

## **Science, Technology and Procurements**

The Procurement and Munitions Business Activities section begins with report on Lockheed Martins purchase of Sikorsky Aircraft, Germany's decision to proceed with MEADS in their Tactical Air Defense System, while Turkey now further contemplates negotiations with China for their missile defense system. Significant munitions procurements from the last three months, spanning re-procurements for traditional systems to the latest equipment, are then also mentioned.

The Science and Technology section includes recent accomplishments and system redesigns, including two interesting laser weapon systems demonstrations by MBDA and Lockheed Martin. This issues concludes with an excellent article on 3D printing and adaptive manufacturing: "Machines Building Machines". The article estimates that researchers have already printed 80 percent of the components that go into a modern missile system, including printed energetics, warhead and seeker components, rocket motors and electronic circuits.

### **Procurement and Munitions Business**

#### **Lockheed Martin to buy Sikorsky Aircraft for \$9 billion**

Lockheed Martin has entered into a definitive agreement to acquire Sikorsky Aircraft, a world leader in military and commercial rotary-wing aircraft, for \$9.0 billion. The price is effectively reduced to approximately \$7.1 billion, after taking into account tax benefits resulting from the transaction. This acquisition would enhance Lockheed Martin's aerospace market, while adding a civil element to its defense-oriented portfolio. The demand for military and civil helicopters has softened in recent years, primarily due to reduction in demand from the military and offshore operators in the oil and gas business. The Corporation plans to align Sikorsky under the Lockheed Martin Mission Systems and Training (MST) business segment. MST and Sikorsky currently partner on a number of critical programs, including the VH-92 Presidential Helicopter, Combat Rescue Helicopter and the Naval MH-60 Helicopter.

<http://www.lockheedmartin.com/us/news/features/2015/sikorsky-acquisition.html>

#### **Germany to Replace its Patriots with MEADS**

MBDA Deutschland welcomes the decision of the German Federal Ministry of Defence (BMVg) to proceed with the Tactical Air Defence System (TLVS or Taktisches Luftverteidigungssystem) based on the development results already achieved by MEADS. With this decision, Germany will be fulfilling the Bundeswehr's requirements for a powerful, latest-generation air defence and missile defence system. It will also be taking full advantage of the successful MEADS investments it has made thus far. It is assumed it will thereby replace the Patriot air defense systems initially fielded in the 1980s. MEADS has been developed through MEADS International, a cooperative venture between MBDA and Lockheed Martin. TLVS is being carried out under the system leadership of MBDA Deutschland, which continues to draw on MBDA Italia's capabilities, as well as on a proven industry partnership between Lockheed Martin and Airbus Defense and Space. The technologies generated within the framework of the tri-national MEADS development process represent the equivalent of € 4 billion. Germany has shouldered a 25% share of the investment.

<http://www.mbda-systems.com/mediagallery/#/news/3502>

#### **(Defense News reports) Turkey May Renegotiate Air Defense Deal With China**

Turkey would consider renegotiating a Chinese bid to construct the country's first long-range air- and anti-missile defense system, Turkish President Recep Tayyip Erdogan said. That bid has largely remained idle after several months of negotiations.

Erdogan said that the \$3.44 billion deal with China would be discussed during his visit to Beijing. In September 2013, Turkey said it selected China Precision Machinery Import-Export Corp. (CPMIEC) for the air defense architecture, a contract dubbed T-LORAMIDS. CPMIEC, offering a solution at \$3.44 billion, defeated the European Eurosam, maker of the Aster 30, and the US Raytheon/Lockheed Martin, offering the Patriot system.

But talks with the Chinese contender have never matured and the contract remains to be signed. Meanwhile, Turkey has opened parallel negotiations with the European and US bidders. NATO and US officials have warned that any Chinese-built system could not be integrated with Turkey's joint air defense assets with NATO and the United States. And recently, Turkey has now offered the US airbase access in order to better deal with the current operations.

