a spacing of six feet.

The course staff and supporting elements were impressive in the way they came up with innovative solutions to adjust

A graduate of the Developmental Period 1 Electrical and Mechanical Engineers Officer proudly shows his trade badge during their graduation parade at the Royal Canadian Electrical and Mechanical Engineers school. Photo: Master Corporal Precious Carandang

Royal Canadian Electrical and Mechanical Engineers Officer students go through field exercise training at Canadian Forces Base Borden. Photo: Sailor third class Melissa Gonzalez

the lesson plans to accommodate a COVID environment. For example, the urban company siting demonstration was held in the residential housing units (RHUs), and Creemore was conducted virtually using tools like Google Maps and Streetview to investigate the area. Additionally, the lectures provided by the Land Engineering Support Centre (LESC) were delivered virtually by the guest speakers, forcing the course staff to get rather creative with a webcam attached to a blue fleet van during the mobility demonstrations in the training area.

All that aside, training in a COVID environment drove home the importance of mental health and the impact of isolation on the members of the RCEME School. More than ever, candidates and staff alike had to support each other through this shared experience and understand that although one may feel alone at times, there are ample systems in place to provide much needed understanding and support.

Though COVID presented unique challenges previously unseen by the military, the results are evident. At the conclusion of ODP 1.2 in April 2021, there were many new qualified RCEME officers. Their course experience may have been a little different than in previous years, but their resiliency and adaptability in the face of the unknown has been proven and will continue to be something they rely on in their future as leaders in the Canadian Armed Forces.

2Lt Pamela Reed was a student at the RCEME School.

Regenerating the lost arms of the Materials Technicians

By Sgt Mathieu Bélanger

A number of years ago, the Materials Technician trade was amputated of multiple "arms" as a result of the implementation of a project called Military Occupational Structure Analysis, Redesign and Tailoring (MOSART).

Although skills such as woodworking, machining, and painting were removed from the core competency of the trade, qualified technicians took it upon themselves to maintain these skillsets within the trade. They did so by passing on their knowledge to the newer generation.

However, over time, many of those skills were lost through attrition, and it was determined that it was time to bring them back. Over the past few years, the Military Employment Structure (MES) was reviewed and most of that material is set to reappear in fundamental core training.

In October 2018, a Rank Qualification Private (RQ Pte) Materials Technician Qualification Standard (QS) Board was conducted, and more recently a Training Plan (TP) Board was convened in May 2021. Changes to the training will be implemented in the near future

to ensure that the trade remains relevant. New skills will be added and old skills will return.

Welding has always been the Materials Technician's bread and butter and will remain a core competency within the trade. The way of thinking was always to train the technician to be able to weld on armoured vehicles right from RQ Pte. Once the Corps analyzed what tasks a RQ Pte technician was required to perform, it was realized that the focus of the training was not in line with the job requirements. The TP writing board members realigned training to support the job description of a RQ Pte graduate.

Computer-Aided Design (CAD) has been a part of the manufacturing industry for years and, although some of the newer generation of technicians already utilize it, no Materials Technicians are officially trained on that software. The addition of a new Performance Objective (PO) on RQ Pte training, includes basic hand drafting, CAD, to go along with Computer Numerical Control (CNC) plasma cutting and Additive Manufacturing (AM). This will realign our Materials Technician qualifications with civilian industry.

Basic machining will be introduced into the early development of an RQ Pte. Although this skill is still being taught as a Unique Specialty Qualification (USQ), most would agree that Materials Technicians require that skill. By adding the basic machining training early in a technician's development, it will be possible to influence the occupation's thought process. In the future, when a technician is analyzing a job, the thought process will evolve from: "Maybe I can grind this piece down." to "Machining this piece will save hours of work!"

Although RQ Pte technicians receive training on composites and protective coatings, it was determined that this PO is far too short, failing to provide technicians with adequate enough knowledge and skills to effectively perform tasks of this nature. By expanding this PO, we will ensure that our technicians will have a solid foundation to face future challenges.

A large number of technicians work with wood, either on their own time or at work. The addition of woodworking to the RQ Pte training will provide an extra skillset in the Materials Technician's toolbox to properly support CAF units.

