SHEPHARD

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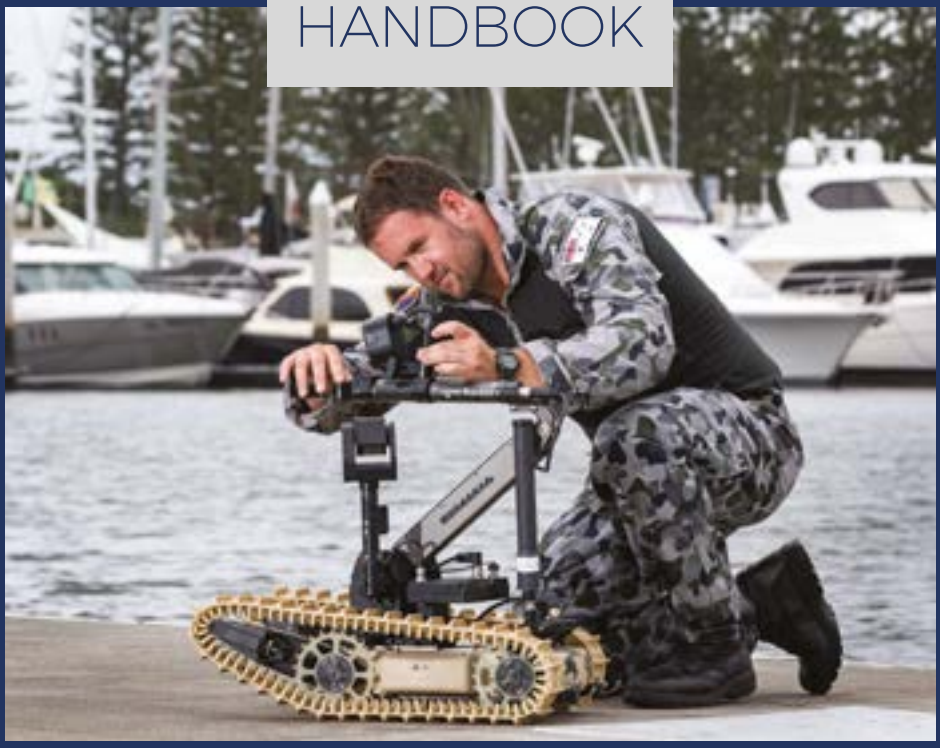
HANDBOOK



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THE CONCISE GLOBAL INDUSTRY GUIDE

MILITARY UNMANNED SYSTEMS


SCHIEBEL
CAMCOPTER® S-100
SCHIEBEL
UNMANNED
Wide Area
Patroller
MULTI-SENSOR PERFORMANCE

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COVER: A Royal Australian Navy clearance diver checks a Dragon Runner EOD UGV during training activity in support of the 2018 Gold Coast Commonwealth Games. (Photo: Australian DoD)
ABOVE: A Canadian soldier practises using the Raven-B UAV during Exercise *Pièces Aguérries 2*, in the training areas of CFB Valcariter in Quebec in October 2017. (Photo: Canadian Armed Forces)

SPECIFICATIONS

UAVs

This section includes most military UAVs and unmanned combat air vehicles (UCAVs) that are currently under development or in production worldwide.

Entries are arranged nationally, then alphabetically by manufacturer and system name. The specifications are supplied by the OEMs. Further information can be obtained by contacting these companies directly.

In accordance with current thinking, ballistic or semi-ballistic vehicles, cruise missiles and artillery projectiles are not considered to be UAVs, and are therefore not included.

If your company produces UAVs that you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure your system appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: A US Army specialist prepares to launch a Puma UAV near Al Tarab, Iraq. (Photo: US Army)

China ▸ China Aerospace Science and Technology Corporation (CASC) ▸ CH-802

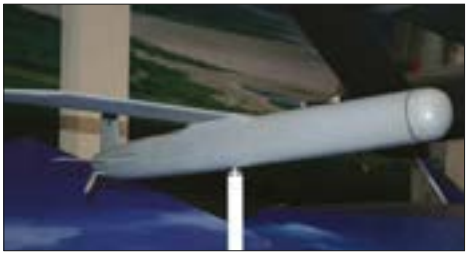
Fixed-wing micro air vehicle intended for surveillance and reconnaissance missions. **Applications:** tactical reconnaissance **Length:** 1.8m **Wingspan:** 3m **Max speed:** 49kt **Cruise speed:** 32.4kt **MTOW:** 6.5kg **Cruising/operational altitude:** 980-3,280ft **Recovery:** skid **Payload weight:** 1kg **Launcher:** hand or bungee catapult **Range - mission radius:** 30km **Ceiling:** 13,100ft **Endurance:** 2.5h **Status:** available

China ▸ China Aerospace Science and Technology Corporation (CASC) ▸ CH-803

Fixed-wing UAV for reconnaissance and surveillance missions. **Applications:** reconnaissance and surveillance **Length:** 1.8m **Payload:** various **Wingspan:** 3m **Max speed:** 70kt **Cruise speed:** 43-59kt **MTOW:** 18kg **Ceiling:** 11,400ft **Endurance:** 5h **Cruising/operational altitude:** 1,640-4,920ft **Recovery:** parachute **Payload weight:** 3.5kg **Launcher:** catapult **Range - mission radius:** 50km **Status:** available

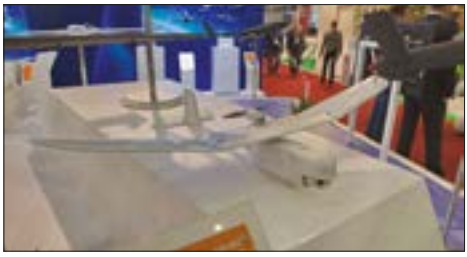
China ▸ China Aerospace Science and Technology Corporation (CASC) ▸ CH-901

CASC's CH-901 is a system capable of both reconnaissance and attack tasks. It is designed to equip a single solider or small combat unit and can be deployed for reconnaissance, monitoring and attack tasks. Its strike capabilities can be used against targets such as weapon launchers or armed personnel. The system is designed to be portable and easily assembled and deployed. **Length:** 1.5m **Height:** 0.6m **Wingspan:** 2m **MTOW:** 9kg **Endurance:** 1h **Ceiling:** 1500m **Launcher:** Container Launch **Recovery:** Glide (without warhead), No Recovery (with warhead)



China ▸ China Aerospace Science and Technology Corporation (CASC) ▸ CH-902

CH-902 is CASC's hand-launched surveillance and reconnaissance UAV. Its capabilities also include target positioning and border patrol and can be deployed in the context of urban combat, anti-terrorism campaigns, domestic order, traffic monitoring, weather and environmental detection. The system can be operated by an individual. **Payload:** EO and IR **Max speed:** 70km/h **MTOW:** 3.7kg **Launch setup time:** 3min **Launcher:** Hand-launcher **Recovery:** Deep stall **Cruising/operational altitude:** 4000m **Ceiling:** 200m **Range - mission radius:** 15km **Endurance:** 1.5h



China ▸ China Aerospace Science and Technology Corporation (CASC) ▸ CH-906A

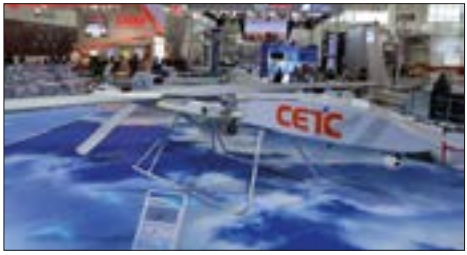
The CH-906A is characterised by its hover and reconnaissance capabilities. The system is suitable for low-level reconnaissance tasks and nuclear and gas detection. It has been designed for applications within a range of sectors including the military, police, fire and rescue, forestry and environment protection agencies. **Payload:** EO camera, IR camera, LLL camera **Max speed:** 32.4kt **MTOW:** 15kg **Launcher:** VTOL **Payload weight:** 5kg **Range - mission radius:** 10km **Endurance:** 50min **Cruising/operational altitude:** 300m

China ▸ China Aerospace Science and Technology Corporation (CASC) ▸ PW 2

PW 2 is a short/medium-range UAV for day and night surveillance and reconnaissance missions. It is the second member of the PW series. **Applications:** all-weather reconnaissance and surveillance, artillery fire correction, data relay, environmental monitoring, scientific research **Cruise speed:** 75-86kt for best endurance **MTOW:** 210kg **Ceiling:** 15,000ft **System components:** UAV, launcher, transportation vehicle, GCS, additional GSE **Launcher:** rocket-assisted from launcher **Recovery:** parachute **Guidance/Tracking:** autonomous, plus GPS mode **Data link:** real-time flight state telemetry and image signal transmission **Payload weight:** 30kg max **Endurance:** 8h **Range - mission radius:** 200km **Status:** in production

China ▸ China Electronics Technology Group Corporation (CETC) ▸ Mysterious Bee

The Mysterious Bee hybrid quadcopter UAV was unveiled at the Zhuhai Air Show 2016. The fixed-wing aircraft can take-off and land on ships, small islands, mountainous areas and other complex terrain. It can be mounted on a visible-light camera, IR imager and other mission payloads to execute various military applications, including ship escort, battlefield surveillance and island patrol. **Max speed:** 75.6kt-86.4kt **MTOW:** 280kg **Recovery:** VTOL **Launcher:** VTOL **Payload weight:** 50kg **Range - mission radius:** 800km **Ceiling:** 9,843ft **Endurance:** 6h **Data link:** 200km LoS link



China ▸ Joyton ▸ Axiom P

Axiom P is a military-standard, rugged UAS with a carbon-fibre composite framework designed to operate in hostile environments. The system has a three-axis gimbal for stable and flexible imaging, GCS and an optional wireless beacon device. The UAV comes equipped with a 10x optical-zoom RGB and high-resolution thermal sensors which provide real-time long-distance HD video. The Axiom P can be utilised for a range of tasks including civil security, border control, anti-terror operations, fire scene examinations, critical infrastructure inspections, radiation monitoring and post-disaster relief operations. **Length:** 75cm **Power:** 18650 Li-ion battery **Cruise speed:** 30km/h **MTOW:** 6.6kg **Range - one way:** 8-10km **Guidance/Tracking:** GPS/INS, optional RTK **Endurance:** 40-45min

EQUIPMENT

UAV ENGINES

The following section provides data on a selection of engines produced for UAVs.

Entries are arranged nationally, then alphabetically by manufacturer and engine name.

The specifications are those supplied by the OEMs. Further information can be obtained by contacting these companies directly.

If your company produces engines which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure your system appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: 49th Aircraft Maintenance Squadron airmen hoist an engine cover panel onto an MQ-9 at Holloman AFB in New Mexico during surge operations in May 2017. (Photo: USAF)

3W INTERNATIONAL

3W-110i B2

The 3W-110i B2 is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 11.12hp Weight: 3.1kg including ignition Max torque: 12.54Nm

3W-110xi B2 TS HFE FI

The 3W-110xi B2 TS HFE FI is an air-cooled two-cylinder engine with four ball bearings, designed for long life. The soft running characteristics contribute to reliability. Power: 7.1hp at take-off Weight: 4.9kg Torque at take-off: 8.07Nm Fuel system: fuel injection Max torque: 8.4Nm Displacement: 110cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests considered Ignition system: 3W electronic with auto timing

3W-110xi B2 TS Rear

The 3W-110xi B2 TS Rear is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. Also available with fuel injection upon request. Power: 9.92hp Weight: 3.1 kg incl ignition Max torque: 11.60Nm

3W-112i B4 FI

The 3W-112i B4 FI is an air-cooled four-cylinder engine, designed for long life, with its running characteristics and twin-spark technology contributing to system reliability. Power: 9.17hp Weight: 3.9 kg including ignition Max torque: 9.97Nm

3W-140xi B4 TS FI

The 3W-140xi B4 TS FI is an air-cooled four-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. Power: 10.94hp Weight: 4kg including ignition Max torque: 12.59Nm

3W-157xi B2 TS

The 3W-157xi B2 TS is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 19.12hp Weight: 4.1kg including ignition Max torque: 20.98Nm

3W-157xi B2 TS HFE FI

The 3W-157xi B2 TS HFE FI is an air-cooled two-cylinder engine, designed for a long life. Running characteristics and twin-spark technology contribute to reliability. Power: 11.56hp at take-off Weight: 6kg Torque at take-off: 10.27Nm Fuel system: fuel injection Max torque: 13.2Nm Displacement: 157cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests are considered Ignition system: 3W electronic with auto timing

3W-170xi B2 TS

The 3W-170xi B2 TS is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 19.12hp Weight: 4.1kg including ignition Max torque: 20.98Nm