<http://www.defensenews.com/story/defense/air-space/2015/07/28/turkey-may-renegotiate-air-defense-deal-china/30782109/>

## **The International Brigade to be Activated in Poland This Year**

Jul 26, 2015

Headquartered in Lublin, Poland the brigade will command three infantry battalions totaling 4500 soldiers- from Poland, Lithuania and Ukraine, based in each of the member countries. The Brigade will be tasked with peacekeeping and stabilization operations, as directed by the European Union and United Nations. The international brigade will increase Kiev's cooperation with Eastern European countries. The new formation will help infuse western standards and methodologies into the Ukrainian military, paving the way to closer integration of NATO standards.



[http://defense-update.com/20150726\\_litpolukrbrig.html#.VbdCvv7wuJA](http://defense-update.com/20150726_litpolukrbrig.html#.VbdCvv7wuJA)

<http://www.defence24.pl/240464,lithuanian-polish-ukrainian-brigade-is-being-born-relevant-memorandum-concluded>

## **Polish President Signs a Legal Act That Increases The Defence Spending**

Polish President, Bronisław Komorowski, signed an act which is going to increase the level of Polish military spending. The expenditure is going to reach an amount equivalent to least 2% of the Polish GDP. The new Act would also implement a 10 years planning period and a 4-year long development programming cycle, the aim of which is to plan development of the Polish Army in line with the requirements maintained by the NATO alliance. The increase of defence spending up to the value equal to 2% of the GDP also constitutes a realization of the commitments made during the NATO Summit in Newport.

Works on the bill which increases the military spending up to the level of 2% of GDP began last year, after President Komorowski's statement made during the Barack Obama's visit to Poland. The statement referred to the increased funding which would be provided for the Polish Army.

<http://www.defence24.com/240186,polish-president-signs-a-legal-act-that-increases-the-defence-spending>

## **Lockheed Martin Receives \$1.5 Billion Missile Interceptor Deal**

July 24, 2015 – United States and allied military forces are set to upgrade key missile defense capabilities under a new \$1.5 billion contract for production and delivery of Patriot Advanced Capability-3 (PAC-3) missiles and PAC-3 Missile Segment Enhancement (PAC-3 MSE) missiles.

The contract includes PAC-3 and PAC-3 MSE interceptor deliveries for the U.S. Army, and Foreign Military Sales of PAC-3 interceptors, associated equipment and spares for the Republic of Korea, the Kingdom of Saudi Arabia, Qatar, Taiwan and the United Arab Emirates.

The PAC-3 Missile is a high velocity interceptor that defends against incoming threats including tactical ballistic missiles, cruise missiles and aircraft using hit-to-kill technology. PAC-3 currently provides missile defense capabilities for six nations – the U.S., the Netherlands, Germany, Japan, United Arab Emirates and Taiwan; and Lockheed Martin is on contract with four additional nations – Kuwait, Qatar, South Korea and Saudi Arabia.

<http://www.lockheedmartin.com/us/news/press-releases/2015/july/mfc-072415-lockheed-martin-receives-1-5-Billion-missile-interceptor-deal.html>

## **Lockheed Martin Receives \$174 Million Contract for ATACMS Missile Production**

May 13, 2015 – Lockheed Martin received a \$174 million Foreign Military Sales (FMS) contract for Army Tactical Missile System (ATACMS) production for the U.S. Army and the United Arab Emirates.

ATACMS is the U.S. Army's only tactical long-range precision-strike surface-to-surface weapon system.

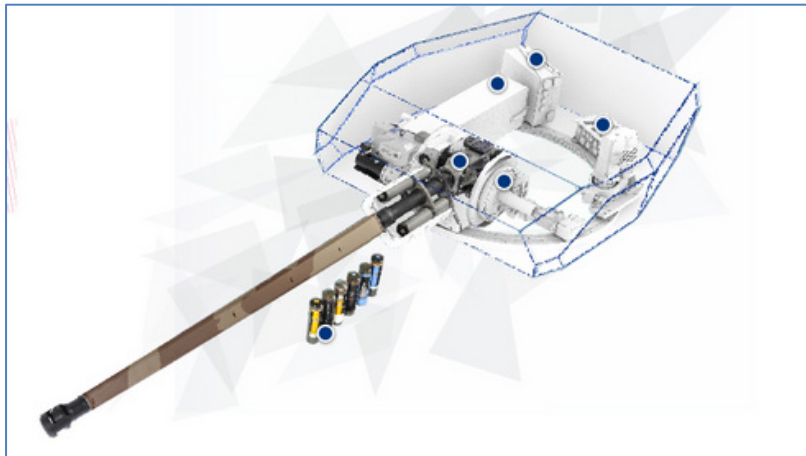
More than 570 ATACMS missiles have been fired in combat and the system has demonstrated extremely high rates of accuracy and reliability while in theater. Each ATACMS missile is packaged in a Guided Missile Launch Assembly pod and is fired from the MLRS family of launchers. ATACMS is currently in the inventory of multiple nations, including the Republic of Korea, Greece, Bahrain, Turkey and the United Arab Emirates. Lockheed Martin has produced more than 3,700 ATACMS missiles over the last 20 years.