Sewing, sheet metal, gas mask, and metallurgy continue to remain a vital component of the occupation. As future Materials Technicians are on-boarded, they will continue to learn and develop their abilities to sew, perform sheet metal work, as well as expand their knowledge of metallurgy. It will be important that the newer skills added to the RQ Pte do not overshadow the fundamental competencies that are required of Materials Technicians.

Although portions of the trade requirements have been removed over the years, the Materials Technicians' arms started to regenerate in 2015 when the Non-destructive Testing (NDT) program was rolled out. As the occupation continues to evaluate and reflect on the requirements of the CAF and the training provided on each course, more of the arms that have been lost will be restored. With new skills like CAD and AM that mesh with existing capabilities, it will be important to realign training to ensure those new skills do not overshadow some of the basic foundational expertise embedded in the occupation since the creation of the trade.

The Materials Technician of the future must continue to evolve as the technology in the civilian industry advances at a rapid pace. By re-evaluating and adjusting the skills taught on RQ Pte, the occupation ensures that there is the potential to regenerate the arms of the Materials Technician so that the trade maintains its relevancy.

Sgt Bélanger is the Standards WO for Material Platoon at the RCEME School.

Exercise REMORQUEUR TACTIQUE **aims at improved battlefield recovery capabilities**

By Lt Shawn Hogan

Maintenance Company, 5 Service Battalion (Svc Bn) has implemented successive serials of what we consider to be advanced recovery techniques in support of domestic and expeditionary operations.

Recent operations in Latvia and Ukraine involve using public roads and highways. Analysis of this factor has led to the conclusion that there may be a gap in our recovery capability: current training does not include complex recovery scenarios involving multiple vehicles, mass casualties, or extraction of wounded personnel.

This task is normally undertaken by civilian fire and ambulance services, not tow trucks. Medics are found in most CAF convoys – however military fire services are not typically equipped with the tools required to open a crushed vehicle and access casualties inside. With our current operations in Europe involving the sharing of high speed routes with the local civilian population, it is reasonable to conclude that a strategy is required for any unfortunate eventuality.

At present, the typical training progression for a vehicle technician recovery tasks (extraction, righting, backloading) is a familiarization during Development Period 1 (DP1), followed by a recovery crew commander phase in DP2. This training consists only of recovery techniques for righting and towing vehicles. It stands to reason, however, that in a real-life situation, we can expect there to be injured personnel present who will have to be extracted, triaged, and

cared for in order to press on. We might also deduce that it will be necessary to be able to coordinate with other elements such as medical, transport, and local civilian authorities.

The intent of this training is to develop the skill set within our vehicle technicians and to use the lessons learned to inform training development by our centre of excellence. The concept is implied by our doctrine, found in the LEMS manual, which says the following:

> *"c. Recovery.21 At the tactical level recovery activities include:*
>
> *(1) Battlefield Recovery. This includes extrication, righting of overturned equipment, and towing to the unit maintenance organizations or ECP, which is the primary task of unit recovery resources. Battlefield recovery also includes special recovery tasks, such as removal of vehicles and debris from operating areas, support to gap crossing, support to bridging, obstacle duties, etc. These special recovery tasks are normally provided by second or third line recovery resources."* [1]

While this certainly leaves room for interpretation, it does seem to be only one logical deduction away from being able to assert something like *vehicle casualties may include human casualties; extraction of wounded and medical triage may be necessary before extrication and righting the vehicle casualty*. It is with this in mind that Maj Nicolas Arseneault conceived of the first iteration of the "Camp de Remorquage".

The training event began as a series of lectures and practical demonstrations with subject matter experts external to Maintenance Company (Maint Coy):

- Fire services to brief us on the types of existing equipment and their use in order to safely access vehicle interiors and casualties inside.
- Medical experts to explain how to effectively and safely care for casualties during the course of the extraction.

Several iterations of this training have occurred thus far, and the scope has grown to include more realistic scenarios. The training platoon in Maint Coy purchased civilian scrap vehicles and obtained authorization to repurpose military vehicles scheduled for demilitarization in order to simulate the types of accidents that could occur on civilian roadways mixed with military vehicles.

In the most recent exercise, civilian contractors were employed in conjunction with military personnel taking on the role of local populations. The contractors were able to simulate smoke and noise in the general area, all adding to the realism one might encounter in such a situation. One scenario even included a Heavy Logistics Vehicle Wheeled Forward Area Refueller (HLVW FAR) rolled on top of a civilian wreck with water leaking to simulate a hazardous material spill.