3W-170xi B2 TS HFE FI

The 3W-170xi B2 TS HFE FI is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to its reliability. Power: 12.24hp at take-off Weight: 6kg Torque at take-off: 15.3Nm Fuel system: fuel injection Displacement: 170cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests considered Ignition system: 3W electronic with auto timing

The running characteristics and twin-spark technology of 3W International's 3W-34xi contribute to its reliability, according to the company. (Photo: 3W International)

3W-180 SRE

3W-International presented its new 3W-180 SRE Hybrid Wankel Engine for the first time at AUVSI Xponential in Dallas in March 2017. The engine can be fuelled by petrol or kerosene and is equipped with two cooling systems: a water-cooling circuit cools the engine housing while an oil-cooling circuit undertakes the internal cooling of the piston. The 3W-180 has a 180cc capacity and the high-power version at 7,500rpm delivers 38.5hp. The engine can be modified to be equipped with two drive pulleys. Through the doubling of the swept volume, the power of the engine is doubled to 76hp in the high-performance variant. The engine can be used as a petrol and heavy-fuel engine. Power: 20KW at 6000rpm Weight: 6.8kg, 9.5kg (with generator) Power to weight ratio: 5.66hp/kg Max torque: 32Nm at 6000rpm Ignition system: starter generator Cooling: water-cooled housing ans oil-rotor cooling

3W-210xi B2 TS HFE FI

The 3W-210xi B2 TS HFE FI is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. Power: 14.75hp Weight: 7.4kg Torque at take-off: 15.52Nm Fuel system: fuel injection Max torque: 17.9Nm Displacement: 210cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests considered Ignition system: 3W electronic with auto timing

3W-210xi TS

The 3W-210xi TS is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 18.25hp Weight: 5kg including ignition Max torque: 19.87Nm

3W-220xi B4 FI

The 3W-220xi B4 FI is an air-cooled four-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to system

reliability. Power: 14hp Weight: 6.2kg including ignition Max torque: 18.9Nm

3W-275xi B2 TS

The 3W-275xi B2 TS is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 25.73hp Weight: 7kg incl ignition Max torque: 29.95Nm

3W-28i

The 3W-28i is an air-cooled one-cylinder engine, designed for long life. Its running characteristics and twin-spark technology contribute to reliability. The engine is also available with fuel injection upon request. Power: 2.9hp Weight: 1.2kg including ignition Max torque: 2.49Nm Max performance: 1500–8600rpm

3W-28i HFE FI

The 3W-28i HFE FI is an air-cooled engine designed for long life with high reliability. Power: 3.12hp at take-off Weight: 2kg Torque at take-off: 2.85Nm Fuel system: fuel injection Displacement: 28cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests considered Ignition system: 3W electronic with auto timing

3W-342i B2 TS

The 3W-342i B2 TS is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 32hp Weight: 8.8kg Max torque: 20.64Nm

3W-342i B2 TS HFE FI

The 3W-342i B2 TS HFE FI is an air-cooled two-cylinder engine, designed for a long life. Twin-spark technology and running characteristics contribute to reliability. Power: 25hp Weight: 12kg Torque at take-off: 23.73Nm Fuel system: fuel injection Max torque: 25.9Nm Displacement: 342cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests considered Ignition system: 3W electronic with auto timing

3W-34i TS HFE FI

The 3W-34i TS HFE FI is an air-cooled engine designed to provide long life with high reliability. Power: 3.4hp at take-off Weight: 2.1kg Fuel system: fuel injection Displacement: 34cc Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests considered Ignition system: 3W electronic with auto timing

3W-34xi

The 3W-34xi is an air-cooled one-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 3.12hp Weight: 1.3kg including ignition Max torque: 2.52Nm

3W-34xi TS HFE FI

The 3W-34xi TS HFE FI is an air-cooled engine designed to provide long life with high reliability. Power: 3.35hp Weight: 2.3kg Fuel type: Jet A-1; JP-5; JP-8; regular gasoline Max torque: 2.8Nm Fuel system: fuel injection Operating temperature range: 18°C

3W-370xi B2 TS HFE FI

The 3W-370xi B2 TS HFE FI is an air-cooled two-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. Power: 29hp Weight: 13kg Max torque: 28.33Nm Fuel system: fuel injection Displacement: 370cc Fuel type: jet A-1; JP-5; JP-8; regular gasoline Configuration: customer requests are considered Ignition system: 3W electronic with auto timing

3W-55xi TS

The 3W-55xi TS is an air-cooled one-cylinder engine, designed for long life. Running characteristics and twin-spark technology contribute to reliability. It is also available with fuel injection upon request. Power: 4.18hp Weight: 1.8kg including ignition Max torque: 6.57Nm

ROLLS-ROYCE

M250-C20W

Like the C20R series, the M250-C20W engine is based on the design of the C20B/J. The C20W differs from previous designs in that it is configured for exhaust-down configurations. Improvements to the C20W include first-stage turbine nozzle material, which extends component life and maintains the engine's performance. This and other improvements continue to decrease direct operating costs, while increasing the mean time between removals. All improvements can be implemented in the field. In March 2016, Enstrom Helicopter and Rolls-Royce signed a five-year agreement to provide M250 engines for the 480B helicopter, which serves as a military trainer and is in use for various civil applications. More than 220 M250-powered 480B helicopters are in service throughout the world. Features: good power-to-weight ratio and SFC, proven modular design Platforms: Enstrom 480, Fire Scout UAV Take-off power: 420shp

ROTRON POWER

RT300

The RT300 rotary engine is designed to deliver a high power-to-weight ratio in a compact and lightweight package, allowing fuel and payload flexibility. Suitable for small to medium UAV platforms, the RT300 offers low levels of torsional vibration and 'zero' radial vibration in the mid-to-high rpm range, contributing to durability and higher endurance life cycles. Length: 268mm Width: 170mm Height: 240mm Power: 32hp at 7,500rpm Weight: 11.9kg Features: electronic engine management; automatic altitude compensation; choice of generators; heavy fuel option Cooling: liquid Fuel system: electronic fuel injection via ECU Max performance: 7,800rpm Displacement: 300cc Configuration: single-rotor, Wankel-type, spark-ignition engine Max torque: 24lb/ft at 6,500rpm Fuel type: gasoline, AVGAS, JP-5, JP-8, Jet A1

RT300HFE

The RT300HFE rotary engine is suitable for small to medium UAV platforms. This compact, single-rotor engine utilises fuel management techniques to achieve reliability in operation, high power-to-weight ratio, low fuel consumption and starting under extreme operating conditions. The RT300HFE offers low torsional vibration and 'zero' radial vibration at mid-to-high rpm, contributing to durability and higher endurance life cycles. Length: 268mm Width: 170mm Height: 240mm Power: 31hp at 7,500rpm max, 29hp at 6,750rpm max continuous Weight: 11.9kg Cooling: liquid Features: heavy fuel engine, liquid-cooled, electronic engine management, automatic altitude compensation, choice of generators Power to weight ratio: 2.6hp/kg Displacement: 300cc Configuration: single-rotor, Wankel-type, spark-ignition engine Max torque: 23.2lb/ft at 6,500rpm Fuel type: JP-5/JP-8/Jet A1

RT600

The RT600 rotary engine is designed to deliver a high power-to-weight ratio in a compact and lightweight package, allowing fuel and payload flexibility. Suitable for small to medium UAV platforms, the RT600 offers low levels of torsional vibration and 'zero' radial vibration in the mid-to-high rpm range, contributing to durability and higher endurance life cycles. Length: 366mm Width: 170mm Height: 240mm Power: 61hp at 7,500rpm max, 52hp at 6,500rpm max continuous Weight: 21.2kg Cooling: liquid Features: electronic engine management; automatic altitude compensation; choice of generators Max performance: 7,800rpm Fuel system: electronic fuel injection via ECU Configuration: twin-rotor, Wankel-type, spark-ignition engine Displacement: 600cc Fuel type: JP-5/JP-8/Jet A1

RT600HFE

The RT600HFE rotary engine is suitable for small to medium UAV platforms. This compact, twin-rotor engine uses fuel management techniques to achieve reliability in operation, high power-to-weight ratio, low fuel consumption and starting under extreme operating conditions. The RT600HFE offers low levels of torsional vibration and zero radial vibration in the mid-to-high rpm range, contributing to durability and higher endurance life cycles. Length: 366mm Width: 170mm Height: 240mm Power: 61hp at 7,500rpm max, 52hp at 6,500rpm max continuous Weight: 21.2kg Cooling: liquid Features: heavy fuel engine, liquid-cooled, electronic engine management, automatic altitude compensation, choice of generators Power to weight ratio: 2.9hp/kg Displacement: 600cc Configuration: twin-rotor, Wankel-type, spark-ignition engine Max torque: 42.4lb/ft at 6,500rpm Fuel type: JP-5/JP-8/Jet A1

UAV ENGINES

AR682

The compact AR682 engine has been developed to power UAVs which have limitations on propeller diameter and therefore cannot use a reduction drive. Power: 75bhp nominal at 6,000rpm Weight: 51kg Features: low cross-sectional area; economic fuel consumption; low levels of vibration Displacement: 294cc per rotor Fuel type: regular grade (min 92 RON) MOGAS (leaded or unleaded) or AVGAS 100LL Configuration: twin-rotor, Wankel-type, spark-ignition engine Ignition system: fully duplicated 28V CD system with magnetic triggering firing twin plugs

AR682R

The AR682R has been developed to power UAVs which require up to 120bhp. It is based on the proven AR642 core that was designed to meet UK CAA/European JAR-E/US FAA FAR-33 certifications for manned flight. Power: 90bhp at 7,000rpm, alternatively 120bhp at 8,000rpm with EFI Weight: 51kg Features: high power-to-weight ratio; small frontal area; economical fuel consumption; low levels of vibration; integral lightweight belt-type reduction drive to propeller Displacement: 294cc per rotor Fuel type: regular grade (min 92 RON) Mogas (leaded or unleaded) or AVGAS 100LL Configuration: twin-rotor, Wankel-type engine Ignition system: fully duplicated 28V DC system with magnetic triggering firing twin plugs

AR731

According to UAV Engines, the AR731 has the highest power-to-weight ratio of any rotary engine in the world. It was specifically designed for use in small target drones and short-life UAVs. TBO is 10-50h depending on duty cycle. Power: 38bhp at 7,800rpm Weight: 9.9kg Features: electronic contactless magneto Displacement: 208cc Fuel type: MOGAS regular grade or AVGAS (100LL) Configuration: single-rotor, Wankel-type, spark-

ignition engine Ignition system: high power-to-weight ratio; small frontal area concentric to propeller axis; low specific fuel consumption allowing greater range or payload; low levels of vibration; tractor and pusher versions available

AR741

The AR741 was developed from the mature AR731 target drone engine to meet the needs of small surveillance-type UAVs. Power: 38bhp at 7,800rpm Weight: 10.7kg without generator Features: high power-to-weight ratio; economical fuel consumption; low cross-sectional area; low levels of vibration; long life Displacement: 208cc Configuration: single-rotor, Wankel-type, spark-ignition engine Ignition system: electronic contactless magneto; RFI suppressed HT system

AR801

The AR801 is an optimised, lightweight, single-rotor, liquid-cooled engine designed and developed for UAVs requiring 35-60bhp, with direct drive to the propeller or vehicle gearbox. It has the facility to mount alternators between 0.9 and 2kW. Power: 40bhp at 6,000rpm, alternatively 51bhp at 8,000rpm (carburettor) or 60bhp at 8,000rpm (EFI) Weight: 24.4kg with cooling system and generator Configuration: Wankel-type, single-rotor engine Ignition system: high power-to-weight ratio; economical fuel consumption; low levels of vibration; low cross-sectional area; long life Features: electronic CD type with magnetic triggering, 12 or 28V option, fully duplicated system firing spark plugs Displacement: 294cc Fuel type: regular grade (min 92 RON) MOGAS (leaded or unleaded) or AVGAS 100LL

AR801R

The AR801R is a lightweight, single-rotor, liquid-cooled engine with integrated reduction drive designed and developed specifically for UAVs requiring 35-55bhp. Power: 40bhp at 6,000rpm, alternatively 51bhp at 8,000rpm Weight: 29.5kg with cooling system and generator Features: electronic CD type with magnetic triggering; 12 or 28V option; fully duplicated system firing spark plugs Displacement: 294cc Fuel type: regular grade (min 92 RON) Mogas (leaded or unleaded) or AVGAS 100LL Configuration: Wankel-type, single-rotor engine Ignition system: high power-to-weight ratio; reduction drive giving high propeller efficiency; low levels of vibration; economical fuel consumption

UAV FACTORY USA

UAV28-EFI

The UAV28-EFI is a turnkey fuel-injected engine system developed for small UAVs with up to 25kg MTOW. The engine is particularly suitable for long-endurance UAVs with fuel consumption at 400g/kWh in cruise and low acoustic signature. An extra 20 minutes engine swap time allows maximising UAV flight time. The life of the engine is >500h and the engine comes calibrated and flight ready. Power: 2.1kW Weight: 1.5kg Speed at cruise: 1,600-8,500rpm Displacement: 28cc Fuel type: automotive 95+ octane

SPECIFICATIONS

UAV TEST RANGES

This section includes some of the most important ranges used for the development and testing of UAVs. Entries are arranged nationally, then alphabetically by the name of the facility.

