

UAV and Drone Power Systems

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BUYER'S GUIDE: UAV AND DRONE POWER SYSTEMS

Listing applications, use cases and types of systems for commercial drones that require longer flights or durations.

By Tom Atwood

As more companies and organizations deploy larger drones and unmanned aerial vehicles for use in applications such as utilities inspection, agricultural surveys, and photogrammetry of land topology for mining and construction, longer-duration power systems for the UAVs are required. Many drone manufacturers are employing “hybrid systems”, which typically include heavy fuel-powered turbines that generate electricity for electric propulsion. Increasingly, these types of systems will be needed as beyond visual line of sight (BVLOS) missions are expanded in future years.

For short duration flights, the ideal solution will continue to be battery-powered drones. Applications in this area can include, but are not limited to, aerial multispectral imaging of agricultural plots, photography of municipal traffic, and simple building inspection by corporate planners. This area continues to improve – see [Cuberg's new lithium metal battery](#), said to enable drones to fly 70% longer duration flights than those powered by traditional lithium-ion batteries.

WHAT THIS GUIDE IS ABOUT

Our goal is to provide you a framework for understanding the types of UAV propulsive power systems currently available, their typical market applications, and general price ranges. We will also refer to UAVs as “drone” systems. The listed power systems are variably used on fixed wing, helicopter, multirotor and hybrid airframes. The association of specific kinds of power plants with airframe types and end-user applications, to the extent that this can be generalized, is described below.

Company profiles are listed in alphabetic order, along with a brief overview of their offerings. Pricing is noted when available, however in many cases cost for mission-specific variables are negotiated with the power system vendor.

Our list is primarily based on a survey of power systems exhibited at the 2019 Xponential conference and trade show in Chicago – we’re including exhibit booth numbers (format #0000) in case you want more information

from the Xponential site.

We believe this list is an accurate representation of the available power systems, but it is not meant to be an exhaustive list, due to the rapid growth of this industry. In the interest of providing comprehensive coverage, several images in the guide were shot at the 2018 Xponential show in Denver, and are noted where possible.

Data in this report was gathered by the author, in collaboration with fellow photojournalists Lucien Miller and Mark Essenburg.

PRACTICAL ADVICE ON POWER SYSTEM COSTS

Contributor Lucien Miller, a power systems expert, UAV designer and drone consultant, notes that customers should consider three separate components when considering total cost of ownership of power systems:

1. Acquisition cost
2. Hourly operating cost
3. Annual maintenance cost

Amortized over the expected life of the engine, these three cost components add up to the total cost of ownership. This is typically looked at as a cost per flight hour over the life of the engine.

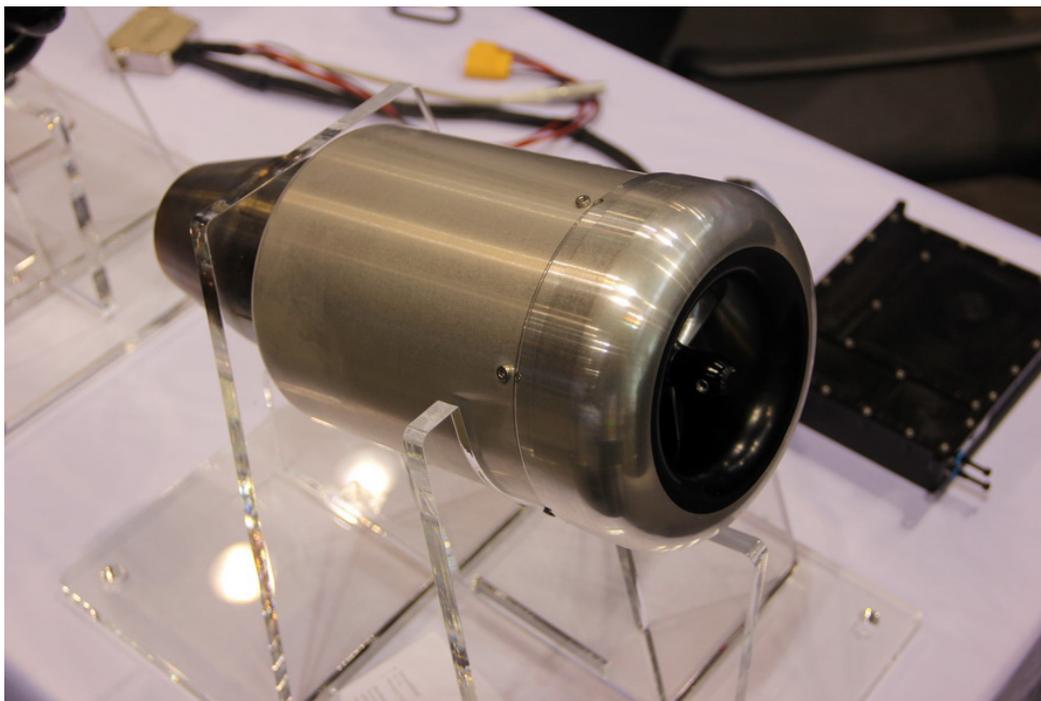
VENDOR PRICING OVERVIEW

For a sense of UAV pricing, first consider prices of Commercial Off-the Shelf (COTS) power units offered in the decades-old giant scale and turbine jet radio control (RC) hobby markets. Many of these power plants are nearly identical to baseline systems used in UAVs, but RC products are not usually subject to UAV certifications that may be imposed on the drone market by regulatory organizations.

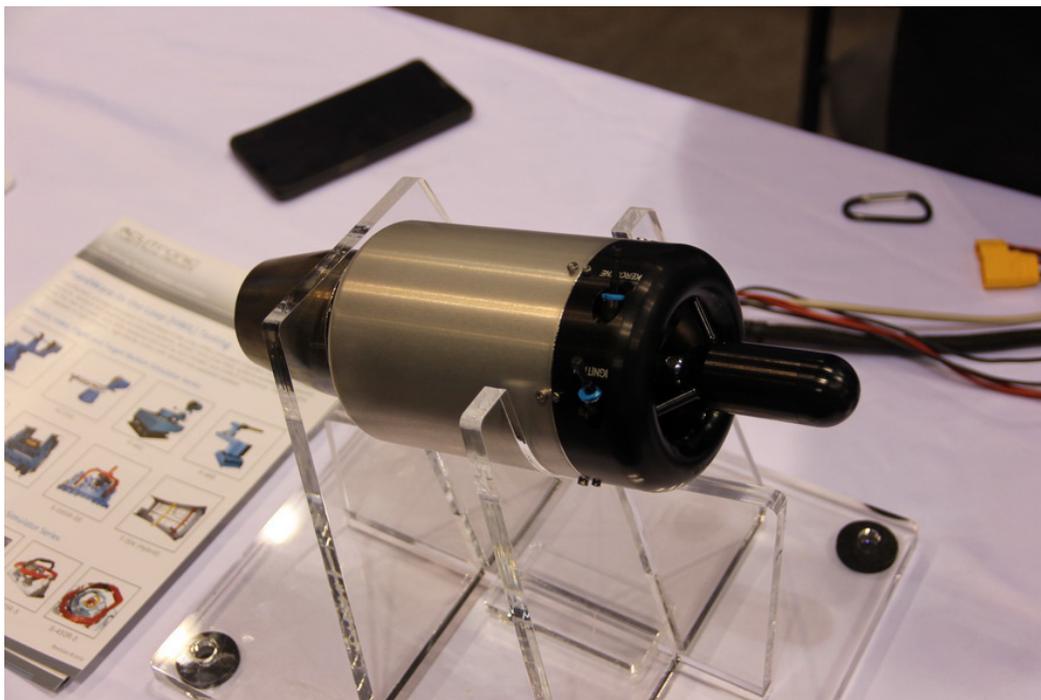
Examples of RC pricing include the Swiwin SW60B Jet Turbine sold by HobbyKing, which is priced at \$1,499 at the time of this writing. The Desert Aircraft DA-200L 4-cylinder gas engine is listed by Chief Aircraft for \$3,045. Note that required certifications in UAV markets, as well as custom enhancements, can multiply the original cost of RC power systems used in drone applications by several times. As a counterpoint, **HFE International** states its systems are 25% the cost of its closest competitors.