The medics and firefighters who delivered the instruction and mentorship during the instruction segment of the training became evaluators during the final confirmatory exercise phase in order to assess the effectiveness of decisions and actions taken by the recovery team commanders and their personnel.

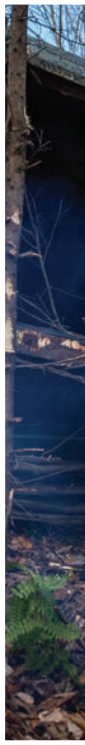
Feedback during the After Action Review (AAR) phase indicates that the development is heading in the right direction. The training audience considered the experience to be valuable and interesting training, in that it:

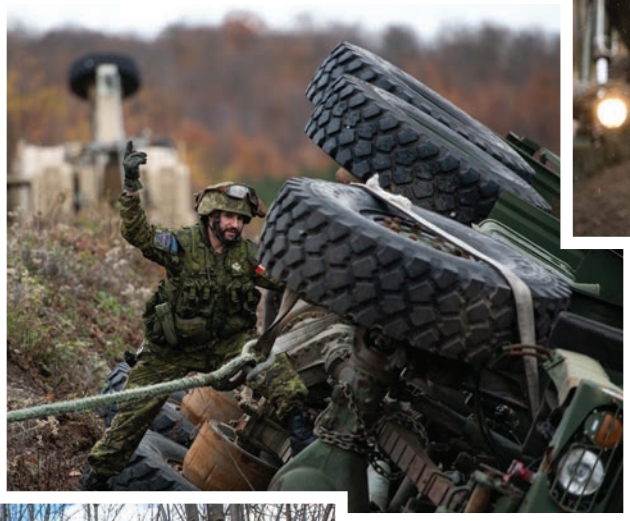
- increased their confidence that they will have the knowledge required to deal with such a situation;
- contributed greatly to the morale and cohesiveness of the teams set for deployment almost immediately following Exercise REMORQUEUR TACTIQUE; and
- made a splash within the brigade which put the spotlight on some of the capacities unique to Svc Bn and The Corps of RCEME.

Reference:

1. ADC CAPABILITY GROUP SUSTAIN, B-GL-342-001/FP-001 THE LAND EQUIPMENT MANAGEMENT SYSTEM, Kingston, ON: Canadian Army Doctrine and Training Centre Headquarters, 2021.

Lt Hogan, formerly a sergeant in the Corps of RCEME, is the acting Maintenance Officer at 5 Svc Bn, Valcartier.






PELICAN

Stepping up to the line to handle M777 C1 repair

By MWO Michael Hogan

Ever since the CAF (Canadian Armed Forces) acquired and subsequently deployed, the M777C1 as its principal artillery system, it has always remained one of Canada's most challenging fleets to sustain.

Factors including technical training, the procurement of parts, increasingly less and less availability of qualified technicians, and an ever-increasing operational tempo have created the requirement to revise the way with which we employ the different lines of maintenance. In fact, these factors clearly bear witness to how far the RCEME community is prepared to go in order to perform even the most complex 3rd line maintenance level tasks at 1st line workshops. Recently the weapons technicians at 1st Regiment, Royal Canadian Horse Artillery (1 RCHA) gladly rose to the challenge, applying their acquired skills and expertise to succeed in an arena traditionally reserved for the manufacturers' level in personnel and facilities.

The repair in question revolved around the complete replacement of a full set of worn traverse track bearing rollers situated inside the traversing rack assembly which were severely damaged and prevented the system from being aimed throughout its full range in azimuth. From a maintainer's perspective, everything they had learned throughout their training came into play. In order to obtain access to change these components, the entire platform needed to be disassembled including the gun barrel and ordnance, cradle,

3rd line M777C1 repair Shilo.
Left to right: Cpl B.C.D. Knapp, Cpl I.J. Hovey, MCpl M.J.R. Boileau and Cpl M.A. Lodder

traversing saddle, elevation mechanism, and finally the main traverse saddle. The technicians relied on everything from overhead cranes to specialized major component stands, sling sets, prying staves, high-power torque wrenches, and of course a rare level of technical know-how and experience.