Most of the specifications are supplied by the organisations or companies which operate these facilities. Further information can be obtained by contacting them directly.

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ABOVE: US Army soldiers assemble a Raven UAV at a training area near Orzysz, Poland, on 18 December 2017. (Photo: US Army)

Australia ▸ RAAF WRC

The Royal Australian Air Force's (RAAF's) Woomera Range Complex (WRC) includes the Woomera Test Range (WTR), located in the northwest region of South Australia, and is the largest military land range in the world, covering 122,000km². The WTR is part of the Aerospace Operational Support Group, headquartered at RAAF Edinburgh, South Australia. Woomera has an international reputation for its clear air – both in terms of its vast open airspace for manoeuvre and its 'quiet' electromagnetic operating spectrum. The range is operationally supported by an RAAF air base capability able to ramp up to operate all types of aircraft and domestically supported by a fully featured permanent support base for up to 500 deployed personnel. Woomera is now in demand for access to its specialised test environments supporting air, space and ground-based weapons systems testing; the conduct of hazardous material and EOD demolition and testing; and for other specialist and joint-force operational preparedness, simulation, testing and training activities. **Range name:** RAAF Woomera Test Range **Location:** South Australia **Operator:** RAAF **Airspace size:** 122,000km² and includes all the airspace over the range

Canada ▸ Foremost UAS Range

The Foremost UAS Range is an area of restricted airspace, located near the village of Foremost, for UAS research and development or testing and evaluation for civil and commercial purposes. With 2,400km² of restricted airspace up to 18,000ft above sea level, the Foremost UAS Range can be used for BVLOS flight operations as well as development and evaluation of payloads, communications and sense and avoid technologies for BVLOS flights. In addition to airspace access and range services, including a newly constructed hangar, the site will provide companies with the following services through its service provider network: Special Flight Operations Certificate (SFOC) applications; assistance completing SFOC applications for UAV operations, including those specifically for UAV operations at the Foremost UAS Range; and UAS consulting services. In November 2016, the Foremost UAS Range received final Transport Canada authorisation to begin operations as Canada's first permanent restricted airspace for UAS research, development, testing and evaluation for civil and commercial applications.

Canada ▸ UAS CE/CED

The UAS Centre of Excellence/Centre of Excellence on Drones (UAS CE/CED) is located at Alma, 175km north of Quebec City, Canada. The site was officially launched in mid-2011 and has been flying UAVs since March 2012. With over 80 such flights to its credit, the centre has flown UAVs in non-segregated airspace (Class B) in a BVLOS configuration. The centre offers access to over 120,000km^2 of restricted airspace to accommodate all sizes of UAVs. More than 20 companies and agencies are involved in the development of the centre, working to demonstrate how UAVs can be used for civil applications, such as remote inspection of pipelines and hydro-electric installations; surveillance of forest fires; observation of critical natural resources; assessment natural disasters; and a range of other tasks. The UAS CE supports R&D and flight testing. Maintenance, storage and modification hangars and shops are available on site to support UAV operators, as well as training facilities and equipment for pilots and support personnel. A new hangar and office space was added in 2013. **Range name:** Unmanned Aerial System Centre of Excellence/Centre of Excellence on Drones **Facilities:** maintenance, storage and modification hangars and shops, training facilities **Uses:** R&D and flight testing **Location:** Alma airport, 175km north of Quebec City **Airspace size:** 120,000km^2

Finland ▸ RATUFC

The Robonic Arctic Test UAV Flight Centre (RATUFC), part of Robonic, owned by Safran Group, operates in Finnish Lapland. RATUFC operates as a complete turnkey service for clients. This includes supporting applications to Finnish regulators on behalf of potential clients to secure all required flight operations permits. The range was commissioned in mid-2006. Systems flown at the range to date include Sperwer A and B tactical UAVs, the Patroller UAV and the Leonardo Falco tactical UAV. Finnish Lapland is the largest remaining wilderness in Europe; the remote location provides good security for test activities. Harsh winter conditions provide a testing environment claimed to be unmatched in continental Europe, covering extremes of cold as well as dryness. With the congested airspace of Central and Western Europe constraining UAV operations, the open environment provided by RATUFC is well positioned to be an important focal point for the development of new systems by Europe's aerospace and defence industries. The range is also available to support airborne scientific research in Arctic environments. **Facilities:** Basic airfield facilities in good condition are available, as well as a weather station and reliable high-speed internet. This service allows for test flights at the range to be monitored in real time by the client's own personnel located at their home corporate facilities. RATUFC also handles all logistics elements from lodging to transport, allowing the customer to remain focused solely on test flying. Support facilities at Kemijärvi, 15min from the airfield, include hotels and local amenities. **Airspace size:** access to 11,000km^2 of airspace above the Arctic Circle, equivalent to half of Belgium in overall size **Range name:** Robonic Arctic Test UAV Flight Centre **Operation/opening times:** supports year-round

operations by civil and military clients, mild summer weather provides 20h of continuous sunlight **Runway:** 1,400x23m sealed **Uses:** supports any test operation with ATC liaison and airfield operations personnel **Location:** Kemijärvi, an hour's flight north of Helsinki and 90km east of the town of Rovaniemi **Operator:** Robonic

EQUIPMENT

UAV LAUNCHERS

This section includes a selection of UAV launchers. Entries are arranged nationally, then alphabetically by manufacturer and product name.

The specifications are supplied by the OEMs. Further information can be obtained by contacting these companies directly.

If your organisation produces UAV launchers which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure your product is included in the new Shephard Plus online database (shephardplus.com) and appears in the next print edition.

ABOVE: A US soldier inspects the launcher of an RQ-7B Shadow drone before launch during the *Integrated Training* Exercise in October 2017. (Photo: USMC)

ALCORE TECHNOLOGIES

Lightweight Catapult

The Lightweight Catapult is made in aluminium and powered by an elastic power band. It is easy to transport and tow by car. The system is armed and bandaged with an electric winch, which is remote-controlled. The trolley is launched with the aircraft and separated during the first second of flight. The speed/power can be adapted with the number of rubber bands. Length: 6m Height: 1m Weight: 180kg Launch type/mechanism: rubber band and electric bander Setup time: 15 min, easy to link trailer on car for transportability, single-axle trailer for European legislation Launch speed: 90km/h, adjustable speed

Portable launching system

This portable launching system is adapted for models like Azimut MK 2. The aircraft is driven on short carbon pipes, with a rubber band fixed in front of the carbon drives. The autopilot can be engaged just after the launcher phase. Length: 2.4m Width: adjustable to UAV Height: 0.4m Weight: 6kg Launch type/mechanism: rubber band Setup time: 20min, easy to install; model on the shelves; technical assistance for design UAV adaptations Launch speed: 31.4km/h, adjustable speed

ARCTURUS UAV

Portable Launching System

Arcturus's Portable Launching System is a pneumatic catapult that can launch UAVs up to 90kg MTOW. The system is lightweight, portable and simple to operate. Launch rods act as pistons in a 4.9m-long, low-pressure launch tube. Compressed air or nitrogen propels the launch rod and airframe to flying speed. Launchers are available as portable units that break down to pieces no longer than 1.83m for transport in two transit cases. Individual launcher components can be picked up by one person. It takes one person ten minutes to assemble the system. Length: 4.88m deployed Weight: 79kg assembled Crew: 1 for setup and launch Launch type/mechanism: pneumatic

ARIES INGENIERIA Y SISTEMAS

Atlas ME-01

The high-pressure Atlas ME-01 pneumatic launcher is designed to launch medium-weight UAVs up to 150kg MTOW. The system can be mounted on a small trailer for transport and launch operations. Length: 8.8m deployed Width: 2m Height: 2.5m Weight: ~2,000kg Crew: 2 Launch type/mechanism: pneumatic Launch speed: 28m/s

Bull EL-01

The Bull EL-01 lightweight bungee launcher is designed to launch light UAVs up to 8kg. The launcher can be disassembled into two parts for backpack carriage. Length: 2m deployed Width: 0.4m Height: 0.7m Weight: 10kg Crew: 1 Launch type/mechanism: bungee Launch speed: 15m/s

Hercules AH-01

The Hercules AH-01 high-pressure pneumatic launcher is designed to launch UAVs of up to 500kg MTOW. Air-transportable (C-130/A400M) and ISO20 palletised structure. Low maintenance cost claimed. Length: 14.4m Width: 2.44m Height: 2.43m Weight: ~7,000kg Crew: 2 Launch type/mechanism: high-pressure pneumatic Setup time: <45min Launch speed: 65m/s

Hercules-Lite

The Hercules-Lite pneumatic launcher is designed to launch lighter UAVs (up to 300kg). Length: 14.4m deployed Width: 2.44m Height: 2.43m Weight: ~6,000kg Crew: 2 Launch type/mechanism: high-pressure pneumatic Setup time: <45min Launch speed: 34m/s

LAE

The LAE is capable of launching 400kg UAVs at maximum speeds of 70m/s by using high pneumatic pressure. Length: 24m deployed Width: 2.4m Height: 2.4m Weight: 14,000kg Crew: 2 Launch type/mechanism: high-pressure pneumatic Setup time: 10h Launch speed: 70m/s

ELIMCO

UAV Foldable Catapult

The Elimco UAV Foldable Catapult is designed to launch small UAVs. The launcher is packed in a rigid case for transport. Status: in production Length: 4m, 2.2m when folded Weight: 35kg Launch type/mechanism: rubber band Launch speed: 33kt for 20kg UAV

HOOD TECHNOLOGY MECHANICAL

Mark 4

The trailer-mounted Mark 4 is the latest of Hood's launch systems, developed to accommodate the need for multiple aircraft types. The Mark 4 makes use of composite and metallic materials to provide users with a rugged machine built for harsh environments including shipboard launch. The Mark 4 is the launcher for the Insitu RQ-21A Blackjack and in early 2013 completed USN sea trials. Status: in production since 2010 Length: 6.4m deployed, 4.3m packed Width: 0.9m deployed/packed Height: 1.5m deployed/packed Launch speed: 62kt

Superwedge HP

The Superwedge High Pressure (HP) launcher, the successor to the Superwedge, provides more launch energy to achieve higher launch speeds and/or to handle heavier UAVs. It is built on the same chassis as the earlier Superwedge, and provides the same mobility, stability, footprint, ruggedness and mode of operation. Length: 4.9m deployed, 3.7m packed Width: 0.9m deployed/packed Height: 3.7m deployed, 1.8m packed Launch speed: 62kt

QINETIQ TARGET SYSTEMS

Hercules

The Hercules UAV launcher can launch a 250kg UAV at a speed of 55m/s, using a low-pressure pneumatic system accelerating along the 16m folding launch rail. The Hercules launcher shuttle accepts a range of custom adapters for different UAVs. A differential hydraulic drive system aids manoeuvring at the launch site and independently controlled hydraulic support legs provide a kneeling facility to allow a degree of levelling. The launcher is operated by one person from a remote

US marines with a Marine Expeditionary Unit load an RQ-21 Blackjack UAS onto a STUAS Launcher during the *Combined Composite Unit Training* Exercise on 9 November 2017. (Photo: USMC)

control panel mounted on a UK Individual Vehicle-Approved single-axle trailer with pneumatic suspension, brakes and a NATO tow hitch. Length: 11.06m in towing configuration, 16.28m with rail extended Width: 2.26m Height: 2.9m in launch configuration, 2.65m in towing configuration Weight: 6,000kg Crew: min 1 for launch Launch speed: 107kt Launch controls: remote Launch type/mechanism: pneumatic

Lightweight Catapult

The Lightweight Catapult is the smallest launcher in the QinetiQ Target Systems (formerly Meggitt Defence Systems) range. It is powered by elastic power bands. The unit, which may be folded for transport, has the ability to launch air vehicles of up to 20kg MTOW at speeds of over 39kt. The free-standing system may be fitted with a remote-controlled electric starter. Launch type/mechanism: rubber band Launch speed: 39kt