<http://www.lockheedmartin.com/us/news/press-releases/2015/may/mfc-051315-lm-receives-174million-contract.html>

### **Cased Telescoped technology enters production phase**

CTA International (CTAI), the joint venture between BAE Systems and Nexter, has been awarded a £150m contract from the UK Ministry of Defence (MoD). The contract for 40mm Cased Telescoped Cannons for the UK's Scout and Warrior Capability Sustainment Programmes, will be the first time that this state-of-the-art munitions technology has gone into full production. The programme will see CTAI deliver a total of 515 Cased Telescoped Cannons over seven years, with the first cannons scheduled for delivery in mid-2016.

The revolutionary design provides a weapon that is both powerful and compact with low intrusion, allowing the munitions to be fired at high elevation and on the move. This capability will give the British Army increased flexibility to use their new vehicles in different theatres.



"This contract, which signals the commencement of full production scale output of the 40mm cannon system, represents a significant milestone on this journey and when incorporated on the UK vehicles, will provide a step change in the fire power capability for the British Army.

The qualified cased telescoped ammunition for the UK MoD is also manufactured by BAE Systems Munitions at its Glascoed and Washington

facilities in the UK. The next phase is the completion of the certification testing for the high explosive General Purpose Rounds: Point Detonation (GPR –PD) and Air-burst (GPR-AB).

[http://www.baesystems.com/article/BAES\\_183437/](http://www.baesystems.com/article/BAES_183437/)

### **General Dynamics Awarded Contracts Totaling \$126 Million for Hydra-70 Rocket Program**

General Dynamics Ordnance and Tactical Systems was recently awarded two contract modifications by the U.S. Army Contracting Command in Redstone Arsenal, Ala., for production of the 2.75"/70mm Hydra-70 air-to-ground rocket system for U.S. military services and Foreign Military Sales customers. Hydra-70 is a family of unguided rockets offering several warhead configurations that enable an aircrew to match the rocket to the specific mission. Rockets can be fired from a variety of rotary and fixed-wing platforms, including the U.S. Army Apache and U.S. Marine Corps Cobra attack helicopters, the U.S. Air Force F-16 Fighting Falcon and combat aircraft of many nations worldwide. General Dynamics has been in continuous production of Hydra-70 rockets since 1996.

[http://www.generaldynamics.com/news/press-releases/detail.cfm?customel\\_dataPageID\\_1811=20034](http://www.generaldynamics.com/news/press-releases/detail.cfm?customel_dataPageID_1811=20034)

## **U.S. Navy Awards Lockheed Martin \$24 Million in Contracts for Enhanced Laser Guided Training Rounds**

June 8, 2015 – Lockheed Martin received \$24.2 million in contracts from the U.S. Navy to produce Enhanced Laser Guided Training Rounds (ELGTR), a cost-effective alternative to using operational laser-guided bombs (LGB) during training.

ELGTR emulates the flight characteristics of Paveway<sup>TM</sup> II laser-guided weapon systems and presents pilots with the same information they would see in an actual mission.

The award represents the third order under the 2013 ELGTR contract. Lockheed Martin has produced more than 140,000 advanced training rounds for the U.S. Navy, Marine Corps and international customers since LGTR production began in 1992.

<http://www.lockheedmartin.com/us/news/press-releases/2015/june/mfc-060815-us-navy-lockheed-martin-contract-elgtr.html>

## **Raytheon secures JSOW order from US Navy, Saudi Arabia**

The US Navy has ordered 555 AGM-154 Joint Stand-Off Weapons (JSOW) from Raytheon for \$180 million for itself and Saudi Arabia, according to a recent contract announcement.