Following the progress of the technicians throughout each step to gain access to the rollers and then to go on to successfully change out the entire line of traverse rollers was impressive to say the least. This particularly intricate and time-consuming repair would normally be performed at a repair and overhaul (R&O) facility such as 202 Workshop as a 3rd line maintenance task. 1 RCHA, being a 1st line combat unit, would normally never even consider undertaking such a repair since the rule of thumb is normally a limit up to four hours maximum for 1st line maintenance tasks. Through consultation with DASPM 3, the Equipment Management Team (EMT) for the M777C1, the task was reviewed by its dedicated team of civilian and military engineers and technicians. Various factors were considered to minimize downtime of the equipment for the user and ensure success of the repair while minimizing costs. Rather than having the equipment shipped to Montreal, it was decided, at the national level that the repair would be done by local unit technicians.

DND and the CAF have always been recognized for the vast technical capacity their RCEME technicians possess and for their level of resourcefulness, efficacy, and patience when it comes to the depth, range of talent, and capability to fix broken equipment.

This was clearly yet another testament to the impact our RCEME technicians have – from the techs "just doing their job"!

MWO Michael Hogan is a weapons technician occupying a position as TA (Technical Authority) with DGLEPM, DASPM 3 armament sustainment on M777C1 howitzers.

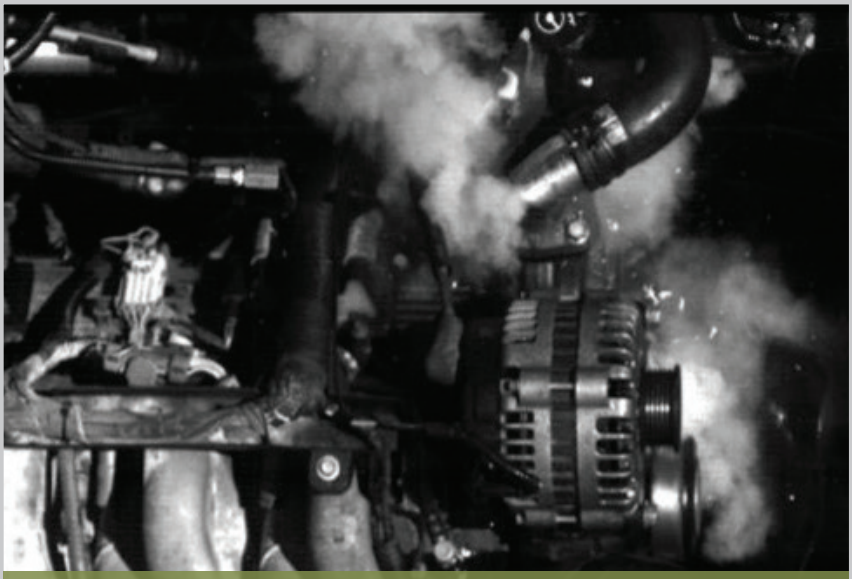
Members from 1st Regiment, Royal Canadian Horse Artillery, fire the M777 Howitzer during a fire mission on Exercise IRON RAM at 3 Canadian Division Support Base (3 CDSB) Garrison Wainwright's Training Area on October 24, 2017. Photo: Corporal Jay Ekin, Wainwright Garrison Imaging

Aiming for an answer: **Can you stop a vehicle with a bullet?**

By MWO Sylvain Bouffard

Do we really have the ability to stop a vehicle with our sniper weapon systems? Would shooting into the engine block of a vehicle be enough to protect our brothers and sisters in arms in the field while on operations?

These were real questions I asked myself when I was deployed to Afghanistan as a sniper. In fact, the entire sniper community was questioning this hypothesis. This is why, in the fall of 2017, one of my colleagues approached the Defence Research and Development Canada Centre in Valcartier (DRDC-V), hoping to get some fact-based evidence on the subject. Until then, no source had been able to give a valid answer to such a crucial query that could, in the future, confirm whether the doctrine used for protecting the force was effective.



Effect of firing a sniper weapon into an engine block. Photograph taken with a high-speed camera. Photo: Courtesy of Munitions Experimental Test Centre (METC)

With an ability to provide direct support to its military partner for operational needs, the DRDC-V was able to take up the challenge. After the Centre's Military Support Unit (MSU) went to great lengths to obtain the necessary authorizations, volunteers from three different sections of the DRDC-V – Weapon Systems (WS), Weapons Effects and Protection (WEP), and Defence Experimentation Valcartier (DEV) – as well as members of the Munitions Experimental Test Centre (METC) – all working together to achieve their goals.