Mk IV KEC

The Mk IV KEC catapult launcher has been in production for almost 30 years, during which time more than 100 have entered service. It is generally used to launch air vehicles up to 100kg in weight at speeds of more than 58kt. It is a three-piece, foldable rail made from tubular steel mounted on top of a two-wheeled trailer for transportability. Powered by up to 20 elastic power bands each of 3,600N, the launcher can operate in temperatures from -20˚C to +50˚C. The launch rail is usually positioned on the top of a trailer unit but can also be used as a free-standing unit or fitted on a 4t truck or similar vehicle. For transport, the system fits inside a standard 20ft ISO container. Single-axle trailer meets 2014 European legislation. Length: 11.8m with rail extended Launch speed: 58-68kt dependent on target weight and number of power bands fitted

ROBONIC

Kontio (MC2555LLR)

The Kontio high-pressure pneumatic launcher is a member of Robonic's third-generation launcher family designed as a universal solution to support tactical UAVs and target drones of up to 500kg in temperatures from -30˚C to +45˚C. It provides a wide speed and weight envelope for operation with various UAVs of different configurations, including propeller- and turbine-powered. Adjustable launching pressure allows the Kontio to provide variable take-off speeds optimised to UAV types and missions. The closed pneumatic system allows system pressures to recover quickly, reducing the gap between individual launches. A launch lock system helps extend the UAV's lifespan by reducing stresses on the airframe, onboard electronics and optronic payloads. The Kontio is trailer-mounted for transport and storage and can be packed into a standard 20ft ISO container. Robonic launchers currently support operational deployment of the Sperwer family of UAS and is used to launch the LMUIS Fury and intended to support the RUAG Ranger and supports most major types of target drones including the Airbus DO-DT family, Meggitt Banshees and Voodoo, and the CEi Firejet. Flights have been conducted with the Elbit Hermes 450 and Leonardo Falco. Over 15 different air vehicles have been launched from the Kontio. Robonic also supports air vehicle and launcher interface (adapter) design and manufacture as well as integration of the air vehicle on the launcher and into the UAV system. Robonic has integrated in excess of 20 different air vehicles on to its Kontio launcher. On 30 October 2017, Robonic announced they had been contracted to deliver a third-generation Kontio pneumatic launcher to the Swedish Defence Materiel Administration (FMV) for use at its Vidsel test range. Delivery is scheduled to take place before the end of 2017. Country: Finland Length: 16.7m deployed Width: 2.27m Power: 1.5mW Weight: ~5,000kg Crew: min 1 for launch Launch type/mechanism: pneumatic Setup time: <15min Launch speed: 39-136kt depending on UAV

Karhu (MC015015)

The MC0315L Karhu pneumatic launcher, a member of Robonic's third-generation launcher family, is designed to launch small UAVs and light target drones

of up to 40kg, whether propeller- or jet-powered. A wide envelope of mass and launch speeds are supported through the use of adaptors, enabling new operational roles and missions to be supported. The launcher is used to launch the Avartek AT-04 and the Meggitt Snipe. The launcher is equipped with its own compressor, making it self-sustaining for operations. Alternatively, nitrogen-filled high-pressure air vessels can be used if required. It has been designed to field-deploy under wide temperature extremes (-20/+50˚C) with minimal maintenance requirements. Country: Finland

OHTO (MC1555LLR)

The Robonic OHTO high-pressure pneumatic launcher is a fourth-generation zero-point pneumatic launcher with a wide envelope in launch mass and exit velocity. Part of the family of multi-purpose UAV launchers from Robonic, the OHTO is designed to launch various tactical systems as well as target drones in varying climatic and operational conditions. The rapid relaunch capability makes it suitable for any operation where time to operate or relaunch are critical. The launcher can be transported in a 20ft ISO container, towed by an SUV or sling loaded with an NH90 helicopter. Robonic also supports air vehicle and launcher interface (adapter) design and manufacture as well as integration of the air vehicle on the launcher. Length: 16m deployed, 5.4m with tow bar retracted, 7.4m for tow configuration Width: 2.1m Height: 1.9m Weight: <3,500kg Crew: min 1 for launch and set-up Launch type/mechanism: Pneumatic Setup time: <10min Launch speed: 150kg at 106kt, 300kg at 77kts

UAV FACTORY USA

6kJ Portable Pneumatic Launcher

Designed for launching UAVs up to 35kg in weight, such as UAV Factory Penguin B/BE/C, in temperatures from -20˚C to +50˚C. It features a rugged aluminium structure which can be disassembled into a man-portable transportation case. UAV Factory can provide a one-day operator and maintenance training course. Packed Size: 1313 x 704 x 543 mm Length: 4m rail Power: 11-16V DC Weight: 110kg packed Launch type/mechanism: pneumatic Launch speed: 44.7kt

12KJ Portable Pneumatic Launcher

The 12KJ Portable Pneumatic Launcher is designed for launching UAVs up to 60kg in weight, in temperatures from -20˚C to +50˚C. It features a rugged aluminium structure, which can be disassembled into a man-portable transportation case. UAV Factory can provide a one-day operator and maintenance training course. Packed size in two cases is 1313x704x543mm. Length: 6m rail Power: 11-16V DC Weight: 1st case 80kg, 2nd case 85kg Launch type/mechanism: pneumatic Launch speed: 44.7kt

VTUL A PVO PRAHA

OP1

Take-off launcher powered by rubber ropes that has been designed for fixed-wing aircraft weighing up to 10kg. Launcher can be disassembled into four parts and for transport folded to the size of 2,450×200×230mm. Country: Czech Republic Launch speed: 75km/h

The Hercules UAV launcher can propel a 250kg UAV at a speed of 55m/s, using a low-pressure pneumatic system accelerating along the 16m folding launch rail. (Photo: Qinetiq Target Systems)

ZODIAC ARRESTING SYSTEMS AMERICA

HP 2002

The HP 2002 launcher is based on launch technologies and components utilised in ESCO's family of UAV launchers and specifically leveraged from the larger HP 3003 launcher. It is designed to launch UAVs with an MTOW of 45-113kg. The HP 2002 consists of a modified HMMWV trailer, mounting pallet, launch rail assembly, shuttle and UAV interface, launcher controls and launch power source. The self-contained power source is a closed-loop hydro-pneumatic system designed to provide the requisite performance at low ambient temperatures and altitudes significantly above sea level. Crew: 2 Launch type/mechanism: pneumatic Setup time: 10min with 2 crew Launch speed: 65kt

HP 3003

The HP 3003 launcher is designed to launch UAVs with an MTOW of 68-240kg at launch velocities up to 75kt. The components are assembled on a modified HMMWV Model LTT-HC trailer. The launcher consists of the trailer, launch rail assembly, shuttle and UAV interface, launcher controls, and a self-contained launch power source. The power source for launch is a closed-loop hydro-pneumatic system, which stores energy when dry nitrogen is compressed in an accumulator by pumping in hydraulic fluid. The hydraulic pump is driven by a multi-fuel engine. Crew: 2 Launch type/mechanism: pneumatic Setup time: 10min with 2 crew Launch speed: 75kt

HP 3004

The HP 3004 launcher, based on a modified Model LTT-HC HMMWV trailer, is designed to launch UAVs with a 68-295kg MTOW. The launcher consists of the trailer, launch rail assembly, shuttle and UAV interface, launcher controls and a self-contained launch power source. The power source is a closed-loop hydro-pneumatic system, which stores energy when dry nitrogen is compressed in an accumulator by pumping in hydraulic fluid. Weight: 2,540kg Crew: 2 Launch type/mechanism: pneumatic Setup time: 15min Launch speed: up to 75kt

EQUIPMENT

GROUND CONTROL STATIONS

The following section provides data on a selection of ground control stations (GCS) produced for UAVs and other unmanned platforms.

Entries are arranged alphabetically by country, manufacturer and product name.

The specifications are those supplied by the OEMs. Further information can be obtained by contacting these companies directly.

If your company produces equipment which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: A British Army soldier pilots a Desert Hawk UAV from a remote-control unit in Afghanistan. (Photo: UK MoD/Crown Copyright)

AERO SURVEILLANCE

ASG T150

The AGS T150 is a fully integrated transportable GCS designed for harsh environments, which is capable of controlling all AS and ASV RPA systems. The AGS T150's typical configuration includes two HD (1080p) rugged displays – one assigned for C2 and one assigned for onboard mission equipment; an integrated rugged computer with up to 2TB of solid state storage with multiple input-output options; COFDM video transceiver in Band S; multiple frequency options with H264 encoding; and a keyboard and dual joysticks to manually control aircraft and mission equipment. Length: 1,030mm Width: 500mm Height: 400mm Weight: up to 55Kg (depending on options) Power supply: AC or DC maximum 500W (configuration dependent) Features: automatic pointing antenna with up to 50km range (additional antenna options available, integrated FlyView Ground Control Software suite with multiple UAS C2 and mission sensor suite options.)

AERTEC SOLUTIONS

Ground Control Station (GCS)

Aertec Solutions' GCS has been designed with in-house technology and allows for various types of unmanned vehicles to be controlled from the system. This single common interface for the running of different systems offers advantages with operator training and management systems. The GCS is capable of gathering data recorded at each vehicle's location to transmit a unified compiled report through specific data transmission software, following a defined protocol.

ASELSAN

UxV Control Station

Aselsan's UxV Control Station is a C2 station applicable to all domains of unmanned vehicles: air, land and sea. The station complies with NATO standards and US interoperability profiles. The modular station can be used to control unmanned vehicles, monitor their status, dynamically plan tasks and communicate with C4I interfaces. Applications: UAV, UGV, UMV

BRVANT

BRV-GCS-01

The BRV-GCS-02 is a portable C2 station applicable to all domains of manned and unmanned vehicles. The design allows integration with other C2 stations and infrastructure that creates a communication relay and increases the integrated network point-to-point in mesh topology. Applications: UAV, UGV and USV management Crew: 1

BRV-GCS-02

The BRV-GCS-02 is a portable C2 station applicable to all domains of manned and unmanned vehicles. This design allows the management of up to four platforms at same time, integration with other C2 stations and infrastructure that creates a communication relay and increases the integrated network point-to-point or in mesh topology. Applications: UAV, UGV and USV management Crew: 1

DELTA DRONE

STaFF Solution

Delta Drone's STaFF solution was developed as a UAV-exclusive technology with night and day geo-referenced real-time mapping. This solution provides a real time local map on the Ground Control Station for flame front tracking, allowing upload on map-sharing platforms. It is particularly applicable for firefighter departments in case of forest and urban fires, floods and search for missing persons. The live feed can be shared between operators via 3G/4G or satellite data-links.

ECA GROUP

MAMBA

MAMBA is an IED and CBRN countermeasures system allowing the transport, deployment and control of UGVs or UAVs in hostile areas. A light manned vehicle for first intervention can be supplied as an off-road 4x4 or a small truck. MAMBA is a GCS for UGVs/UAVs and a vehicle for deploying ECA systems such as Cobra Mk 2 (I,E,C) and Cameleon (E,C) UGVs or IT180 UAVs as well as other companies' products. Its main features are: acts as GCS for several UGVs/UAVs at the same time; quick deployment for situation assessment, avoiding first responder exposure in hazmat areas; and detection of chemical and radiological emissions (depending on configuration). Applications: UGVs, UAVs

ELISTAIR

Safe-T

Safe-T is a tethered station for drones, designed to offer unlimited endurance and a safe data connection. Safe-T is suited to a range of applications, including surveillance of events, forest fire management, harbour monitoring, anti-poaching, pop-up telecommunications (4G, Wi-Fi, radio), traffic management (camera or radar based), and industrial Inspections. The cable allows vehicles to operate to an altitude of 100m. Integrated with various sensors, the Safe-T is able to continuously self-check its status and uses fail-safe procedures. On 17 October 2017, it was announced that Vodafone Group had tested the Elistair Safe-T tethering station to support the UAS-provision of 4G coverage in areas with no cellular coverage. A UAS tethered to the Safe-T station and equipped with a network device can fly for hours while offering coverage with no risk of interference in the network or loss of the UAS. Elistair Safe-T has been approved for tethered flights by French Civil Aviation. Applications: monitoring and observation Weight: 28kg

EMBENTION

NM& TS150

The NM& TS150 tether station powers multirotors directly from an on-ground power source using ultra-light cable and provides unlimited flight time up to 500ft high. An embedded Wi-Fi module provides system status information and is able to monitor and control the drone from any PC or Tablet and a high bandwidth Ethernet connection provides video and data transmission through the cable, enabling a two-way communications channel. In addition, the cable data transmission enables safe data communications,

The Globe UAV Groundstation is a 4G LTE mobile internet-based application with bidirectional data communication. (Photo: Globe UAV)

avoiding jamming attacks and data piracy and capture. The NM& TS150 tether station has a length and width of 63cm and a height of 36cm. Length: 63cm Width: 63cm Height: 36cm Weight: <60kg Platforms: UAS Power supply: 12V DC or 110-230V AC

GENERAL ATOMICS AERONAUTICAL SYSTEMS

Legacy GCS

The Legacy GCS is an RPA control centre, housed in a customer-furnished building and used to control GA-ASI aircraft. The GCS racks are installed on wheeled bases so that the system can be installed and secured within a building. The GCS is designed primarily for remote operations via a SATCOM data link. Features of the system include SATCOM and three multifunction workstations; a digital intercom system; an integrated UPS battery backup/power distribution system; and casters providing for movement within the facility with minimal equipment. The GCS is ideally suited for raised flooring environments (cooling, cable and power distribution).