The navy's \$58 million order is for 200 units of the latest C-1 version, which is currently in operational testing on the Boeing F/A-18E/F Super Hornet ahead of its roll-out to operational units in 2016. Saudi Arabia is buying 355 standard Block III C-models for \$123 million.

Raytheon JSOW programme director Celeste Mohr says operational testing is ongoing, and is currently in the captive-carry flight test phase at the Department of Defense's China Lake and Point Mugu test ranges in California. A series of free flights will take place some time between September and December.

JSOW C-1 adds a Link 16 datalink and an improved seeker for in-flight re-targeting and strikes on moving vessels at sea. When launched from 40,000ft, the weapon has a range of 70nm (130km) and a 10min flight time, during which its flight path can be updated.

<http://www.flightglobal.com/news/articles/raytheon-secures-jsow-order-from-us-navy-saudi-arabia-415061/>

## **Saab Receives SEK270 Million (\$31.4M USD) Order for RBS 70 Missiles**

Saab has received an SEK270 million order for the delivery of RBS 70 missiles and additional equipment and training from an undisclosed customer. Deliveries will occur between 2015 and 2016.

The Saab portfolio of short-range ground-based air defence missile systems includes the RBS 70 and the further enhanced RBS 70 NG. The RBS 70 system has an impressive track-record on the market with more than 1,600 launchers and over 17,000 missiles delivered to 19 countries.

<http://saabgroup.com/Media/news-press/news/2015-06/saab-receives-sek270-million-order-for-rbs-70-missiles/>

## **Saab Receives NLAW anti-tank weapon Order From Finnish Defence Forces**

Saab has received an order from the Finnish Defence Forces for the NLAW anti-tank weapon. The contract value is approximately EUR32 million (approximately SEK295 million) and deliveries will take place during 2015.

In 2007 Finland ordered the NLAW, becoming the second export customer for the short range anti-tank weapon. Finland has now ordered an additional number of NLAWs.

Saab's NLAW (Next generation Light Anti-tank Weapon) is a shoulder-launched, anti-tank missile system that attacks the target from above. This makes it the most effective anti-tank weapon for dismounted light forces operating in any environment, including built-up areas. Originally developed for Sweden and Great Britain, it meets all requirements for a modern anti-tank weapon system for use during international operations as well as for national defence.

<http://saabgroup.com/Media/news-press/news/2015-06/saab-receives-nlaw-order-from-finnish-defence-forces/>

## **Saab Receives EDA Order for Carl-Gustaf Ammunition**

Saab has signed a SEK127 million (corresponding to MEUR13.6) contract with the European Defence Agency (EDA) to deliver Carl-Gustaf ammunition to Agency member states Estonia, Latvia, Lithuania, the Czech Republic and Poland. Deliveries will take place during 2016.

This order is the first to be agreed under the framework agreement signed by the EDA and Saab in 2014, allowing for the co-ordinated purchase of Carl-Gustaf ammunition by the five participating member states. In July 2014 Saab and the European Defence Agency (EDA) signed a framework agreement to support potential orders and deliveries of Carl-Gustaf ammunition to Estonia, Latvia, Lithuania, the Czech Republic and Poland. The agreement is in effect for five years with a possible extension of two further years. The framework provides for potential orders of approximately SEK460 million.

As a true multi-role, man-portable shoulder-fired weapon, the Carl-Gustaf system is currently in use with more than 40 countries worldwide. The reusable system has a long and successful history and stands in a class of its own as a modern and capable ground support weapon. The Carl-Gustaf has been progressively enhanced and adapted to meet new requirements. In 2014 Saab introduced the latest M4 variant which incorporates a host of lightweight, flexible and intelligent design features. The Carl-Gustaf system is part of Saab's wide range of battlefield weapons that deliver a flexible capability so that troops can remain agile and effective in any scenario.

<http://saabgroup.com/Media/news-press/news/2015-06/saab-receives-eda-order-for-carl-gustaf-ammunition>



## Science and Technology

### **SM-2 Missile Explodes Shortly After Launch from a Guided Missile Destroyer**

Jul 23, 2015

The USS The Sullivans (DDG-68) guided missile destroyer was damaged by a surface-to-air missile that exploded shortly after launch during an exercise off the U.S. Atlantic coast on Saturday USNI Reports.