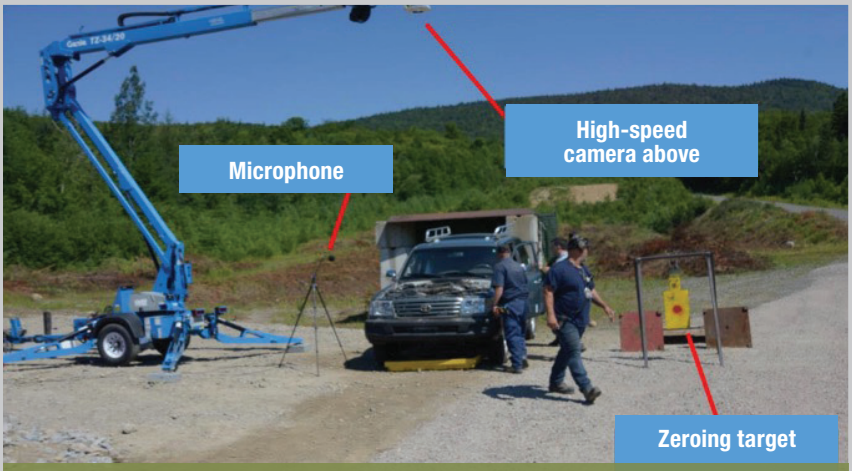
All members of a multidisciplinary team rolled up their sleeves to make this project possible. These entities regularly work with the Director Land Requirements (DLR) and the Director General Land Equipment Program Management (DGLEPM) in order to optimize the use and acquisition of the Canadian Army's equipment.

However, it wasn't going to be easy. In addition to a schedule already filled with other tasks, the team would have to face various obstacles along the way.

The first step was to obtain the resources required for conducting these tests since the long-range firing had to be done on moving vehicles. After the acquisition of suitable targets, it was necessary to ensure all environmental safety conditions were met. The preferred solution was to use vegetable oil and ethanol for running the engines, thereby mitigating the risk of soil contamination.

It also took resourcefulness in order to find quick, effective ways to temporarily repair the engines hit by bullets. In fact, they had to be restarted as often as possible in order to carry out a greater number of tests to obtain conclusive results. Mounting the external data-acquisition instruments was also a major challenge. Fortunately, Mother

Result of firing a sniper weapon into an engine block. Photo: Courtesy of METC

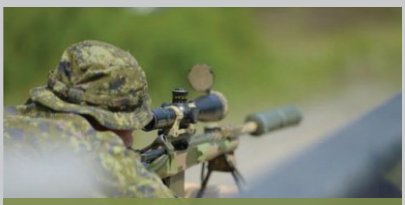


Snapshot of the installation before the shooting for data collection. Photo: Courtesy of METC

Nature cooperated. Even keeping the ammunition at a stable level required unique expertise.

After extensive planning and coordination with all technical stakeholders, in partnership with snipers from 1er Battalion, Royal 22e Régiment (1 R22eR), the tests were conducted as planned in July 2018. The data collected proved to be invaluable. An in-depth analysis followed, among the teams' many other projects, highly-relevant charts and diagrams were created to increase the visibility of results.

I had just entered the DRDC-V when I was asked if I would use my experience as a sniper to consolidate the data. Therefore, I consolidated the results and incorporated my recommendations for the field, in the form of a PowerPoint presentation. Obviously, the COVID-19 environment and imposed health protection mandates had a dramatic effect on the entire process. However, the finished product was submitted to the Canadian snipers in March 2021.



1 R22eR sniper in firing position.
Photo: Courtesy of METC

Because of the confidential and sensitive nature of this project, no further information can be published at this time.

The results of this research will be incorporated into future national training by the Sniper's Cell in Gagetown. Due to the teamwork, multi-agency collaboration, agility, and motivation of the DRDC-V members, it was shown how beneficial it can be to combine all the capabilities of the defence scientific and METC Test & Evaluation communities. This collaboration and partnership will ensure that snipers will be better prepared for operations in the future operating environment.