STORM GCS

GA-ASI's Safety Tactical Operational Reliability Maintenance (STORM) GCS significantly improves the human-machine interface (HMI), ergonomics, and mission capability for operators, according to the company. STORM consists of a GA-ASI legacy Pilot/Payload Operator (PPO) GCS workstation equipped with a Linux PC hardware upgrade. This provides processing performance, reliability, ease of software coding, and a high-definition (HD) video software architecture backbone. HMI improvements include HD-integrated touch screen displays, as well as a video switching capability that allows aircrew to move any video source to any screen. A 24in display between the pilot and payload operator provides screen space for shared pilot/payload data such as weather, airspace, or any information of interest to both aircrew. Other ergonomic layout improvements include adjustable heated aircrew seats and adjustable rudder pedals. Features: PPO workstation equipped with 11 HD displays; pop-out monitors improve viewing angle for operators; upgradeable HOTAS featuring F-35/F-16 fighter controls; STORM cockpit hardware supports GA-ASI Advanced Cockpit GCS software (with open architecture)

GLOBAL INDUSTRIAL & DEFENCE SOLUTIONS (GIDS)

GIDS GCS and Communication Link Station

Air conditioned/insulated container. Features include: generator/UPS for power backup, standard equipment consoles, payload consoles, crew consoles for mission commander, internal pilot and payload operator, mission planning software suite, mission building module, inserting/editing waypoints on maps, mission monitoring software, video and data recording and launch and recovery of multiple UAVs from a single GCS.

GLOBE UAV

Groundstation

The Globe UAV Groundstation is a 4G LTE mobile internet-based application with bidirectional data communication. Applications that the Groundstation has been designed for include SAR first aid information, events, air surveillance, environmental flights and border protection. The Globe UAV GUAV7/8 Copters will automatically connect to the local Wi-Fi at the landing process and transmits high resolution data from the camera to the Globe UAV Groundstation. The GCS has variable flight modes including a GPS mode, the Click'n Fly mode where the drone flies to a designated location, Waypoint mode where the drone flies to predefined missions on its own, emergency mode which allows the user to command the copter to the inserted address and starting it within 15 seconds in standby mode, and an automatic take-off and landing mode. The Groundstation has an option for a thermal camera and night view camera mode, which enables flying at night. Optional safety components are also available for the Groundstation, including a laser obstacle avoidance system and an automatic parachute system.

INSITU

ICOMC2

The ICOMC2 allows one operator to manage multiple UAVs, uses a small-footprint, mobile hardware and supports known map data formats and RTSP and RTP video. The system features an open-architecture design that users can customise. Net-centric technology enables other services on the network to utilise system or payload data and allows operators to interact with services provided by other network-based applications outside of ICOMC2. The Augmented Video Overlay System lets operators overlay video with terrain elevation, satellite data, target identification, border information, acoustic detectability and AIS data all in a single picture. It also features a virtual camera mode and auto tracking mechanism so the operator can perform hands-off monitoring of roads, borders or base perimeters. Other features include cursor-on-target for networked target, track and vehicle route data; Common Route Definition (eCRD) allowing exchange of routes with third-party mission planners; MPEG2-TS with H.264 video and STD.0601.02 KLV Metadata; and SAE AS-4 JAUS-IOP to communicate with UGVs.

EQUIPMENT

COUNTER-UAS SYSTEMS

This section includes systems designed to jam, disrupt or destroy hostile UAS threats, both on the battlefield and in defence of critical infrastructure.

Entries are arranged alphabetically by manufacturer and system name. The specifications are those supplied by the OEMs. Further information can be obtained by contacting these companies directly.

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ABOVE: A USMC specialist with Marine Air-Ground Task Force-5 launches a C-UAS while conducting a Mechanized Assault Course at Twentynine Palms, California, on 30 October 2017. (Photo: USMC)

AARONIA

Aaronia DDS

Aaronia Drone Detection Software (Aaronia DDS) is able to detect UAS based on the directional real-time measurement of the EM emissions of the aircraft and its remote control. The only limitation of its detection range is the distance between the UAV and its operator. The Aaronia DDS gives a warning the moment the remote control is on air – before the UAS itself is airborne. The system is based on Aaronia's IsoLog 3D antenna, real-time spectrum analyser and RTSA suite software plugin. It provides early warning and, by recognising remote control profiles, can automatically jam UAS. The system comes in Single or Multiple Slide variants: Single comprises of a 3D DF antenna and a stationary or mobile spectrum analyser, suitable for a smaller area such as a home. The Multiple Slides variant consists of several antennas and analysers centralised by a monitoring PC, enabling triangulation of signals for tracking. An unlimited amount of receivers makes this variant suitable for larger areas, such as stadiums or industrial facilities. Frequency: 20MHz-6GHz Weight: 20kg (antenna) and 8.5kg (portable)/25kg (stationary) Detection equipment: RF Detection ranges: >1km Disruption method: jamming UAS control signal Features: auto-jam option, video link recording (as upgrade)

ASCENT VISION

Counter UAS Operator Assist

Operator Assist software contributes to force protection by utilising algorithms to detect and track objects in the air and on the ground. This increases the likelihood of detecting targets that go unnoticed by an unassisted operator. The automated detection software provides operators with live, real-time cues of target objects, with the aim of reducing decision time when identifying UAVs through more rapid identification, and helping operators make informed decisions whilst reducing error, fatigue and workload. The system includes algorithms for static and moving target detection. The moving target detector identifies objects in the FOV quicker than can be achieved manually by an operator. This shortens the decision cycle for the operator and allows them to prosecute a hostile target sooner. Operator Assist can track up to 200 targets simultaneously.

ASELSAN

Ihasavar

The Ihasavar anti-drone jammer system is designed to be a cost-effective, man-portable solution that does not need any sensor systems to disrupt hostile UAVs. The software-defined RF jammer system is based on the Kirpi manpack jammer, with the omnidirectional antennas removed and combined with a rifle-style device. Its high-gain directional antenna disrupts signals between the UAV operator and aircraft. Type: hand-held backpack Power: rechargeable Li-Ion batteries, up to 1.5h Weight: <14kg Features: over 100 jamming profiles can be programmed Disruption method: DDS-based FPGA-controlled swept jamming MIL Standards: MIL-STD-810

Ihtar

The Ihtar anti-drone system consists of radar, EO and jamming elements, available in fixed and deployable configurations against mini-UAS. It detects and tracks multiple UAS using a thermal camera, and has directional jamming capability for specific targets or omni-directional jamming for swarm attacks. Ihtar uses Aselsan's Gergedan IHA counter-UAS jammer, and is operated from a centralised C2 station. The system also uses Aselsan's ACAR radar as its primary surveillance sensor, which is capable of detecting and tracking UAVs during the day and night and in all weather conditions. Aselsan unveiled the Ihtar system at the High Tech Port by MÜSİAD exhibition in Turkey in November 2016. Detection equipment: radar, thermal camera Disruption method: direction/omni-directional jamming Radar: Ku-band pulse-Doppler radar with pulsed compression Features: automatic target tracking, scanning Detection ranges: 5km

BATS

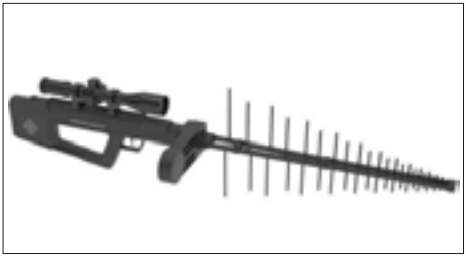
Drone Guard

Drone Guard consists of several COTS sensors, integrated via a C2 centre to provide an integrated solution for detection, identification, decision-making and eventual disruption of hostile UAS. The detection segment is based on 3D compact radars (AD26D or AD26B), capable of detecting and tracking. The radar provides the first layer of detection necessary to activate other parts of the protection suite. The identification segment comprises an EO system that is cued to the detected UAS for classification and identification. The EO system operates independently on a dedicated pedestal and is cued to the radar targets. The C2 segment enables the operator to make informed decisions based on the detection and identification layers and to elect to operate the flight disruption system. The flight disruption segment provides the typical countermeasure against the targets. These are activated from the C2 system based on inputs from the detection and identification layers. Countermeasures include cued jammer JAM12 to target threat elimination. Drone Guard is able to provide alerts and long-range protection. It is designed for 2km-plus detection ranges for small, low and slow flying objects. It is designed to effectively jam a Phantom UAV from 2km when the operator is 200m away from the air vehicle. Frequency: 433MHz/900MHz/1.575-1.620GHz (GNSS)/2.4GHz/5.8GHz Detection ranges: >2km (dependent on target RCS) Detection equipment: radar, EO/IR cameras Disruption method: jamming Radar: AD26B (transportable)/AD26D (portable) Camera: autonomous EO/IR (such as POP)

BATTELLE MEMORIAL INSTITUTE

DroneDefender

DroneDefender is a directed-energy UAS countermeasure that disrupts the adversary's control of the aircraft, neutralising it so that no remote action (including detonation) can occur, minimising platform damage and risk to public safety. DroneDefender can defend airspace up to an altitude of 400m against UAS without compromising safety or risking collateral damage. The lightweight, point-and-shoot system is described as requiring no extensive training and providing rapid disruption of unwanted UAS using remote control and GPS disruption. Country: USA Power: 5h battery life Disruption method: GPS disruption electronics



The Ihasavar software-defined RF jammer system is based on the Kirpi manpack jammer, with the omnidirectional antennas removed and combined with a rifle-style device. (Photo: Aselsan)

BLIGHTER SURVEILLANCE SYSTEMS

AUDS

The Anti-UAV Defence System (AUDS) is designed to disrupt and neutralise UAVs engaged in hostile airborne surveillance and potentially malicious activity. The AUDS system combines electronic-scanning radar target detection, EO tracking/classification and directional RF inhibition capability. AUDS is a smart sensor and effector package capable of remotely detecting small UAVs and then tracking and classifying them before providing the option to disrupt their activity. The system may be used in remote or urban areas to prevent UAVs being used for terrorist attacks, espionage or other malicious activities against sites with critical infrastructure. The system comes in three standard configurations: deployable (two-mast system, one with radar and the other with RF and EO systems), field mast and fixed (with containerised control station). AUDS brings together a consortium of UK defence companies. Blighter's A400 series air security radars are able to detect small UAVs in all weather conditions, 24 hours a day flying in urban areas or near to the horizon. The company states the system can detect a UAV the size of a DJI Phantom at a range of 3.6km. The Chess Dynamics Hawkeye EO/IR camera system, using a long-range colour camera and a high-sensitivity TI, along with video tracking technology, is able to track the UAV and, combined with radar target information, classify the target. The operator is then able to make an informed decision to use the Enterprise Control Systems smart RF inhibitor to selectively interfere with the C2 channels on the UAV, allowing the system to disrupt the UAV's mission. The smart RF inhibitor uses directional antennas to achieve maximum range of operation with minimum collateral effect. In January 2017, it was announced that the AUDS UAV defence system reached TRL-9 capability, following its deployment and testing with US forces. The company said a system has also been tested at an airport in North Africa and testing is also under way at US airports under the guidance of the FAA. Applications: disrupt and neutralise UAVs Frequency: Ku-band, GNSS Frequency: high-gain quad-band antenna system (penta-band 5.8GHz option) FOV: azimuth coverage: 180° (standard) or 360° (optional). Elevation adjustment: -40° to +30° using optional Blighter Radar Tilting System (BRTS) Detection ranges: 10km Radar: E-scan FMCW Doppler surveillance radar Detection equipment: Piranha 46 HR camera, thermal camera, EO video tracker, optical disruptor (option), micro-Doppler radar, IR camera

CACI INTERNATIONAL

SkyTracker

SkyTracker detects, identifies, tracks, and mitigates UAS threats. The system provides continuous, 24-hour automated monitoring in all weather conditions. It can identify and locate both the UAS and its ground operator, and initiate countermeasures that do not interfere with legitimate electronics or communications systems in the area, or with UAS that are being lawfully operated. The system also creates an electronic perimeter boundary around sensitive locations.