POWER SYSTEM PROFILES

[ACUTRONIC USA INC., #4205,](#)



Acutronic thrust engines feature a starter generator.



In addition to drone power plants, Acutronic designs and builds test systems for aviation and defense industries.



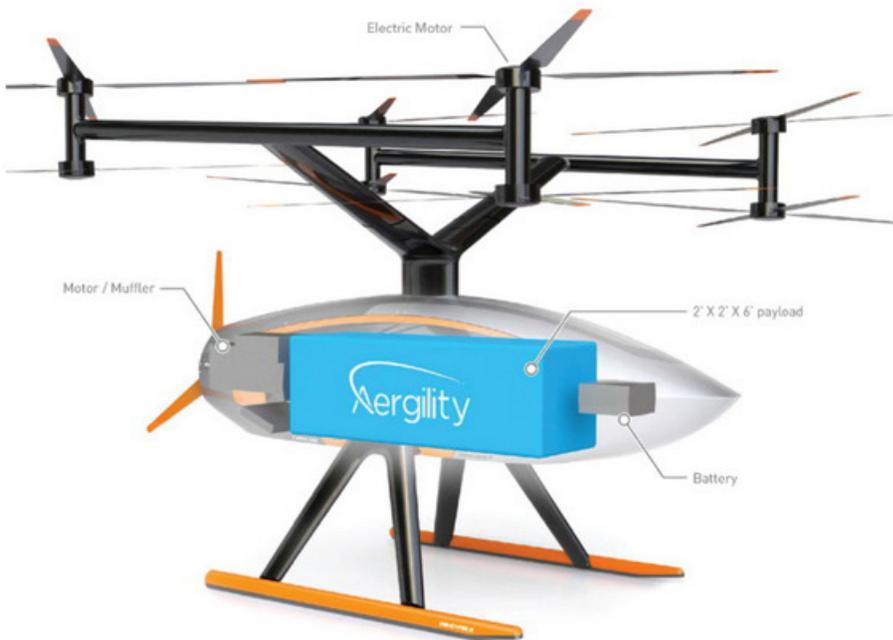
Acutronic thrust engine shown at Xponential 2018.

Acutronic designs and manufactures motion simulation and test systems for automotive, maritime, space, aviation and defense industries. Acutronic provides custom gas turbine generators, thrust engines and actuators for UAV airborne operations. Their thrust engines include an embedded starter/generator and run on heavy fuel with 5% turbine oil.

AERGILITY, #4307



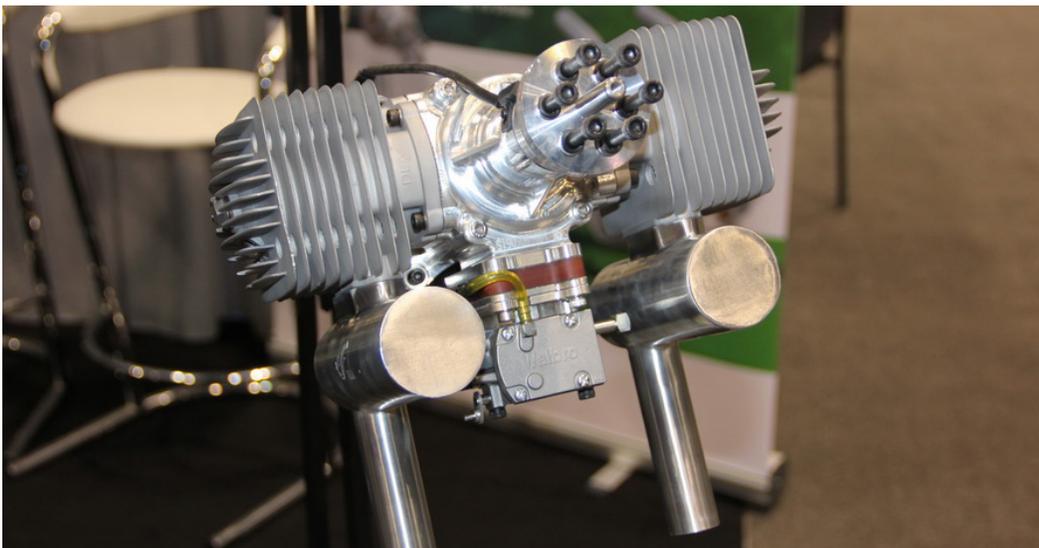
The Aergility Atlas Cargo UAV generates electric power with a bank of autogiros mounted above the vehicle.



Aergility Atlas illustration with parts called out.

Aergility is not a power system vendor per se, but is mentioned here to illustrate a new type of compound drone power system, which marries a pusher gas engine system with aerodynamically-generated electric power that runs onboard electronics. The electric power is generated by a bank of autogyro rotors that spin micro-generators as the autonomous Aergility Atlas Cargo UAV flies. In development for several years, the Aergility design has been proven in advanced testing of scale prototypes and suggests the potential for development of new, as yet unimagined, compound drone power systems.

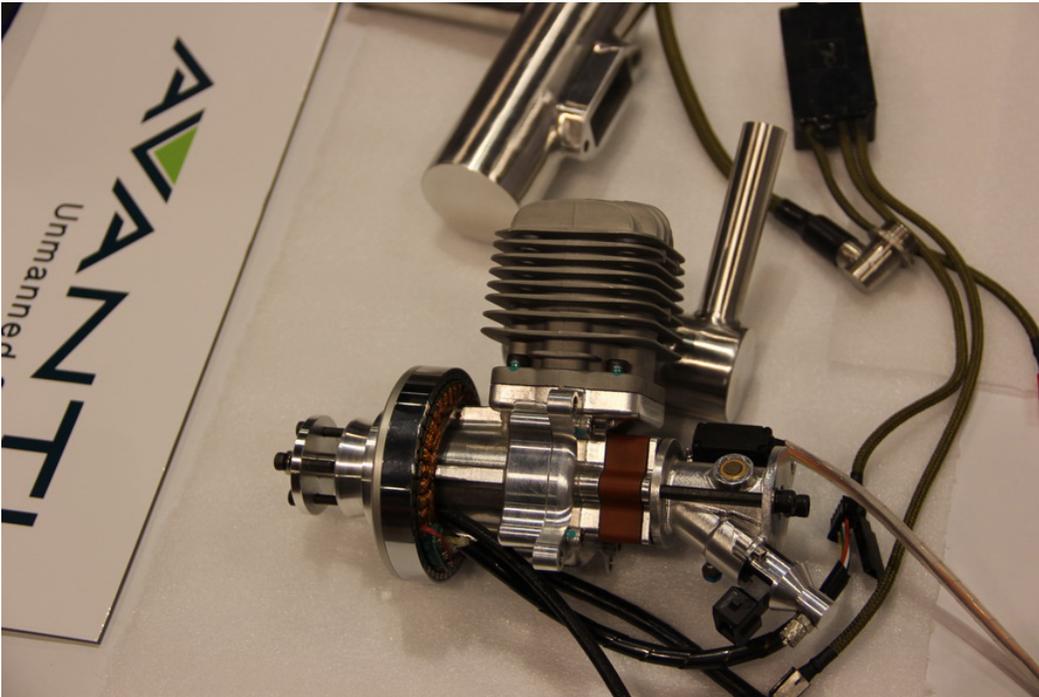
[AVANTI UNMANNED SYSTEMS, #4342](#)



Avanti Unmanned Systems engines come with electronic fuel injection or carburetors; this twin is a carburetor option.