The US Navy confirmed that a Raytheon made Standard



Missile-2 test missile exploded after suffering a malfunction as it was fired from the guided-missile destroyer USS The Sullivans (DDG 68) during a planned missile exercise off the coast of Virginia. There were no injuries and only minor damage to the port side of the ship resulting from missile debris. The ship returned to Naval Station Norfolk for assessment.



The Navy said an investigation into the malfunction has been ordered and is being conducted by the Navy's Program Executive Office for Integrated

Warfare Systems, which is part of Naval Sea Systems Command.

[http://defenseupdate.com/20150723\\_sm2\\_launch\\_failure.html#.VbdGh\\_7wuJA](http://defenseupdate.com/20150723_sm2_launch_failure.html#.VbdGh_7wuJA)

### **Certifiable Predator B (CPB) – Redesigned for the European Taste**

Addressing the concern of restrictions of operating MQ-9 Reaper drones over Europe, due to the fact that this drone has not been certified to fly over civilian airspace, General Atomics Aeronautical Systems, Inc. (GA ASI), the drone's manufacturer is developing a variant of the Predator B Remotely Piloted Aircraft (RPA) to be certified for flight according to the NATO Airworthiness Standard for unmanned aircraft.

Four European air forces have already selected the Predator B RPA. The UK and France are operating these drones overseas (in the Middle East and Africa), while the Netherlands ordered the drones but cannot operate them in country. Italy is the only European country operating the drones in its airspace. Germany, Spain and Poland also consider buying such RPAs but have reservations about their ability to fly them in Europe.

This new model, known as 'Certifiable Predator B' (CPB) will receive certification-compliant wings and redesigned tails, both are expected to complete flight-testing late in 2015. The wings span 79 feet and enable over 40 hours of flight time for the aircraft. The company also has also applied for FAA Type Certification and is working with the FAA to develop Unmanned Aircraft Systems (UAS) airworthiness standards. The development of the system follows international airworthiness standards that include STANAG 4671, UK DEFSTAN 00970, SAE ARP4754A, MIL HDBK-516C, DO-178, and DO-254, as well as others.

[http://defense-update.com/20150615\\_certifiable-predator-b-cpb-redesigned-for-the-european-taste.html#.VbdICv7wuJA](http://defense-update.com/20150615_certifiable-predator-b-cpb-redesigned-for-the-european-taste.html#.VbdICv7wuJA)

### **A first in Europe: the FREMM Aquitaine fires a naval cruise missile from MBDA 20/05/2015**

The frigate Aquitaine, the first unit in the multi-mission frigate program (FREMM), has successfully fired its first missiles: an Exocet MM40 surface-to-surface missile and a naval cruise missile. The missiles were fired respectively on 12 and 19 May on the firing ranges of the DGA missile testing centre off Levant Island. This is the first time that a European surface ship has fired a European cruise missile.

The two synthesis firings prepared by the crew of the French Navy, the DGA teams and manufacturers MBDA and DCNS are part of the verification of the technical capabilities of the FREMMs before entry into active service. This is another major milestone, after the firing of an Aster 15 anti-aircraft missile in 2013 and the commissioning on March 13 of the MU 90 lightweight torpedo on the Caiman marine helicopter, the naval version of the NH90 helicopter.

<http://www.mbda-systems.com/mediagallery/#/news/3493>

## **Latest Evolution Of Lockheed Martin Laser Weapon System Stops Truck In Field Test; Demonstration Represents Highest Power Ever Documented by a Laser Weapon of its Type**

March 3, 2015 – Lockheed Martin's 30-kilowatt fiber laser weapon system successfully disabled the engine of a small truck during a recent field test, demonstrating the rapidly evolving precision capability to protect military forces and critical infrastructure.

Known as ATHENA, for Advanced Test High Energy Asset, the ground-based prototype system burned through the engine manifold in a matter of seconds from more than a mile away. The truck was mounted on a test platform with its engine and drive train running to simulate an operationally-relevant test scenario.

"Fiber-optic lasers are revolutionizing directed energy systems," said Keoki Jackson, Lockheed Martin chief technology officer. "We are investing in every component of the system – from the optics and beam control to the laser itself – to drive size, weight and power efficiencies. This test represents the next step to providing lightweight and rugged laser weapon systems for military aircraft, helicopters, ships and trucks."