DEDRONE

DroneTracker

The DroneTracker platform provides airspace monitoring and management through a browser interface. DroneTracker allows users to configure multiple sensors, active and passive countermeasures, and alerts for automatic 24/7 operation. The software displays real-time airspace information and detects and identifies UAVs with analysis and pattern recognition capabilities. Defensive measures against hostile UAS can be activated automatically, with security service providers notified as appropriate. It is available as a modular configuration dependent on customer needs. Frequency: X-band 9-650MHz Detection equipment: RF sensor, radar Detection ranges: RF sensor 1,000m, Radar 3-9km Disruption method: jamming system with HP DDS Sweep; counters GPS, GLONASS, Galileo, WLAN 2.4GHz and from 5,000-6,000MHz

DELFT DYNAMICS

DroneCatcher

DroneCatcher is a counter-UAS detection system, designed to support military and commercial missions, including protecting military bases, airports, prisons and parliament buildings. The multicopter system is armed with a netgun and can safely remove illicit drones from the air. DroneCatcher has an endurance of 30min and has been designed with multiple onboard sensors, a laser rangefinder and a track and trace system. The counter detection can also be paired with Delft Dynamics' GCS that is equipped with velocity control and waypoint control. Height: 350mm Weight: <6kg Detection ranges: <20m

GENERAL DYNAMICS LAND SYSTEMS

MEHEL 2.0

The Mobile Expeditionary High Energy Laser (MEHEL) is a counter-UAS capable vehicle that employs directed energy to neutralise targets. MEHEL 2.0 was first seen at AUSA 2016, with General Dynamics Land Systems developing the system in partnership with Boeing and US Space and Missile Defense Command. The 5kW laser is mounted on a Stryker armoured vehicle with the system operating autonomously. Fitted with an EW system, radar with K-band Acquisition Tracking System (KATS), the vehicle can go out by itself to conduct C-UAS missions separate from the network. A Maneuver Aviation Fires Integrated Application (MAFIA) integrates the systems and provides the mapping and FCBC2 friend or foe identification. The US Army demonstrated the C-UAS capability of the MEHEL 2.0 during the Joint Improvised-Threat Defeat Organization

SPECIFICATIONS

UGVs

This section includes major UGVs that are currently in production or in development around the world.

Entries are arranged nationally, then alphabetically by manufacturer and system name. The specifications are those supplied by the OEMs. Further information can be obtained by contacting these companies directly.

If your company produces UGVs which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure your system appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: A Talon robot is operated by US soldiers during Exercise *Vanguard Proof 17* at Pocek Range in Postonja, Slovenia. (Photo: NATO)

Austria ▸ Taurob ▸ Taurob Tracker

Taurob Tracker is a UGV for hazardous missions and is ATEX directive-certified to operate in explosive atmospheres. It is in operational use by fire departments but also intended for military applications. The system is IP67 waterproof and therefore easily decontaminated after use. It operates using Taurob's universal control device, remotely stationed to protect humans from harmful materials, atmospheres or unsafe structures. Camera feedback informs tactical decisions. Fire hoses attached can reduce the danger source in many cases. **Applications:** hazardous environment UGV missions **Length:** 1m **Width:** 58cm **Height:** 42cm **Weight:** 60kg **Max speed:** 7km/h **Max slope:** 40° **Features:** manipulator arm, fire hose, cameras **Clearance min and max:** 35cm obstacles **Mission radius/range:** 500-1,000m LOS **Operating temperature range:** -20/+60°C **Weight with payload:** 85kg

Brazil ▸ BRVANT ▸ BRV-UGV-01

The BRV-UGV-01 is designed to get immediate situation awareness in real time to C2 stations. The throwable robot has a high mobility is equipped with a universal payload adapter and a modular concept and interface. **Applications:** reconnaissance and surveillance **Weight:** <2.23kg **Payloads:** day/night zoom camera, thermal imagers, chem/bio sensors, mini robotic arm, laser pointer and customised sensors **Status:** available

Canada ▸ Allen-Vanguard Canada ▸ Defender

The Defender ROV is a large bomb disposal robot constructed from titanium with heavy lifting capability. It has been designed to deal with changing threats while retaining core capabilities to extend operating parameters of current EOD requirements. It can be deployed in CBRNE situations to carry detection equipment. **Applications:** EOD, CBRNE **Length:** 1.52m stowed **Width:** 0.73m stowed **Height:** 1.15m stowed **Weight:** 275kg (without accessories) **Max speed:** 3.25km/h **Tracks/wheels:** independent 6-wheel drive **Climb:** 20cm stairs at 45° **Endurance:** 5hr depending on mission **Payloads:** colour CCD front-drive camera, colour CCD rear-drive camera, pan/tilt camera with 40x zoom, colour CCD camera on claw, adjustable B&W CCD turret camera with IR illumination, moveable B&W CCD auxiliary camera **Status:** in production

Canada ▸ Allen-Vanguard Canada ▸ Vanguard

The Vanguard UGV is designed to provide mission support for EOD technicians in both law enforcement and the military. It can be deployed in EOD/IED incidents where access is restricted, such as the aisles of aircraft and buses and underneath vehicles. The most recent upgrade to the Vanguard, a digital command system, has made it interoperable with the larger Defender. Both UGVs share the same digital communications telemetry and are operated with the same command console. **Applications:** EOD **Length:** 1.04m stowed **Width:** 0.45m stowed **Height:** 0.56m stowed **Weight:** 56kg (without accessories) **Max speed:** 2.25km/h **Payloads:** cameras – colour CCD drive camera, pan/tilt camera with 40x zoom, colour CCD camera on claw, articulated arm with 6 axes of movement **Arm reach:** up to 2.27m **Endurance:** up to 5h depending on mission **Tracks/wheels:** 2 independent tracks with anti-flip device **Climb:** 20cm stairs at 45° **Status:** in production

Canada ▸ Clearpath Robotics ▸ Clearpath Jackal

Launched in September 2014, Jackal is a small, portable, integrated and weatherproof UGV. It has been built on a metal chassis and has four wheels and skid-steer drive for traction and durability. It uses up to 500W of onboard power for manoeuvring. The ROS API provides end-to-end visibility of operation, including interaction between the power system, motors, IMU, GPS and localisation estimate. Application-specific payloads can be installed on the customisable top plate. **Applications:** research, field tests **Length:** 50.8cm **Width:** 43cm **Height:** 25cm **Weight:** 17kg **Max speed:** 2m/s **Clearance min and max:** 6.5cm **Battery life:** heavy use 2hr, basic use 8hr **Communications/data link:** Ethernet, USB 3.0, RS-232 (IEEE 1394 available) **Operating temperature range:** -20/+45°C

Canada ▸ Clearpath Robotics ▸ Grizzly

The Grizzly Robotic Utility Vehicle (RUV) is designed for various military, mining and agricultural applications in rugged environments. The 4x4 Grizzly has front-axle articulation designed to keep the vehicle grounded and stable on difficult terrain. Various payloads can be fitted on the front and rear mounts, and on the 1.07m² top deck. The Grizzly includes onboard 5/12/24/48V user power and vehicle-wide Ethernet and USB connectivity. The vehicle can be operated in tele-operated, semi-autonomous and autonomous modes. **Applications:** military, civil **Length:** 1.75m **Width:** 1.28m **Height:** 0.81m **Weight:** 660kg **Max speed:** 19km/h, 8.3km/h when towing **Min ground clearance:** 203mm **Endurance:** 6h speed optimised, 12h towing optimised **Payloads:** 600kg **Status:** available

SPECIFICATIONS

UMVs

This section includes major UMVs that are currently in production or in development around the world.

Entries are arranged nationally, then alphabetically by manufacturer and system name. The specifications are those supplied by the OEMs. Further information can be obtained by contacting these companies directly.

If your company produces UMVs which you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure your system appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: A USN fire control technician assigned to Unmanned Undersea Vehicle Squadron 1 performs maintenance on a Bluefin-12D UUV. (Photo: USN)

UK ▸ Saab Seaeye ▸ Double Eagle SAROV

The Double Eagle SAROV is an ROV/AUV hybrid which comes in two main configurations: Mine Reconnaissance, both remotely and autonomously performed; and Mine Disposal. The addition of autonomous operation and underwater docking capability enables the SAROV to be operated with or without a tether. It can be used for a variety of missions, including: underwater survey; REA; detection and identification of underwater objects; and mine disposal. As well as MCM vessels, the SAROV can be used on craft of opportunity where it is housed in a container that can be installed on most ships. The Double Eagle SAROV has been bought by the Royal Danish Navy. **Applications:** MCM, survey, inspection **Length:** 2.9m **Width:** 1.3m **Height:** 1m **Weight:** 540kg **Payload:** >250kg **Max speed:** 8kt **Endurance/mission duration:** 10h+ in AUV mode **Navigation:** INS, Doppler velocity log, GPS **Powerplant/propulsion:** 2x 5kW brushless motors **Depth rating:** 500m standard, 1,500m or 3,000m optional **Status:** available

UK ▸ Saab Seaeye ▸ Falcon

Falcon ROVs were introduced in 2002 as a small platform for use in demanding environments. The Falcon has a distributed intelligence system with each device having its own individually controlled microprocessor. In November 2014, it was announced that Saab Seaeye will supply ten Falcons to the Swedish Defence Material Administration under a new order. The vehicles will be used by the Swedish Navy and Saab will deliver them equipped with an enhanced surface control system. In the same month, the Falcon was used to assist with iceberg research, spending 28 days at a time gathering data on ice thickness, volume, direction and drift. On 17 August 2017, Saab Seaeye announced it had received an order for a second Falcon ROV from Australia-based Huon Aquaculture, which will deploy it for aquaculture operations at its salmon farms to inspect nets, rigging and moorings in its aquaculture pens. On 30 November 2017, Saab Seaeye received an order for a Falcon from the Korean Coast Guard. It will give the coast guard improved resources to carry out maritime SAR and underwater inspection, a requirement identified following the 2014 sinking of the MV Sewol ferry. **Length:** 450m umbilical length (upgradable to 1,100m with F2 Fibre Optic Pack upgrade) **Width:** 600mm **Height:** 500mm **Weight:** 60kg (launch weight) **Payload:** 14kg **Range:** 450m umbilical (1,100m with F2 Fibre Optic Pack) **Powerplant/propulsion:** single-phase AC power input, auto selecting universal 100-270V at 2.8kW **Depth rating:** 300m **Status:** in production

UK ▸ Saab Seaeye ▸ MuMNS

The Multi-Shot Mine Neutralisation System (MuMNS) consists of three subsystems: a vehicle, a mine disposal magazine and a mine disposal system. The vehicle includes a control and display unit, a launch and recovery system and a winch. The mine disposal magazine, known as Storm, is designed as a tooling skid that allows the vehicle to be reconfigured and used for different tasks. The magazine can be fitted to Saab's range of vehicles both defence and commercial. **Length:** 1.3m **Width:** 0.8m **Height:** 0.6m **Weight:** 260kg (in air); adjustable, slightly buoyant (in water) **Max speed:** 0-3kt **Communications/data links:** fibre-optic Gigabit Ethernet **Depth rating:** 300m **Imaging sonars:** multi-beam forward-looking relocation sonar mounted on tilt table **Navigation:** ultra-short baseline, micro-electromechanical gyro, Doppler velocity log, optional INS and GPS speed log

UK ▸ Saab Seaeye ▸ Sea Wasp

The Sea Wasp is designed to be land-portable by a two-person team and consists of a vehicle, generator, pilot station, hand winch and power supply unit. The platform was showcased at UDT Asia 2016. Fitted with an electrical five-function manipulator arm, the operator is able to deploy a range of tools and techniques for IED disposal and EOD, depending on the scenario. **Length:** 1.7m **Width:** 0.5m **Height:** 0.4m **Weight:** <90kg (in air), adjustable, slightly buoyant (in water) **Depth rating:** 60m **Imaging sonars:** multi-beam, forward-looking sonar (other types available on request) **Navigation:** IMU, DVL with integrated compass

USA ▸ Accurate Automation ▸ Sentinel

The Sentinel USV is a family of five variants developed for the USN and funded under the Small Business Innovation Research programme. Sentinel is able to launch a UAV, and it is intended for harbour and strategic facility protection, coastal patrol, ship protection, oil rig protection, optical and electromagnetic field-of-sight extension, ISR missions, target designation, jamming and decoy missions and force protection. **Applications:** various military **Length:** 5, 6, 7, 11m navy RHIB and 11.58m ocean racer

EQUIPMENT

PAYLOADS AND SUBSYSTEMS

This section of the handbook is divided into sub-sections describing the following UV payloads:

- Communications
- EO/IR
- Flight control systems
- FLIR/thermal imaging
- Integrated systems
- Radars
- Weapon systems

The data in these entries has been supplied by the OEMs. Further information can be obtained by contacting these companies directly.