As we go to press, Avanti engines range in size from 32cc to 180cc.



Avanti 58cc drone engine.

Avanti grew out of the certified aircraft engine business. As a result, their drone engine designs have been developed to meet or exceed certified aircraft standards, including materials, design elements, and tolerances. The customer can equip Avanti engines with either electronic fuel injection systems or carburetors. Spark plugs are shielded to prevent RF emissions, and the ignition is CDI controlled.

With engines ranging from 32cc to 180cc, Avanti has a power solution for most UAVs. The 180cc series engine displayed at the show produces 18.5 HP at 7,300 rpm, and comes with an array of options. The 2-stroke, twin cylinder gasoline burning engine can operate either clockwise or counterclockwise as required. It can be air or liquid cooled. The customer can opt for the integrated starter/alternator or not. All this adds up to extreme flexibility. Fuel for these systems is 93 octane.

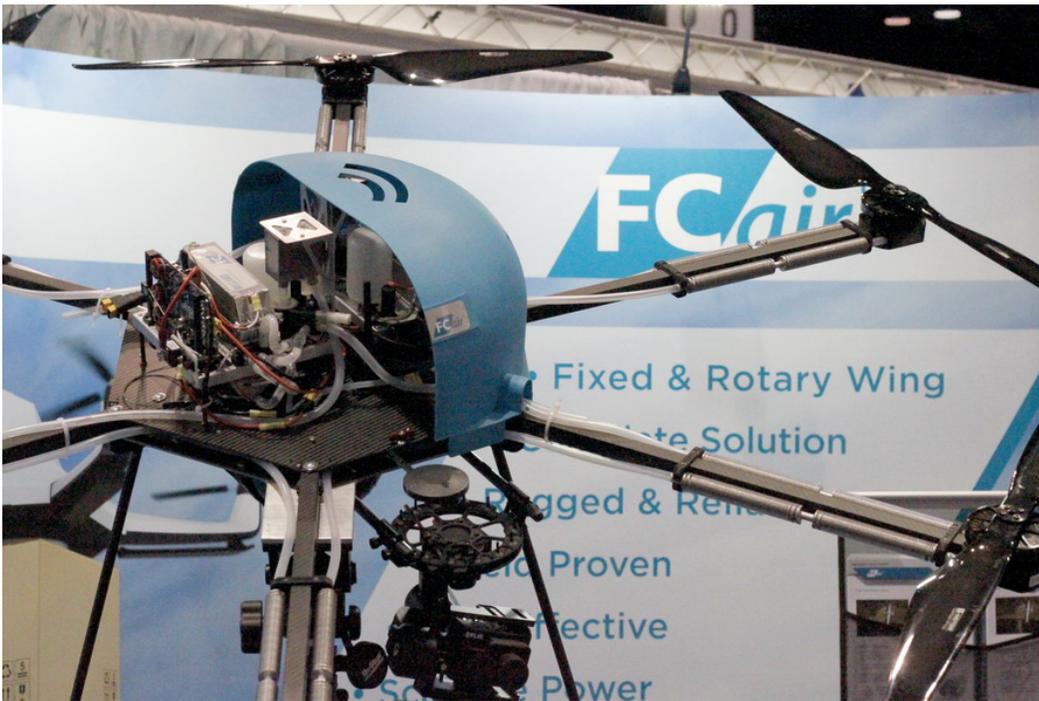
[BALLARD UNMANNED SYSTEMS, #1311](#)



Ballard Unmanned Systems exhibited FCair, an advanced fuel cell power system.



Details of the FCair system.



Ballard displayed a hexacopter mock-up using the FCair power system.

Canadian-based Ballard Power Systems has been developing hydrogen fuel cell solutions for 40 years, and their equipment is used in buses, trucks, rail and marine applications. Ballard has a decade of UAV flight experience in their Ballard Unmanned Systems division. Ballard notes: “Unmanned systems powered by fuel cells operate longer than their battery counterparts, with the same benefits of low thermal and noise signature. Users see improved reliability over small internal combustion engines, providing safe and low maintenance operation.”

This year Ballard launched FCair, a fuel cell power system featuring the Carbon Overwrapped Pressure Vessel line of storage vessels, associated pressure regulators and refueling solutions. It is a turnkey solution for commercial UAVs. The FCair 600 and 1200 liquid-cooled systems put out 600 and 1200 watts of power respectively, and include built-in hybrid battery control and charging. Ballard is currently proving these systems in harsh environments and high altitudes. Ballard said safety is a top priority, and the company continues to work with industry leaders and governments to develop a safety culture in the UAV market.

DESERT AIRCRAFT, #4112



Desert Aircraft UAV power system exhibit.



Desert Aircraft DA215 Inline prototype with alternator/generator.

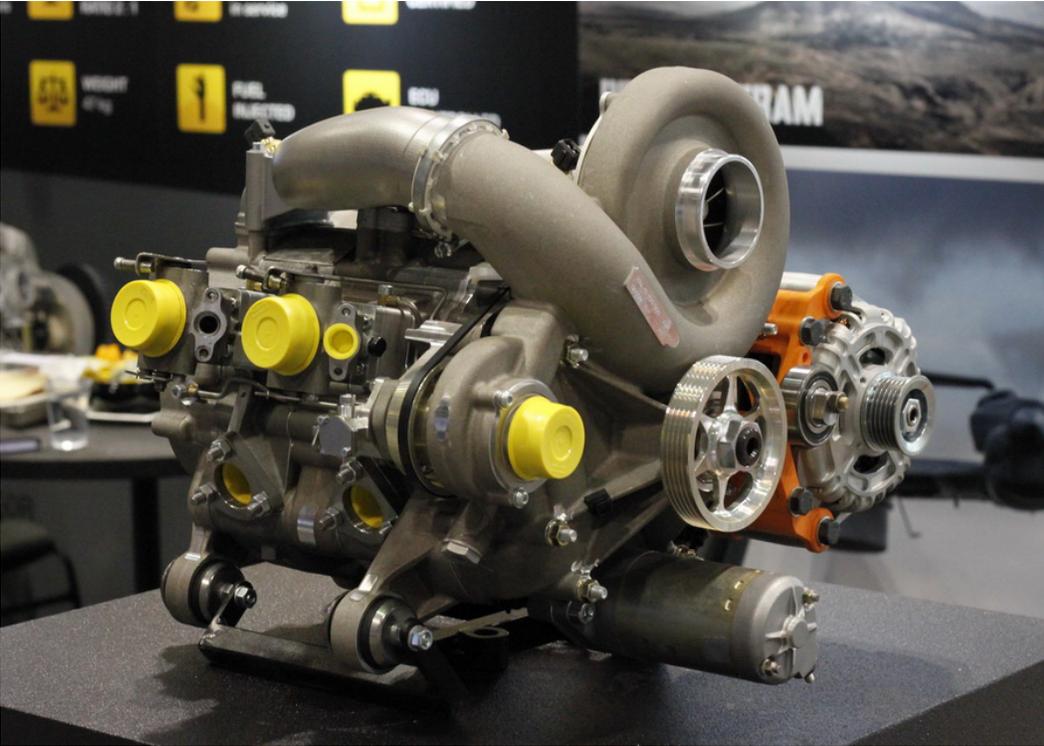


The Desert Aircraft 150 has served giant scale RC and professional UAV markets for decades.