The demonstration marked the first field testing of an integrated 30-kilowatt, single-mode fiber laser weapon system prototype. Through a technique called spectral beam combining, multiple fiber laser modules form a single, powerful, high-quality beam that provides greater efficiency and lethality than multiple individual 10-kilowatt lasers used in other systems.

ATHENA is based on the Area Defense Anti-Munitions (ADAM) laser weapon system developed by Lockheed Martin, which has been proven in demonstrations against small airborne and sea-based targets. It incorporates the 30-kilowatt Accelerated Laser Demonstration Initiative (ALADIN) fiber laser also developed by the company.

<http://www.lockheedmartin.com/us/news/press-releases/2015/march/ssc-space-athena-laser.html>

## **MBDA DEUTSCHLAND SUCCESSFULLY DEPLOYS LASER EFFECTOR AGAINST A MINI DRONE**

**17/06/2015**

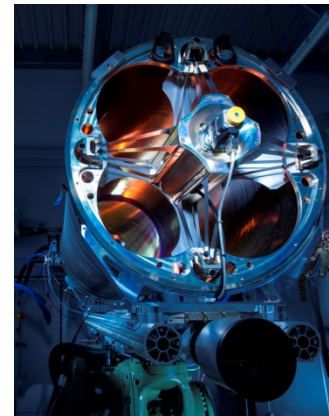
In May 2015, MBDA Deutschland deployed a laser effector to acquire, track, and defeat a free-flying mini drone, the first time such technology has been used to this effect. The mini drone was destroyed within seconds of the start of the test which was carried out at MBDA Deutschland's testing area in Schrobenhausen. The drone in question maneuvered in the target area at a range of about 500m with the test proving the laser effector's capability to combat realistic targets with precision, speed and safety.

Commercial mini drones represent a new type of threat that is nearly impossible to counter with conventional effectors. In 2013 a mini drone crashed at a distance of only two meters from German Chancellor Angela Merkel and other dignitaries during an election campaign event being held in Dresden, Germany. In France alone, more than 60 overflights by such craft over strategically significant locations have been reported since October 2014 and just recently an unauthorized drone landed on the US White House lawn. Highly precise and scalable laser weapon systems could protect major events and critical infrastructures and close a current capability gap.

At the heart of MBDA Deutschland's technological approach is a multi-stage, highly precise tracking procedure and laser effector that bundles numerous laser sources into a single laser beam using the principle of geometric coupling. These processes make it possible to combat small, highly agile targets reliably with a single laser effector.

MBDA Deutschland has proven the functionality of its laser effectors in a range of tests. As far back as 2012, MBDA Deutschland demonstrated the full operational sequence, from target acquisition to target engagement, at distances of up to 2.5 km against a dummy mortar.

<http://www.mbda-systems.com/mediagallery/#/news/3511>



(for another perspective on related technologies, see <http://www.defensenews.com/story/defense/policy-budget/warfare/2015/07/28/us-militarys-bomb-techs-fear-flying-ieds/30747275/>)

### **Automating the Armory: New Weapons Tracker Successfully Tested**

Feb. 18, 2015 – A new, advanced weapons maintenance system developed by Lockheed Martin and Visible Assets, Inc. that manages, diagnoses and tracks sensitive assets such as munitions could potentially save military departments millions by automating the time-consuming process of weapons tracking.

The system, the RuBee® Weapon Shot Counter, addresses the challenge of tracking sensitive munitions remotely. Traditional radio frequency identification (RFID) tags can't always be read or accessed through metals, liquids and other materials; they're also subject to eavesdropping by those wanting access to information about munition supply. In contrast, RuBee operates on the electromagnetic spectrum, rather than the RF spectrum, and is not subject to these deficiencies.

Before the creation of RuBee, munitions at armories had to be tracked manually in a labor intensive process. Early findings from a recent pilot program testing the system with U.S. Navy expeditionary forces found that the system could potentially save a single armory millions of dollars in labor charges annually through automation.