If your company produces equipment that you believe should be listed in this section, please contact Karima Thibou at karima.t@shephardmedia.com to ensure it appears in the Shephard Plus online database (shephardplus.com) and is included in the next print edition.

ABOVE: The new configuration of the Raven R-11B Small UAS with the gimbal payload allows for both day and night operations and gives the operator a nearly 360-degree view around the aircraft. (Photo: US Army)

COMMUNICATIONS SYSTEMS

AIRBORNE INNOVATIONS

MicroraptorHD

Subminiature HD video link with integrated bi-directional C2 data link. MicroraptorHD is an enabling technology for HD video transmission from small unmanned vehicles to larger vehicles that benefit from the low SWaP requirements. It is capable of transmitting 1080p at 30fps, 720p60 and SD video, and can function as a bi-directional C2 data link. The system supports multiple cameras and digital and analogue interfaces, including component HD, analogue SD, Sony HD block camera (digital and analogue), HDMI, multi-megapixel+1080p and other cameras, with support for a variety of HD, SD and IR cameras. 1080p HD cameras are also available as small as 10x10mm. Supports Microhard NanoDDL data links or any Ethernet-based broadband data link. Multiple frequency options and RF amplifiers are available. Multiple serial ports, Ethernet passthrough, and SDK for onboard applications and streaming client/embedded source code licensing available. Applications: HD video link Length: 110mm Width: 40mm Height: 50mm Power: 1W Weight: 0.05kg with radio (0.02kg without) Data rates: 1080p at 30fps, 720p60 and SD video Platforms: UAVs

NanoUxV OEM

The NanoUxV OEM is a compact vehicle and/or payload computer system optimised for vehicles requiring limited SWaP. It contains a variety of interfaces needed by small vehicles and payloads. Expansion capability includes a MiniPCI port suitable for high-power broadband radios, hardware H.264 video compressors, GPS or other expansion modules such as Firewire. It has an Express card interface for high-speed storage or PCIe-based expansion, and a SATA port for ultra-high speed storage. It is also available with a compact and lightweight enclosure. Applications: imaging system vehicle computer Connectivity: dual gigabit Ethernet, 3 USB2 ports, 2 RS-232 ports, CAN bus, GPIO, dual analogue video inputs, wide input range power supply Length: 140mm Width: 80mm Power: 12V Weight: 0.12kg

RaptorEye

The RaptorEye is a lightweight payload computer/imaging system designed as a general-purpose payload system. It is available with Core 2 Duo or Core i7 processors. Airborne Innovations can also provide software optimised for high-resolution imaging applications, SATCOM image transmission, real-time high-resolution image transmission and recording, and custom applications such as hyperspectral/multispectral imaging, multiple camera archiving, video processing, multi-channel video and digital 14-bit FLIR imagery recording and others. It has multiple gigabit Ethernet interfaces, USB and serial ports, CAN bus and a wide input range power supply. It has a MiniPCI expansion interface for internal broadband radios and other interfaces (Firewire, GigE, more serial ports etc). It also supports internal storage or a front panel SATA interface for high-speed, high-capacity removable storage. Applications: payload computer/imaging system Length: 170mm Width: 120mm Height: 50mm Weight: 0.4kg

RaptorEye II

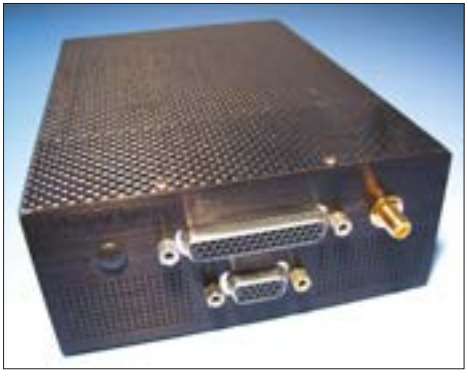
The RaptorEye II is an integrated vehicle computer available with an optional integrated high-capacity SATA storage drive up to 1TB, along with express card and broadband data link interfaces. Designed for imaging applications, it has many external interfaces with a robust connector supporting multiple gigabit Ethernet interfaces, multiple USB and serial ports, CAN bus and a wide input range power supply. It can support analogue video inputs, Cameralink, Firewire 400/800, internal broadband data links and other systems. It is suitable for high-resolution custom imaging applications, hyperspectral/multi-spectral imagery collection, SATCOM imaging, as a general-purpose vehicle or payload computer, and other applications. Applications: imaging applications Connectivity: analogue video inputs, camera link, Firewire 400/800, internal broadband data links, and other systems Length: 150mm Width: 80mm Height: 30mm Weight: 0.2kg

ALSEAMAR ALCEN

GIB FT

The GIB FT portable torpedo and UUV tracking range is composed of a set of buoys that receives acoustic signals transmitted by the pingers mounted on the torpedo and the target. The buoys measure the distances to the underwater vehicle and periodically transmit, through a local radio network, its GPS position and the measured distances to a Control and Display Unit installed on a support ship or at shore. The unit then triangulates the underwater vehicle's positions and displays it over a chart. Length: 6cm Width: 800mm Weight: 60kg dry Features: simultaneous multiple trackings on the same graphical interface (underwater, surface and air vehicles), wide tracking range (up to 100km² with 12 buoys) with a metric accuracy in 3D in the whole coverage area

The RaptorEye is a multi-megapixel aerial imaging system that is capable of transmitting pictures and metadata over broadband links and Iridium SATCOM links for BVLOS missions. (Photo: Airborne Innovations)



The AN/DPX-7 reduced-size transponder is an Identification Friend or Foe system with an embedded ADS-B IN capability. It is designed for platforms with SWaP constraints, such as UAVs.

GIB SAR

The portable GIB SAR is an underwater GPS tracking system. By combining four buoys and a deck unit, which can be installed either on a small boat or on large vessel, the ALSEAMAR system is suited for underwater positioning or deep water and able to withstand rough sea conditions. Applications: various military and civil Length: 2.5m Width: 1m Weight: 29kg dry

X-SUB

The X-SUB towed multifunction antennas allow transmission and reception in the HF, VHF and UHF frequencies & AIS, Iridium, GPS, via small expendable communication buoys released via the Sippican airlock bay. The buoys float to the surface and remain connected to the submarine via a wire connection and then acquire the GPS or AIS position or situation, which is then transmitted to the submarine. Once the link is broken, the buoy is scuttled. Applications: military Length: 975mm Weight: 2.9kg dry

ANTCOM

GPS Antennas

Antcom produces a range of airborne antennas in various sizes, including the industry-standard ARINC 743 and Mini-ARINC, which can be mounted on jets, helicopters or UAVs. The company also manufactures small, lightweight antennas with hermetically sealed circular radomes. These products bear FAA TSO-C144 certification. Applications: antenna

BAE SYSTEMS

AN/APX-117/118/123/124 CXP

Common Transponder (CXP) products incorporate the features required in today's global military and civil ATC environments. Dependent on configuration, the CXP contains an M4/M5 crypto and meets all US and NATO Mode 4 and 5 requirements, compliant with STANAG 4193. The transponder's open-systems architecture design and high-density field programmable gate-array technology ensures ongoing versatility and future utility through software upgrade only, without the risk and cost associated with hardware modifications. Support modes: 1, 2, 3/A, C, 4 and 5 level 1 and 2, ADS-B depending on configuration/model; DoD AIMS 03-1000A-compliant; Mode S level 3 and interface to TCAS II system per RTCA/DO-181C; elementary and enhanced surveillance-compliant. Applications: transponder Length: 140mm Width: 140mm Height: 210mm Power: 28V DC Weight: 5.44kg MTBF: >8,800hr predicted MTBF in airborne inhabited platform

AN/DPX-7

The BAE Systems AN/DPX-7 transponder has been designed for smaller platforms. The company says it incorporates all the features required for future global military and civil air traffic control environments. It provides Mode 4 and 5, and is compliant with STANAG 4193, Mode-S and ADS-B functionality in a reduced-size unit. Support modes: 1, 2, 3/A, C, 4 and 5 level 1 and 2, ADS-B, -R, TIS-B, DoD AIMS 03-1000A-compliant; Mode S level 3 and interface to TCAS II system per RTCA/DO-181C; elementary and enhanced surveillance-compliant Applications: transponder Length: 140mm Width: 140mm Height: <100mm Power: 28V DC Weight: 2.72kg MTBF: >4,000hr predicted MTBF in airborne uninhabited platform

COBHAM SATCOM

Aviator UAV 200

Cobham's UAV 200 is a SATCOM solution that has been designed to enhance a tactical UAV's performance, range and payload flexibility in a number of applications, including SAR, border security enforcement, public safety, disaster management commercial use and scientific research. Although compact and 76% lighter than current SATCOM solutions, the size, weight and power requirements of Inmarsat SATCOM hardware have made it possible to take advantage of higher speed connectivity from satellite networks, says the company. It is also able to deliver Inmarsat Class 4 services, up to 200kbps data. Operators can send flight commands to the UAV in real time, which can help with protecting the UAV and other airspace users, should it need to avoid potential threats or return to base. The SATCOM solution also provides enhanced BLoS surveillance, instead of being limited to LoS operations. The Aviator UAV 200 was unveiled at AUVSI's Xponential 2016. Applications: SATCOM terminal Length: SATCOM terminal Width: 24cm Height: 16cm Power: 6cm Weight: 28 W Data rates: up to 200 kbps (background data service), up to 32kbps (streaming class services) Platforms: tactical UAVs

COMMTACT

AMLS

The Advanced Mini Link System (AMLS) is a miniaturised digital data link designed for mini and small unmanned platforms. The system uses open IP architecture and enables full-duplex wideband, digital link, error correction techniques and high-rate communication in the uplink and downlink channels. The AMLS can downlink real-time video images, LAN, serial data and information from most sensors operating today. It is lightweight, small, has low power consumption and combines commercially proven technologies and standards with advanced algorithms to provide higher reliability and performance. The system's full-duplex wideband provides one uplink for the command to UAV

PRODUCTS

GUIDE TO SUPPLIERS

This section lists key companies supplying goods, services and equipment to the military unmanned systems industry worldwide.

The section is separated into two listings, by product then by supplier.

Products are listed alphabetically with suppliers and their location under each.

Supplier listings from pxxx are shown alphabetically and include:

- Company address
- Email and website addresses
- Telephone and fax numbers
- Contact names

Highlighted listings also include the company's logo and a summary of activity.

To update a listing or submit new information, email Karima Thibou at karima.t@shephardmedia.com.

ABOVE: A USAF technical sergeant launches a Raven B Digital Data Link drone during a demonstration in Southwest Asia in January 2018. (Photo: USAF)

PRODUCTS

UAVS

Associations

ADS Group (UK)
AHS International (USA)
Airborne Law Enforcement Association (USA)
Alberta Economic Development and Trade (CANADA)
American Institute of Aeronautics and Astronautics (USA)
Association for Unmanned Vehicle Systems International (USA)
Association of Diving Contractors International (USA)
Fisher Institute for Air and Space Strategic Studies (ISRAEL)
GICAT - French Land Defence Manufacturers Association (FRANCE)
Global UTM Association (SWITZERLAND)
ITA National Armament Directorate (ITALY)
National Defense Industrial Association (USA)
Portuguese Aerospace Industry Association (PORTUGAL)
Ukroboronprom (UKRAINE)
Unmanned Systems Canada (CANADA)