MWO Bouffard, who spent 20 years with the R22eR, is now a member of the R de Chaud. He's employed by DRDC to provide military support, help with coordination, share experience, support liaison between military and scientists and also holds the position of Sergeant-Major for the Centre's Military Group.

Integrating Advancing Additive Technologies At 202 Workshop Depot

By Lt Sean Menezes

As the Canadian Army continues to modernize, our maintenance and logistic support systems must do the same. In recent years, 202 Workshop Depot (202WD) in Montreal, Quebec has adopted a variety of Additive Manufacturing (AM) technologies and techniques to complement our manufacturing capabilities. Consequently, 202WD can provide DGLEPM and the Canadian Army with new tools and resources to support in-service equipment and provide a wide array of novel AM support functions – from rapid-prototyping to small-scale part manufacturing in collaboration with close partners including the Quality Engineering Test Establishment (QETE), and the Land Engineering Support Centre (LESC).

Currently, in-service additive manufacturing technologies have proven their worth on several occasions by providing interim replacement components for vehicles, or printed solutions to replace and support auxiliary equipment on operations. Within 202WD, AM is consistently integrated into daily practices by the electronics team, most recently by developing cabling brackets for an amplifier and a motherboard stand-off – both demonstrated within Figure 2.

For the motherboard, despite the existing clamps of the system, vibrations would result in the board becoming intermittently, or completely, disconnected. The standoff was designed, printed, and integrated into the system by electronics technicians

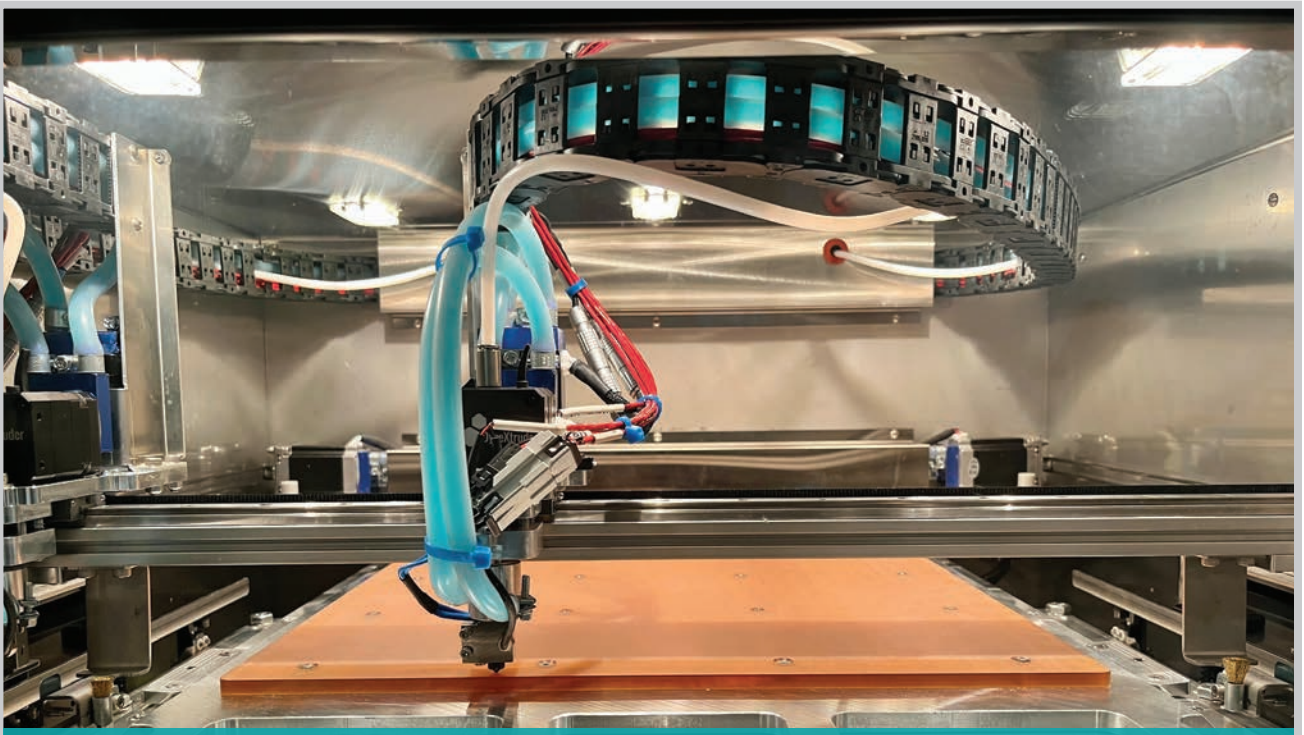


Figure 1. Close-up view of the AON M2 commencing printing application.