During the multi-phased pilot program, tags were embedded in select Naval assets to track weapon performance and diagnostic data.. RuBee successfully provided maintenance and diagnostic data, such as number of rounds fired, rate of fire and calculated barrel temperature. The diminutive sensors also detected performance anomalies, such as gas port erosion and cracked bolts, before they led to potential weapon failure.

<http://www.lockheedmartin.com/us/news/press-releases/2015/february/automating-the-armorynewweapontrackersuccessfullytestedbyusnava.html>

### **Gulfstream Commemorates Collier Trophy Win With City-Pair Record – this business jet connects Paris With Washington, D.C., At Mach 0.90**

June 4, 2015 — Gulfstream Aerospace Corp. today announced that its flagship aircraft, the [G650ER](#), set a city-pair record en route to Washington, D.C., Monday to commemorate the company's 2014 Robert J. Collier Trophy win.

The ultra-long-range G650ER departed Paris-Le Bourget Airport, flew into an average 58-knot headwind and arrived at Washington Dulles International Airport 7 hours 50 minutes later. The aircraft accomplished the 3,869-nautical-mile/7,165-kilometer journey at an average speed of Mach 0.90.

The G650ER entered service in November 2014 and travels farther faster than any other business jet in the world. The aircraft can fly 7,500 nm/13,890 km at Mach 0.85 and 6,400 nm/11,853 km at Mach 0.90. (Just think of how efficient MSIAC could be using one of these to support our country visits...)

[http://www.generaldynamics.com/news/pressreleases/detail.cfm?customer\\_dataPageID\\_1811=19998](http://www.generaldynamics.com/news/pressreleases/detail.cfm?customer_dataPageID_1811=19998)

### **Experimental US Drone Sets Flight Record**

A US experimental drone has set a record for the longest continuous flight of a craft of its size, staying in the air for three days, the International Aeronautical Federation said.

The Orion prototype long-endurance unmanned aerial vehicle, similar to the well-known Predator and Reaper style drones used by the US military, flew for 80 hours two minutes and 52 seconds, according to the data validated by the federation. The feat actually took place in December over California, when four pilots took turns flying the craft designed to carry a payload of cameras, weapons or other equipment of more than one ton. It shattered the previous UAV flight record of 30 hours, belonging to the Global Hawk by Northrop Grumman. The overall record for flight duration by a UAV belongs to a small solar powered craft built by Airbus that carried out a 14-day flight in 2010.

<http://www.defensenews.com/story/defense/air-space/2015/07/16/experimental-us-drone-sets-flight-record/30273295/>

(Recall last year we reported the solar-powered, high-altitude long endurance (HALE) UAV previously known as the [Qinetiq Zephyr](#) set a few records too. <http://www.gizmag.com/zephyr-uav-civil-test-flight/34010/>)



## NUSHIP Adelaide commences sea trials

NUSHIP Adelaide, one of two Landing Helicopter Dock (LHD) ships being built for the Royal Australian Navy (RAN), left BAE Systems Williamstown (17 June) to begin sea trials. After some initial trials in Port Phillip Bay, NUSHIP Adelaide will spend ten days on the water travelling to Sydney. The current testing precedes a second period of sea trials in August, ahead of delivery to the Royal Australian Navy (RAN) later this year.

The LHDs are the largest warships ever to be built for the RAN. As the prime contractor, BAE Systems has worked closely with the Defence Materiel Organisation to deliver the project with subcontractors Navantia, which constructed the hulls in Spain, SAAB and L3 which supplied the combat and communications systems respectively.



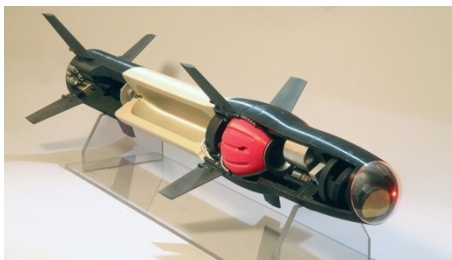
[http://www.baesystems.com/article/BAES\\_183012/](http://www.baesystems.com/article/BAES_183012/)

## Machines Making Machines: Printing Missiles

Jul 19, 2015

Researchers have already printed 80 percent of the components that go into a missile, including warhead and seeker components, rocket motors and electronic circuits. The goal is to print more complicated circuits in three dimensions, with the very high resolution and performance of silicon.