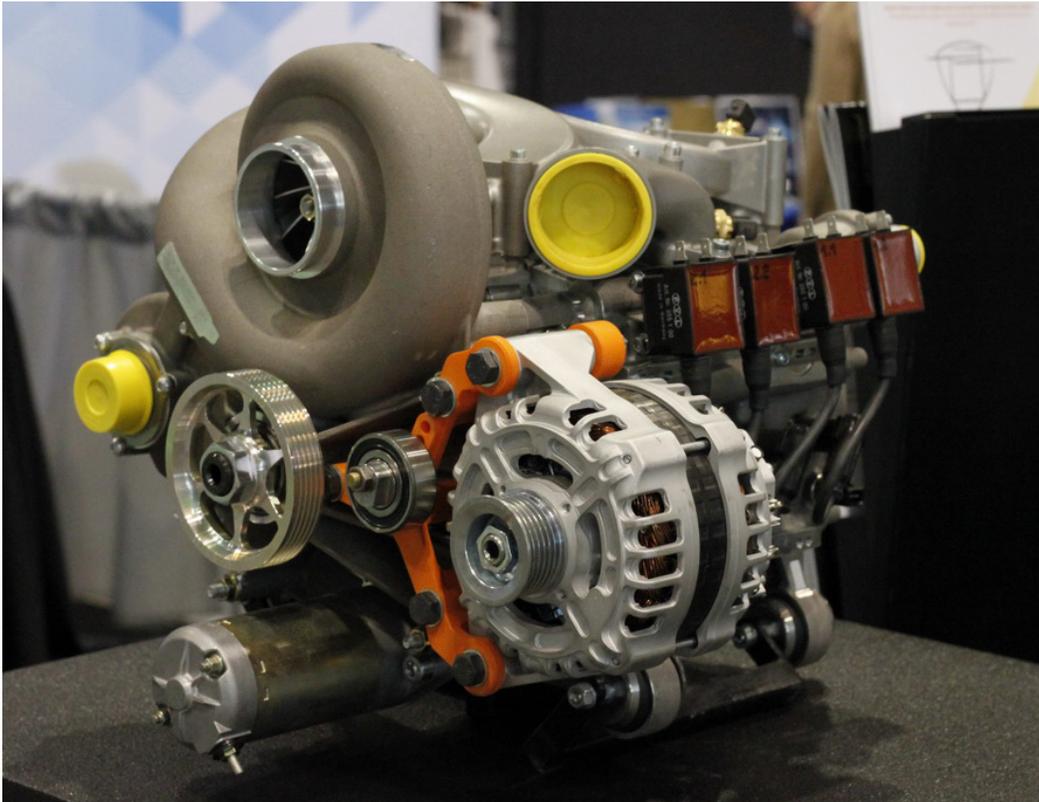
Desert Aircraft (DA), established in 1992, designs and manufactures several two- and four-stroke engines for applications that span the radio control (RC) and drone markets. The more than 50,000 DA engines in service are used in more than 25 programs, including those run by Lycoming, Boeing and Griffon Aerospace. At the show, DA displayed their newest 2-stroke gas engines, ranging from the DA35cc to the DA 215. The 21,000-square-foot manufacturing facility in Tucson, Ariz., builds engines as big as 500cc. The engines displayed were fuel injected with an installed generator and dual electronic ignition. Both single and dual piston engines are available. Depending on operating conditions, UAV operators can expect a Time Between Overhaul (TBO) of 300-400 hours. Systems are manufactured in the U.S., providing easier customization and quick prototyping options, the company said.



Diamond Aircraft AE300 rotary engine.

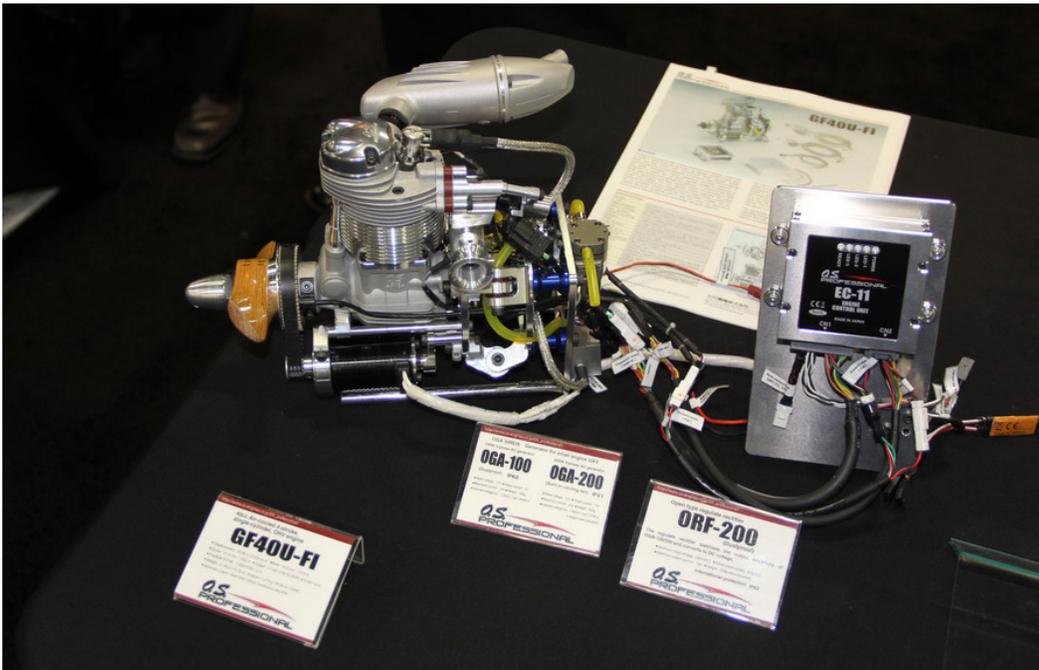


Diamond Aircraft heavy fuel piston engine.



Another view of the Diamond Aircraft piston aviation engine.

Diamond Aircraft sported two rotary engines and one 180-hp turbocharged heavy fuel piston engine, currently in use on the Orion UAV from Aurora. That engine boasts 6-7 gallons per hour in fuel consumption. It can produce these results by using a Common Rail fuel injection system, which is optimized by an integrated Engine Control Unit (ECU). The ECU uses real-time information about current operating conditions, such as power setting and altitude. As emerging rules and regulations begin to take effect, it is likely that certified aviation parts will be required for UAV systems operating in urban environments. The advantage the Diamond has is that they already build certified airplanes. The two rotary engines are already aviation-certified components. Some of the parts in the engines are 3D printed, where this can optimize the part and/or economics.