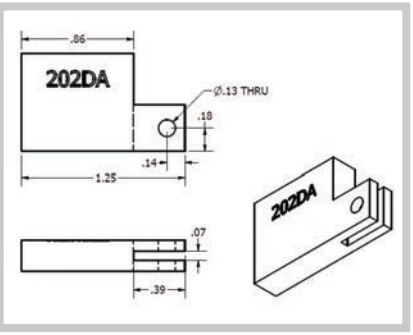
Jean-Francois Carrière, and Mathieu Lessard, pressing the components snugly in place against a pre-existing plate – ensuring the continued functionality of the TPSNG Computer without the intermittent disruptions experienced prior to the part's installation.

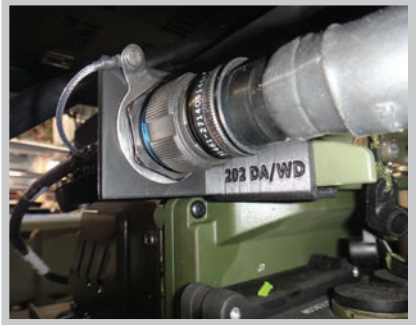
Even though these practices continue to be improved and integrated within the workshop, they remain limited in their capability to replace existing parts due to build size and the variety of materials available, specifically those with high-performance characteristics due to their difficulty in nature to print. To reduce the impact of these two limiting factors, 202WD has integrated two industrial 3D Printers; the AON M2 (2020), and the Desktop Metals Studio, into current manufacturing and support practices.

These two printers, while boasting wildly different characteristics and outputs, provide 202WD with more flexible tools and materials for the task. The AON M2, a large-volume Fused Filament Fabrication (FFF) printer, developed in Montreal, is able to print high performance polymers including PEEK and PEKK, known for their light weight, excellent strength, chemical and corrosion resistance, electrical insulation, and durability throughout a large and variable temperature range.

These materials have the greatest strength-to-weight ratio of any thermoplastic and can potentially be used as an alternative to glass, steel, aluminum, and other polymers. Figure 3 graphically shows a comparision of the material properties of AM composites against Al 6061, demonstrating the possibility to replace metal with composites in certain applications dependent on the project requirements.

Figure 2. 3D Printed Motherboard Spacer and Cabling Bracket developed by Jean-Francois Carrière and Mathieu Lessard.





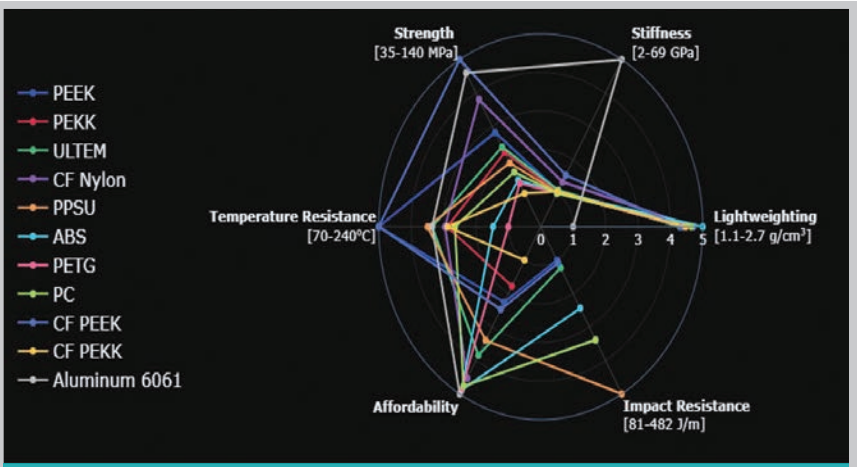


Figure 3. 3D Printing Materials Comparison.