Researchers at Raytheon Missile Systems say they have already created nearly every component of a guided weapon using additive manufacturing, more commonly known as 3-D printing. With commercially available high-end equipment and specially modified versions of low-cost 3-D printers, company researchers have created nearly every component of a guided weapon using 3-D printing, including rocket engines, fins, parts for the guidance and control systems, and more.



The progress is part of a company wide push into additive manufacturing and 3-D printing, including projects meant to supplement traditional manufacturing processes. Engineers are exploring the use of 3-D printing to lay down conductive materials for electrical circuits, create housings for the company's revolutionary gallium nitride transmitters, and fabricate fins for guided artillery shells.

A cutaway model showing the printable components of a small missile. Photo: Raytheon

The process may reduce costs associated with traditional manufacturing, such as machining of parts. It allows for quick design and rapid changes because engineers only need change the digital model representing the part. As long as they stay within set parameters, they can have new parts in hours instead of weeks.

An array of mid-missile rocket boosters built with 3-D printing fire in this image taken from video. Photo: Raytheon

"You can design internal features that might be impossible to machine," said Raytheon engineer Travis Mayberry, who is researching future uses of additive manufacturing and 3-D printing. "We're trying new designs for thermal improvements and lightweight structures, things we couldn't achieve with any other manufacturing method."



One of the new areas in weapon 3D printing is warhead design and manufacturing. Warhead designers attempt to create blast effects that meet specific criteria. "Once you get into detonation physics you open up a whole new universe," James Zunino, a materials engineer for the U.S. Army Armament Research, Development and Engineering Center (ARDEC) said.

The limits on what can be produced using machine tools limit warhead shapes. By lifting limitations through the expanded capabilities that come with additive manufacturing, space is used more efficiently. "The real value you get is you can get more safety, lethality or operational capability from the same space," Zunino said.

These innovative additive manufacturing processes bring together printed metals, printed energetics and other materials, layered onto substrates into the components that comprise an "initiation train" in explosive warheads. "You can vastly simplify the manufacturing of energetic materials by printing them," Zunino said.

A major contribution of 3-D printing is its potential to streamline the manufacturing process, said Leah Hull, additive manufacturing manager for Raytheon.

"Ensuring consistent production integrity will be part of the next steps to realize this vision," said Dr. Teresa Clement, a Raytheon materials expert who also serves as the chair of the executive committee of America Makes, an initiative of the National Additive Manufacturing Innovation Institute. Other printed elements include complex electronic circuits – Engineers at the Raytheon University of Massachusetts Lowell Research Institute are developing ways to print such circuits, particularly microwave components – the building blocks of sophisticated radars. The current method of building microscopic circuits involves removing material to create a circuit pathway. In contrast, 3-D printing lays down just the material needed to build the electronic pathway.

Circuits can already be printed with inkjet printers. The goal is to print more complicated circuits in three dimensions, with the very high resolution and performance of silicon.

"There's currently a hierarchy in our manufacturing. We make the structures, the housings, the circuit cards, with the right materials, and then we integrate them into a system," said McCarroll. "What we see in the near future is printing the electronics and printing the structures, but still integrating. Eventually, we want to print everything together. An integrated system."

Engineers at the research institute are already able to lay down the conductors and dielectrics needed for printed electronics. They can even lay down carbon nanotubes, tiny structures made of linked carbon atoms, and are working to align them to build futuristic circuits.

So could soldiers someday print and assemble missiles on the spot, in the same way that artillery crews custom-load their rounds or weapons handlers mount guidance kits on some types of bombs? McCarroll said that's still a ways off.

"Before a warfighter can print a missile in the field," he said, "you need quality, controlled processes to fabricate all the component materials: the metallic strongbacks, and the plastic connectors, the semiconductors for processors, and the energetics and propulsion systems. The hard part is then making the connections between these components, as an example, the integrated control circuit that receives the command to light the fuse. At some relatively near-term point you may have to place chips down and interconnect them with printing. Or, in the future, maybe you'll just print them."

3D printing of missiles and warheads will allow engineers to utilize complex geometries and patterns that previously could not be produced or manufactured, driving missiles and warheads to be lighter, smaller, more compact and more affordable. It will also enable focused lethality, rendering warheads more effective, thus reducing collateral damage risk.

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