Communications/ data links

5-D Systems (USA)
Advanced Defense Technologies (USA)
Advanced Microwave Products (USA)
Aero Telemetry (USA)
Aérodrones (FRANCE)
Aerodyne (USA)
Aeronautics (ISRAEL)
AeroVironment (USA)
Airborne Innovations (USA)
Airbus Defence & Space (UK)
AirScan (USA)
Alion Science and Technology (USA)
ALSEAMAR Alcen (FRANCE)
Antcom (USA)
Applied Systems Engineering (USA)
Aselsan (TURKEY)
Astron Wireless Technologies (USA)
AValon RF (USA)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
Barco Fredrikstad (NORWAY)
BES Electronic Systems (ISRAEL)
Bharat Electronics (INDIA)
BlueBird Aero Systems (ISRAEL)
BML Benfield Marketing (NEW ZEALAND)
Britannia 2000 (UK)
Broadcast Microwave Services (USA)
BSC Filters (UK)
CeoTronics (GERMANY)
Chemring Technology Solutions (UK)
Cobham Antenna Systems (USA)
Cobham Antenna Systems Microwave Antennas (UK)
Cobham SATCOM Cape Town (SOUTH AFRICA)
Codarra Advanced Systems (AUSTRALIA)
Commtact (ISRAEL)
Controp Precision Technologies (ISRAEL)
Cooper Antennas (UK)
Cornet Switching Systems (UK)
Cornet Technology GmbH (GERMANY)
Cosworth (UK)
CT-Video (GERMANY)
Curtiss-Wright Avionics & Electronics (IRELAND)
Curtiss-Wright Avionics & Electronics (US) (USA)
Curtiss-Wright Defense Solutions (USA)
Dara Aviation (USA)
Data Link Solutions (USA)
dB Control (USA)
Delta Digital Video (USA)
Domo Tactical Communications (USA)
Ecarys (GERMANY)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Emteq (USA)
EuroHawk (GERMANY)
Extant Aerospace (USA)
FreeWave Technologies (USA)
GE Aviation (USA)
General Dynamics UK (UK)
Gilat Satcom (ISRAEL)
Global Teknik (TURKEY)
GPSat Systems (AUSTRALIA)
Green Hills Software (UK)
Harris (USA)
HeliMedia (UK)
Honeywell Aerospace (USA)
HR Smith Group of Companies (UK)
IAI ELTA Systems (ISRAEL)
IAI Israel Aerospace Industries (ISRAEL)
IAI Malat Division (ISRAEL)
IAI North America (USA)
ING Robotic Aviation (CANADA)
Instrument Control Sweden AB (SWEDEN)
Integrated Dynamics (PAKISTAN)
Intuicom (USA)
IRIS Technology (USA)
ITS Electronics (CANADA)
Kongsberg Defence & Aerospace (NORWAY)
Kongsberg Maritime (NORWAY)
Kratos Unmanned Systems Division (USA)
KVH Industries (USA)
L3 Communication Systems-East (USA)
L3 Communication Systems-West (USA)
L3 Telemetry & RF Products (USA)
L3 Unmanned Systems (USA)
Leonardo (ITALY)
Lexycom Technologies (USA)
LIG Nex1 (SOUTH KOREA)
Liteye Systems (USA)
Lockheed Martin UK (UK)
Logos Technologies (USA)
Lom Praha (CZECH REPUBLIC)
Lord (USA)
Martin UAV (USA)
MASS (UK)
MDA – MacDonald, Dettwiler and Associates (CANADA)
Meggitt Defense Systems (USA)
Meggitt Polymers & Composites (UK)
Melcom Electronics (UK)
Mercury Systems (USA)
Microdrones UK (UK)
Microhard Systems (CANADA)
MTC America Enterprises (USA)
MTC Industries and Research (ISRAEL)
National Chung-Shan Institute of Science and Technology (TAIWAN)
NovAtel (CANADA)
Orbital Research (USA)
Paramount Advanced Technologies (SOUTH AFRICA)
Patria (FINLAND)
Pharad (USA)
Phoenix International Systems (USA)
Proxy Technologies (USA)
QinetiQ (UK)
Radionor Communications AS (NORWAY)
Raytheon (USA)
Raytheon Intelligence and Information Systems (USA)
RCAT Systems (USA)
RGB Spectrum (USA)
Rheinmetall Defence Electronics (GERMANY)
Rockwell Collins (USA)
Rolta (INDIA)
Rotating Precision Mechanisms (USA)
Sagetech Corporation (USA)
Sandia National Laboratories (USA)
Scorpion Oceanics (UK)
SEA (UK)
Seabird Aviation Australia (AUSTRALIA)
Sierra Nevada Corporation (USA)
Silvus Technologies (USA)
Stark Aerospace (USA)
Survey Copter (FRANCE)
Swarm Systems (UK)
Swedish Defence Materiel Administration (SWEDEN)
TAI – Turkish Aerospace Industries (TURKEY)
TATA Advanced Systems (INDIA)
TE Connectivity – Aerospace, Defense & Marine (USA)
Telephonics (USA)
Tellumat (SOUTH AFRICA)
Thales (FRANCE)
Thales UK (UK)
Times Microwave Systems International (UK)
TNO (NETHERLANDS)
Trimble (USA)
Troll Systems (USA)
TT electronics AB Connectors (UK)
UAV Vision (AUSTRALIA)
Ultra Electronics Advanced Tactical Systems (USA)
Ultra Electronics Communication & Integrated Systems (UK)
Ultra Electronics Flightline Systems (USA)
UTC Aerospace Systems - ISR Systems USA (USA)
ViaSat (USA)
Wind River (USA)
Wireless Avionics (ISRAEL)
Zala Aero Group (RUSSIA)

Consultancy

Aero Surveillance (FRANCE)
Aero Telemetry (USA)
Aerodyne (USA)
Airbus DS Airborne Solutions (GERMANY)
Alcore Technologies (FRANCE)
Altran UK (UK)
Battlespace (USA)
Blue Bear Systems Research (UK)
Burdeshaw Associates (USA)
Chemring Technology Solutions (UK)
Codarra Advanced Systems (AUSTRALIA)
Cranfield Aerospace (UK)
CSRA (USA)
Defence Imaging (UK)
DO Systems (UK)

Elimco (SPAIN)
ING Robotic Aviation (CANADA)
Integrated Dynamics (PAKISTAN)
Liebherr Aerospace & Transportation (GERMANY)
LikeAbird (ITALY)
Lockheed Martin UK (UK)
Lockheed Martin Unmanned Integrated Systems (USA)
Marshall Aerospace and Defence Group (UK)
MDA – MacDonald, Dettwiler and Associates (CANADA)
Modern Technology Solutions (USA)
PASSUR Aerospace (USA)
QinetiQ (UK)
R-PAD Technology (UK)
RCAT Systems (USA)
Siemens PLM Software (USA)
Skycam UAV (NEW ZEALAND)
Strat Aero (UK)
Swedish Defence Materiel Administration (SWEDEN)
Tapestry Solutions (USA)
Teledyne Brown Engineering (USA)
Thales (FRANCE)
TNO (NETHERLANDS)
Viking Air (CANADA)
Zodiac Inflight Innovations (USA)

Control stations

Aertec Solutions (SPAIN)
Aselsan (TURKEY)
BRVANT (BRAZIL)
Dara Aviation (USA)
Delta Drone (FRANCE)
ECA Group (FRANCE)
Embention (SPAIN)
General Atomics Aeronautical Systems (USA)
Global Industrial & Defence Solutions (GIDS) (PAKISTAN)
Globe UAV (GERMANY)
Insitu (USA)
Kutta Technologies, Inc. (USA)
Lockheed Martin Canada CDL Systems (CANADA)
Lockheed Martin (USA)
Raytheon Intelligence and Information Systems (USA)
Skycam UAV (NEW ZEALAND)
Textron Systems Unmanned Systems (USA)
UAV Factory USA (USA)
UAV Solutions (USA)
Uavos (USA)
Vislink (US) (USA)
Yuneec (UK)

Counter-UAS Systems

Aaronia AG (GERMANY)
Ariel Photonics (ISRAEL)
Aselsan (TURKEY)
Battelle Memorial Institute (USA)
Blighter Surveillance Systems (UK)
CACI International (USA)
Dedrone (USA)
Delft Dynamics (NETHERLANDS)
General Dynamics Land Systems (USA)
Hensoldt Sensors (GERMANY)
IAI ELTA Systems (ISRAEL)
Kelvin Hughes (UK)
Kirintec Inc (USA)
Leonardo Land & Naval Defence Electronics (ITALY)
Liteye Systems (USA)
MC-Clic (MONACO)
MGT Europe (UK)
Mitsubishi Electric (JAPAN)
Northrop Grumman (USA)
OpenWorks Engineering (UK)
Phantom Technologies (ISRAEL)
Radio Hill Technologies (USA)
Rafael Advanced Defense Systems (ISRAEL)
Sensofusion (FINLAND)
SpotterRF (USA)
SRC (USA)
TCI (USA)
TRD Consultancy (SINGAPORE)
UAV Vision (AUSTRALIA)
Wireless Avionics (ISRAEL)

Data storage

ACES Dynamic Instruments (USA)
Aero Surveillance (FRANCE)
AeroVironment (USA)
Airborne Innovations (USA)
Curtiss-Wright Avionics & Electronics (IRELAND)
Curtiss-Wright Avionics & Electronics (USA)
Curtiss-Wright Defense Solutions UK (UK)
Dara Aviation (USA)
Elbit Systems (ISRAEL)
Emteq (USA)
General Dynamics (USA)
Honeywell Aerospace (USA)
IAI ELTA Systems (ISRAEL)
IAI North America (USA)
ING Robotic Aviation (CANADA)
Kongsberg Defence & Aerospace (NORWAY)
Kongsberg Maritime (NORWAY)
L3 Telemetry & RF Products (L3 TRF) (USA)
MDA – MacDonald, Dettwiler and Associates (CANADA)
Mercury Defense Systems (USA)
Pathfinder Systems (USA)
Phoenix International Systems (USA)
RADA Electronic Industries (ISRAEL)
Rheinmetall Defence Electronics (GERMANY)
Rockwell Collins (USA)
Sekai Electronics (USA)
Thales (FRANCE)
TNO (NETHERLANDS)
Uconsystem (SOUTH KOREA)

Electronic warfare

Advanced Defense Technologies (USA)
Aero Telemetry (USA)
Airbus Defence & Space (GERMANY)
Albrecht Telecommunications (SWITZERLAND)
Alion Science and Technology (USA)
Annapolis Micro Systems (USA)
Applied Systems Engineering (USA)
Argon ST (USA)
Ariel Photonics (ISRAEL)
Aselsan (TURKEY)
Astron Wireless Technologies (USA)
BAE Systems Australia (AUSTRALIA)
BAE Systems Electronic Systems (USA)
BAE Systems Underwater Systems (UK)
Bharat Electronics (INDIA)
Black Diamond Advanced Technology (USA)
CAE Integrated Enterprise Solutions (CANADA)
Chemring Technology Solutions (UK)
Cobham Antenna Systems (UK)
Cubic Global Defense (USA)
Curtiss-Wright Defense Solutions (USA)
Curtiss-Wright Defense Solutions (UK)
dB Control (USA)
DTM Global (UK)
e2v (UK)
Elbit Systems (ISRAEL)
EuroHawk (GERMANY)
Extant Aerospace (USA)
General Atomics Aeronautical Systems (USA)
General Dynamics (USA)
GEW Technologies (SOUTH AFRICA)
HR Smith Group of Companies (UK)
IAI ELTA Systems (ISRAEL)
IAI North America (USA)
ImSAR (USA)
Indra Sistemas (SPAIN)
ING Robotic Aviation (CANADA)
Kongsberg Defence & Aerospace (NORWAY)
Kongsberg Maritime (NORWAY)
L3 Communications Randtron Antenna Systems (USA)
L3 TRL Technology (UK)
Laser Detect System (ISRAEL)
Leonardo (ITALY)
Leonardo DRS (USA)
Leonardo UK (UK)
Lockheed Martin (UK)
Marshall Aerospace and Defence Group (UK)
MASS (UK)
Melcom Electronics (UK)
Mercury Defense Systems (USA)
Mercury Systems (USA)
Northrop Grumman Mission Systems (USA)
NSWC Crane Division (USA)
Pathfinder Systems (USA)
Phantom Technologies (ISRAEL)
Power Technology (USA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Space & Airborne Systems (USA)
Rheinmetall Defence Electronics (GERMANY)
Rockwell Collins (USA)
Rotating Precision Mechanisms (USA)
Sierra Nevada Corporation (USA)
TATA Advanced Systems (INDIA)
TE Connectivity – Aerospace, Defense & Marine (USA)
Tecom Industries (USA)
Teledyne Defence & Space (UK)
Tetis Pro (RUSSIA)
Thales UK (UK)
Times Microwave Systems (USA)
TNO (NETHERLANDS)
Wind River (USA)

Engineering

ACP Composites (USA)
Advanced Technologies Incorporated (USA)
Aero Surveillance (FRANCE)
Airbus DS Airborne Solutions (GERMANY)
Alcore Technologies (FRANCE)
Bye Aerospace (USA)
Cytec Solvay Group (UK)
Defence Research & Development Organisation (INDIA)
Forward Composites (UK)
GF Peters & Partner (Peters Engineering) (GERMANY)
Highland Composites (USA)
ILMOR Engineering (UK)
Innocon (ISRAEL)
Kanfit (ISRAEL)
L3 Communications MAS Canada (CANADA)
Liebherr Aerospace & Transportation (GERMANY)

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Mussafah, Abu Dhabi, UAE
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Pietro Amati, MD

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Shehzaad Callachand, CEO

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Philippe Roy, CEO

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David H Dack, VP Sales

Aero Tec Laboratories was founded in 1970 as a design and testing facility for 'flexible composite' materials. Today, ATL enjoys sales of both 'catalogue' and 'custom' devices to prestigious clients in the world's top 40 industrialised nations. ATL is also an AS 9100C and ISO 9001 certified company, the highest quality standard attainable.

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