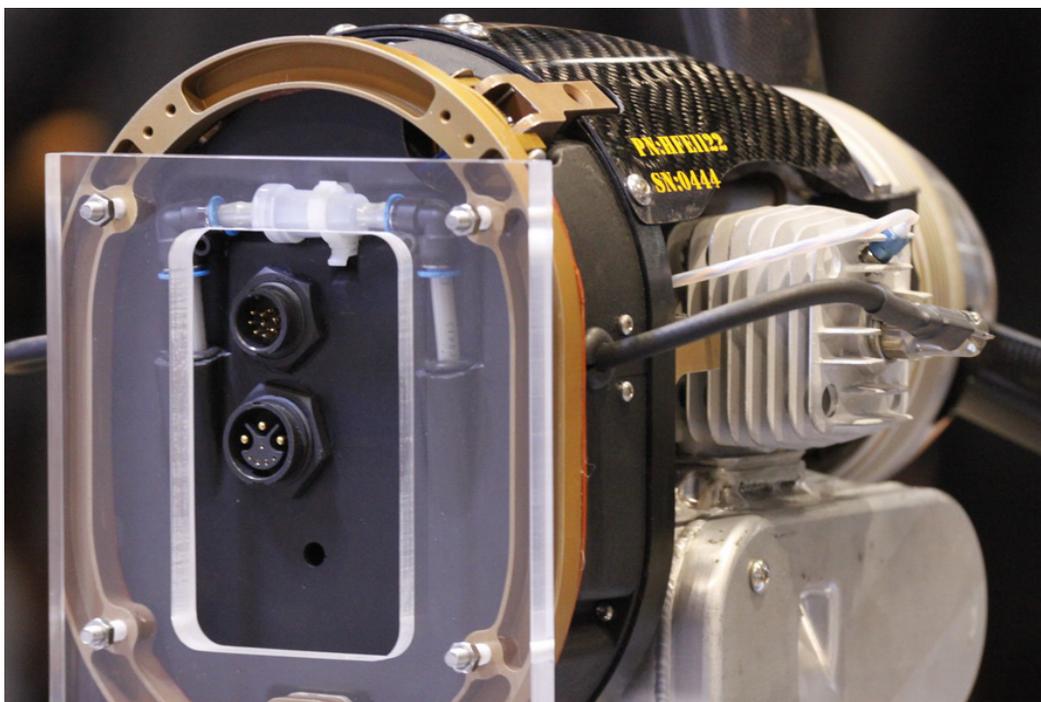
This Futaba 4-stroke engine with electric generator and fuel injection was shown at the Denver 2018 Xponential.

The Japanese companies Futaba and O.S. have a long history of collaboration in the production of high-quality products for RC and UAV markets. Shown from Xponential 2019 are various Futaba servos, and a single cylinder Futaba engine with an O.S. EC-11 “engine control unit” or ECU. The ECU contains a rectifier to allow users to run the electronic ignition, charge batteries, and utilize different DC voltages.

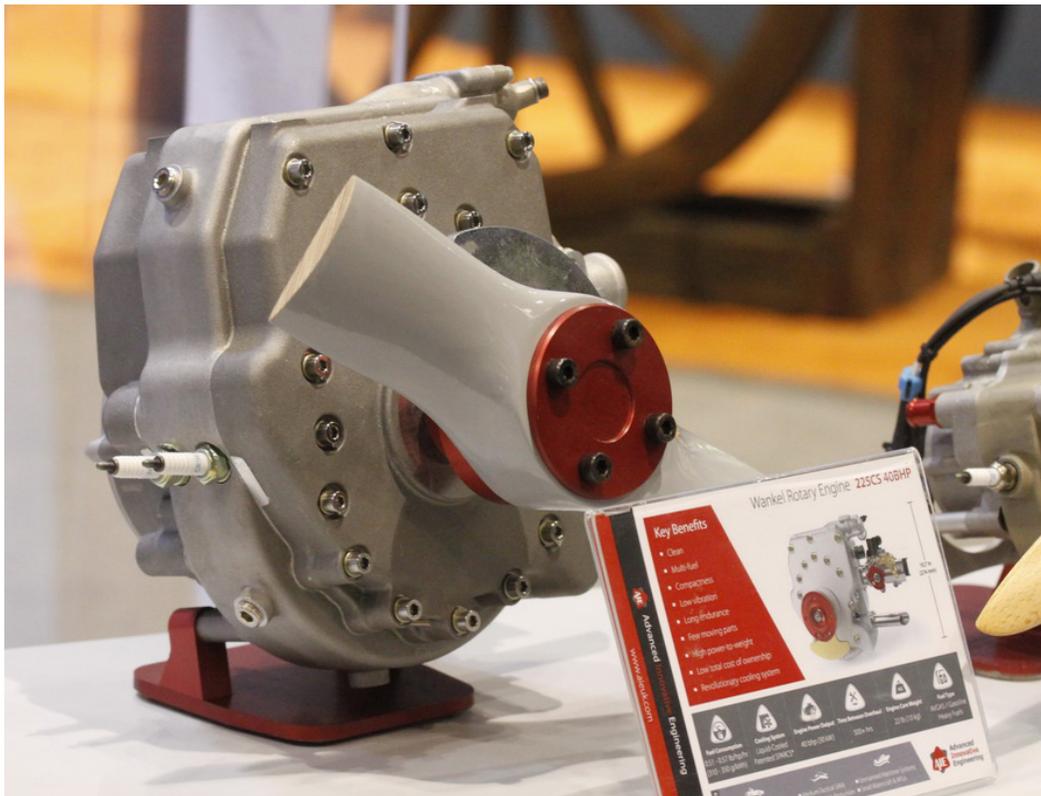
Also shown is a similar 4-stroke cycle engine, shot at the 2018 Xponential, with typical O.S. immaculate machining. This has a pressure sensor and electric generator, and features fuel injection and an exhaust muffler. Shielded wiring goes to the spark plug to prevent magnetic forces from interfering with electronics.



HFE International
DA 150 Gen Pod.



Note electrical and
fuel ports at the HFE
Gen Pod interface.



HFE Wankel rotary engine.

HFE International introduced their new Gen Pods at the show. The DA 70 and DA 150 Gen Pod are both modular systems. All the engine-related components are mounted in the pod which simply, in the words of mechanical engineer and CEO Thomas West, “... pops off the airframe.” This modular approach significantly reduces time spent to remove the engine from the UAV for maintenance. All connections to the UAV are condensed into a few connectors built onto the back of the pod. Removing the pod from the airframe is a simple matter of releasing three clamps and disconnecting the electrical and fuel connectors. The pod can be replaced immediately with an identical pod so the UAV can be returned to service while maintenance is conducted on the removed pod. This approach practically eliminates down time for the UAV system.

The pod is available in 70- and 150-cc models that include integrated vibration isolation, spinner and propeller, decompression valves, brushless starter and 500-watt alternator, fuel pump, ignition system and muffler. These engines also sport electronic fuel injection and engine control modules. HFE has a full line of single and twin engines, as well as rotary options available as large as 650 cc. HFE said its products are battle tested with more than 1,000 sold and deployed with the U.S. armed forces, and states, “Our propulsion systems are 25% the cost of the closest competitor.”

HIRTH ENGINES, #4536

- 2-Stroke
- Air Cooled
- Exceptional reliability
- Meets the demanding requirements for UAVs
- Maximum performance in extreme conditions



HIRTH Engines
41 Series twin.



HIRTH Engines 42 Series
engine configuration.