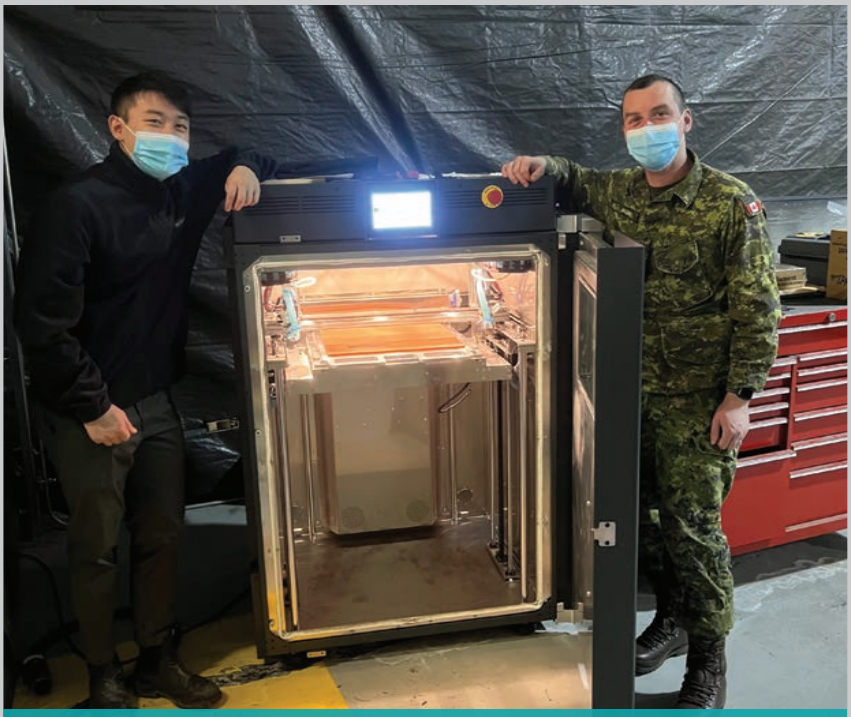


Figure 4. Maj. Jason Dalziel (right), MCE Program Lead, and EIT Basil Nham (left) demonstrate the newly operational AON M2.

The Desktop Metals Studio is a bound metal deposition system that combines the properties of metal injection molding with fused filament fabrication as used within the AON M2. The three-part system incorporates the use of a printer, a debinder, and a furnace. The system works by using closed filament cartridges composed of rods of metal powder held together by a wax and polymer binder. This filament is then fed through a heated extruder and onto the build plate shaping the part layer-by-layer. The debinder dissolves the primer and the furnace fuses the metal particles to reduce porosity and increase mechanical strength. This setup, while not without its own challenges, will allow 202WD to produce prototypes, jigs, fixtures, and end-use items in metals like steel or titanium.

These systems – having specific ventilation, consumable, and power requirements – have resulted in 202 WD dedicating facilities toward their permanent installation and continued use, along with their supporting hardware. Alongside these printers will be the existing metrology capabilities, the CreaForm Metra and HandyScans, which will enable large-scale 3D scanning.

202WD is also taking a role in building an AM community within the Corps of RCEME by providing a platform to share AM knowledge and by conducting outreach activities. The unit developed a SharePoint site and virtual 'help desk' to support other units across the Army in troubleshooting their respective implementation of AM systems, or in the support of their current projects with AM augmentation.

The 202WD SharePoint provides up-to-date policy, guidance, and storyboards on recent projects and innovations within and exterior to the unit in order to support the promotion and continued use of additive manufacturing technologies.

The AM Help Desk can be reached at the following address:

+202 DA Additive Manufacturing@202 DA@Montreal

The Desk supports units within Canada and on operations overseas with novel projects, troubleshooting of CAD models or equipment, the development of prototypes and modifications, or installation of AM technologies.

202 Workshop Depot also works closely with partners QETE, and LESC to test, improve, and evaluate AM solutions. Equipment Management Teams (EMT) or units looking for support in the development or certification of 3D-printed replacement components for future use are welcome to reach out to the help desk as required.

As the battlefield continues to adapt, all across the Canadian Armed Forces our practices and technology must continue to do the same. While this is another large leap forward for the continued implementation and use of additive manufacturing, it certainly won't be the last.

Lt. Menezes is a RCEME Projects Officer from 202 Workshop Depot, Montreal aiding with integrating additive manufacturing technologies for the Manufacturing, Fabrication, and Components program.