Hirth founder Hellmuth Hirth said he was influenced by the Wright Brothers, Edison and Zeppelin, thus connecting the corporate roots of this highly experienced firm to the pioneering days of aviation. Hirth engines offer a wide range of customizations, including using heavy fuel. The Hirth 41 SERIES engines are based on the 4103 engine, which Hirth reports has flown more than 20,000 missions worldwide. These air-cooled 2-stroke engines utilize advanced closed-loop control. The HIRTH 42 SERIES features automatic altitude and temperature compensation, optimizing performance in extreme environments. Hirth prides itself in offering high-value engineering that delivers the best in power-to-weight ratios and low maintenance costs. “Extensively proven in civilian and military domains, Hirth’s engines are the propulsion system of choice in the helicopter and fixed wing unmanned aerial vehicle (UAV) sector,” the company said.

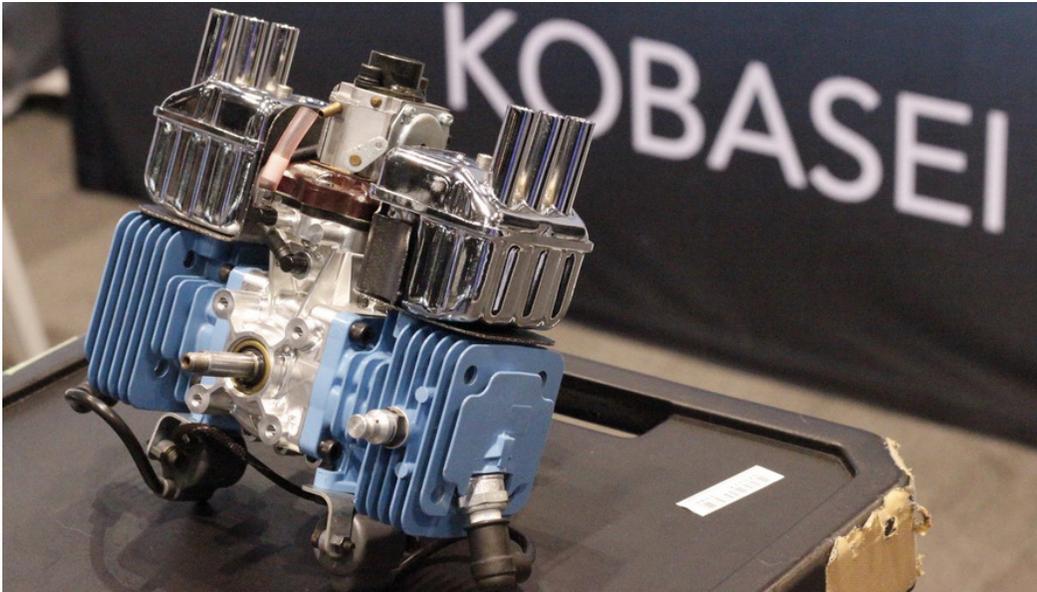
[INNOV8TIVE DESIGNS,](#)

Innov8tive Designs began in 2006 to globally distribute Scorpion Motors and Speed Controllers. As the Scorpion product line became recognized worldwide as a premium choice for fixed wing, helicopter and multirotor RC and UAV power systems, Innov8tive Designs’ addition of proprietary Cobra Motors and Speed Controllers further bolstered the company’s market position. During this period of corporate growth, Innov8tive Designs distinguished itself in performing consulting services for private companies and selected law enforcement agencies that were expanding their expertise in drone systems. Today, the firm offers consulting services on power systems and provides scalable stock, semi-custom and full custom electric power systems for a wide range of UAV and drone applications. Innov8tive Designs said its products meet and exceed the requirements of drone applications in extreme environments. The firm said it places a premium on top level customer support before, during and after any product purchase.

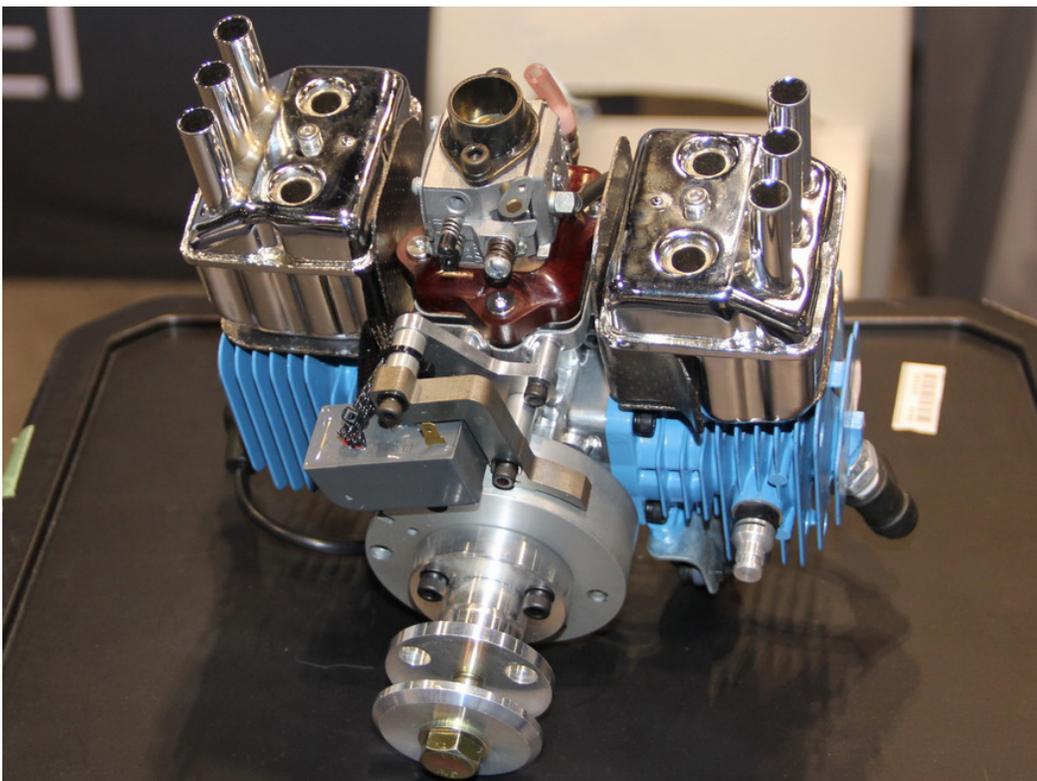


KDE Direct quadcopter camera harness detail.

KDE Direct specializes in brushless motors, Electronic Speed Controls (ESCs) and propellers designed to set the standard in UAV propulsion systems. KDE notes on its home page: “KDE Direct has manufactured brushless motors for drones and UAVs for over a decade. With heavy-lift motors for the longer flight times and larger weights, KDE Direct has a range of motors from multi-rotor to single-rotor for specific applications. Our components have been used in the aerial filming of the biggest global opening in movie history, as well as delivering medicine to those in need in Africa.” The company emphasizes innovation and world-class customer support.

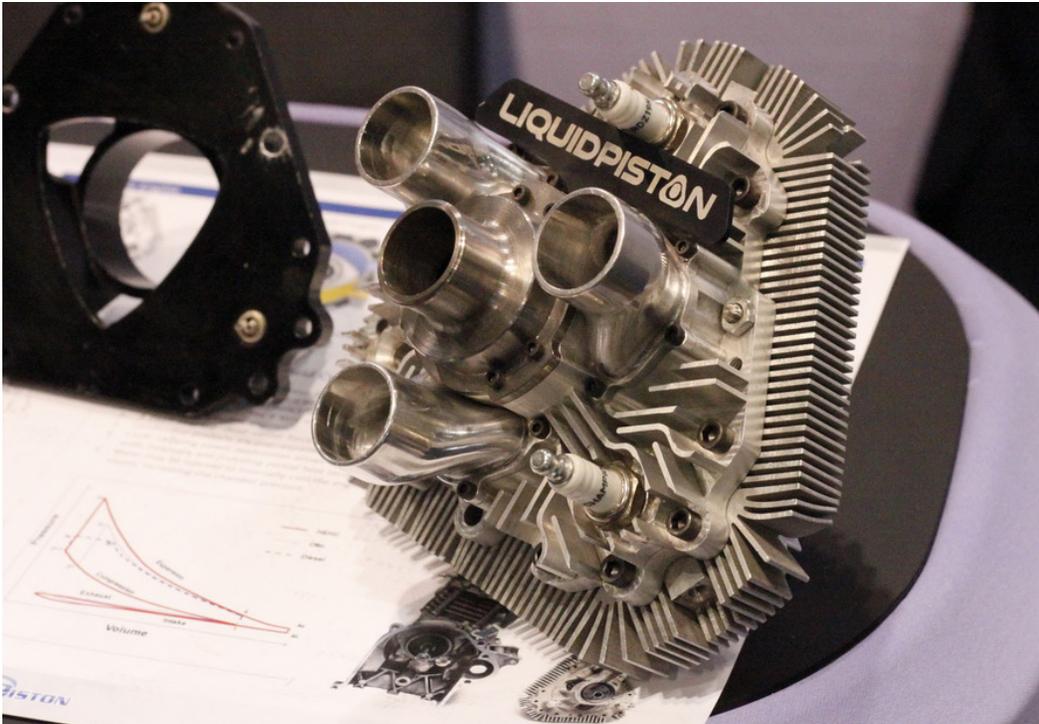


Kobayashi Precision Industry Co., Ltd., showed its KOBASEI 2-cylinder, 2-cycle BT-86 engine with magneto ignition system.

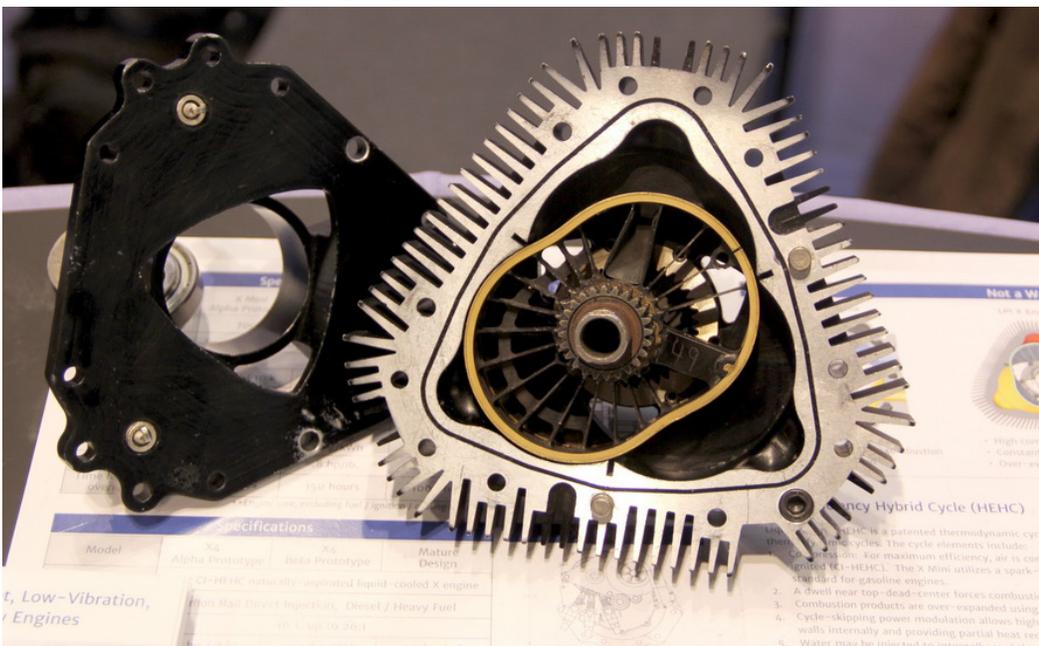


Another KOBASEI engine configuration.

Kobayashi Precision Industry Co. exhibited the KOBASEI 2-cylinder, 2-cycle BT-86. This 86cc premixed gasoline/oil engine weighs in at only 2.95 Kg, and churns out a hefty 5.6 hp. The engine features a magneto ignition system, which is unique. Despite the legendary reliability of magnetos, not many manufacturers employ them. Starter and generator options are available.



Liquid Piston is well known for its ingenious rotary design, and showed its HEHC “high efficiency hybrid cycle” power plant.



The air-cooled Liquid Piston S-Mini 70cc engine can produce 5 hp in a 3 lb. package.

Typical rotary engines have problems with the apex seals. Liquid Piston, with its patented TRL-5 technology, has developed a High-Efficiency Hybrid Cycle (HEHC) engine that, while still a rotary, puts the seals on the stationary portion of the engine as opposed to the rotor. The benefits are the seals last longer, work better and can be replaced like spark plugs, making them a maintenance item instead of an engine teardown item.

The result of more than a decade of development is the air-cooled X-Mini 70cc, a high-efficiency engine that is responsive, compact and lightweight; capable of producing up to 5 hp in a 3-lb. package. The multi-fuel engine can burn the most extensive variety of fuels, including diesel, gasoline, natural gas and heavy fuel but, will do so in the most miserly of ways. Fuel efficiency is expected to be reduced by as much as 50%, the company said. The engine will provide a quiet, low vibration solution in sizes from 1 hp to over 1,000 hp.

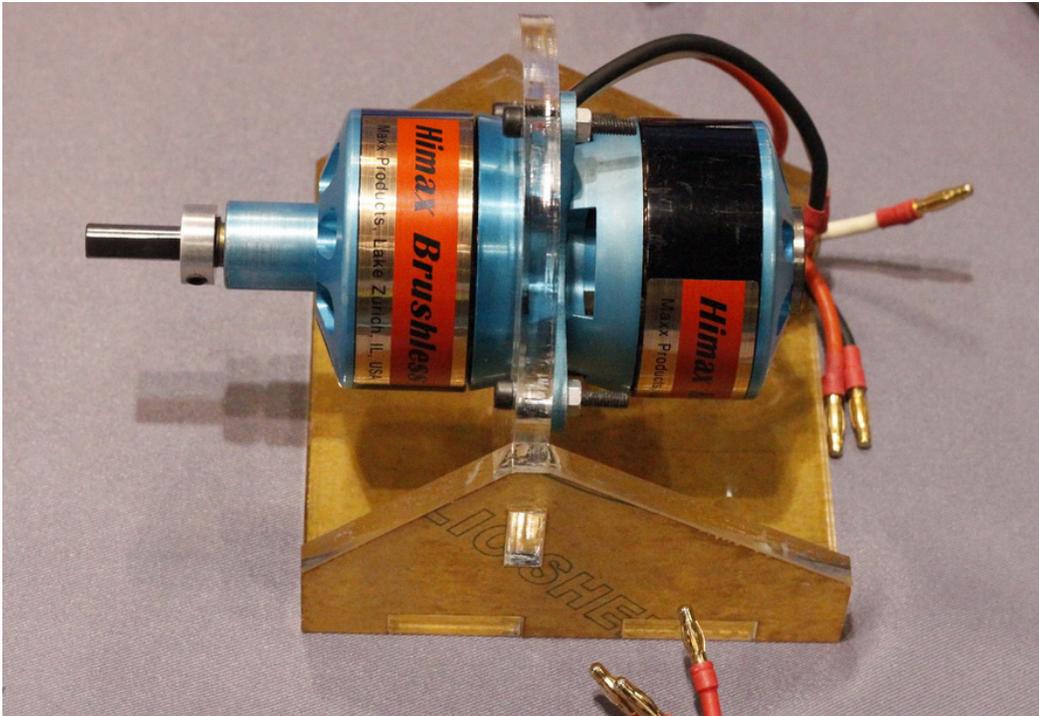
[MARYLAND UNMANNED, #2031](#)



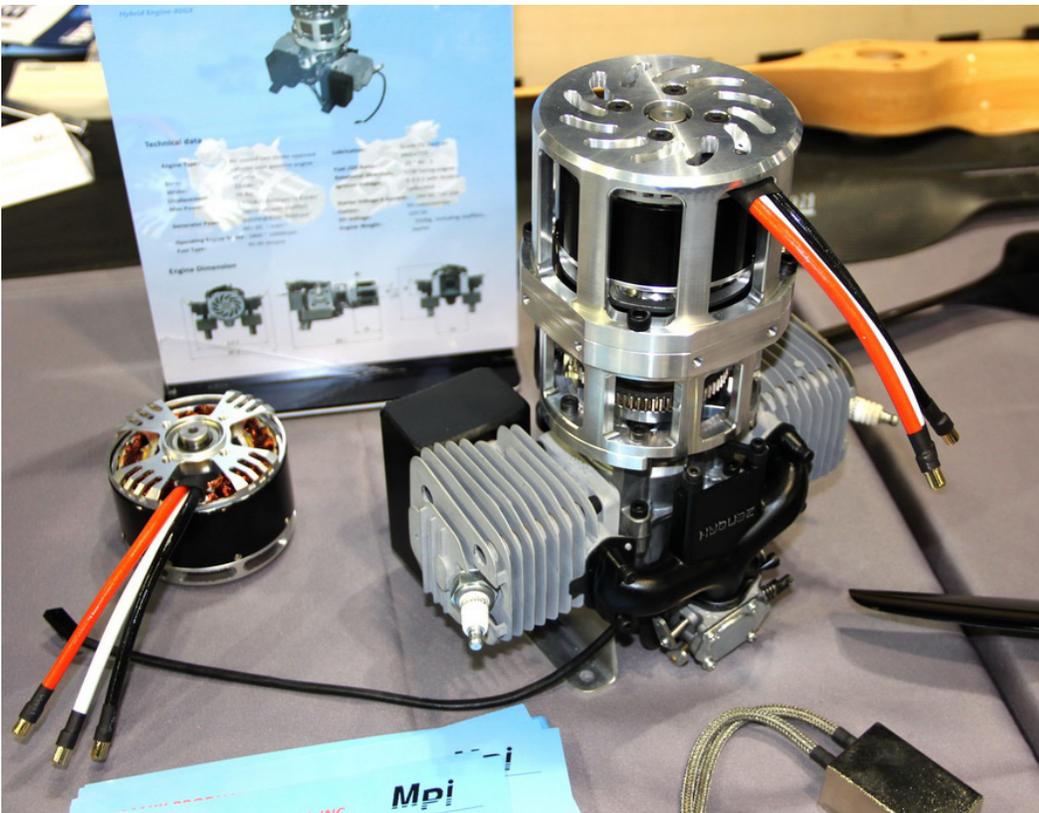
Maryland Unmanned exhibited this opposed 2-stroke twin at Xponential 2018. Baffling around the cylinder heads forces air to cool the pistons.

Maryland has been a testbed in NAS development for over two decades. As a center in aerospace and home of the University of Maryland, the state hosts more than 9,000 aerospace and defense businesses. In this image shot in the Maryland exhibit at the Denver Xponential 2018, shielding can be seen on wires leading to the spark plugs in this opposed 2-stroke cycle twin cylinder engine, with a single spark plug. Notably, the prop drives air into the front, and baffling around the cylinder heads forces air to cool the pistons.

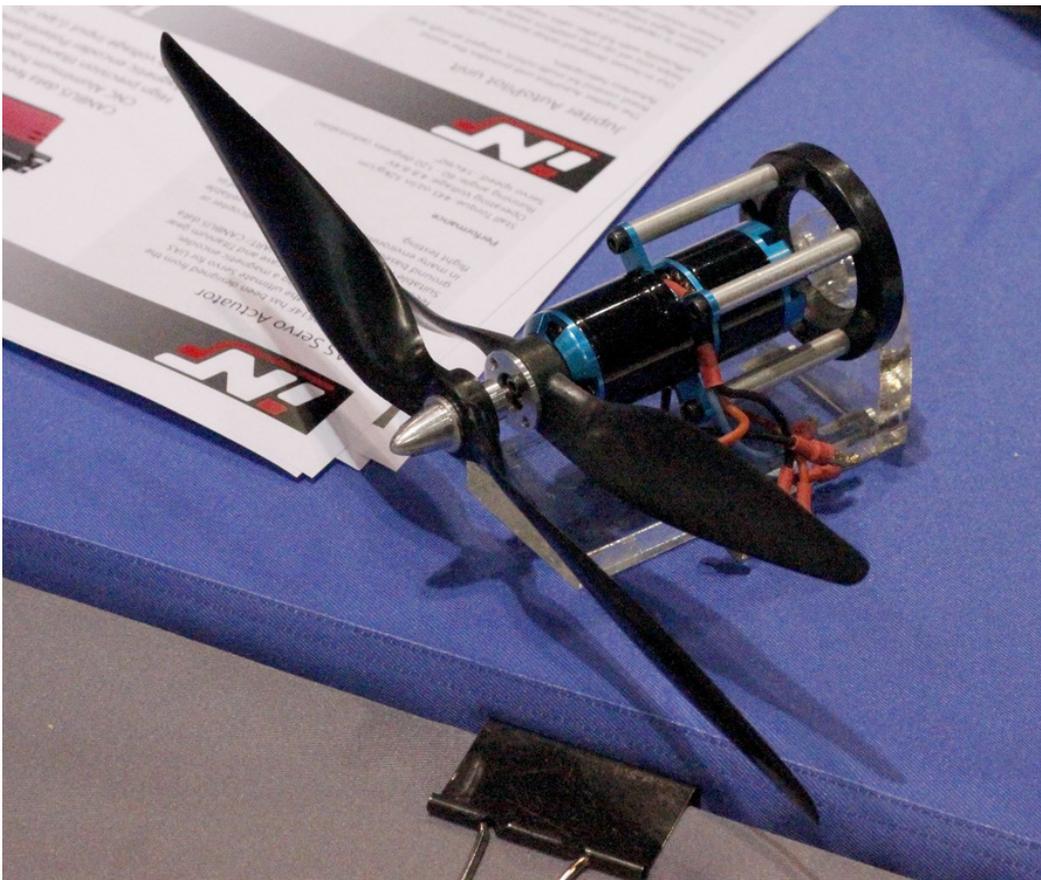
MAXX PRODUCTS INTERNATIONAL (MPI), #4320



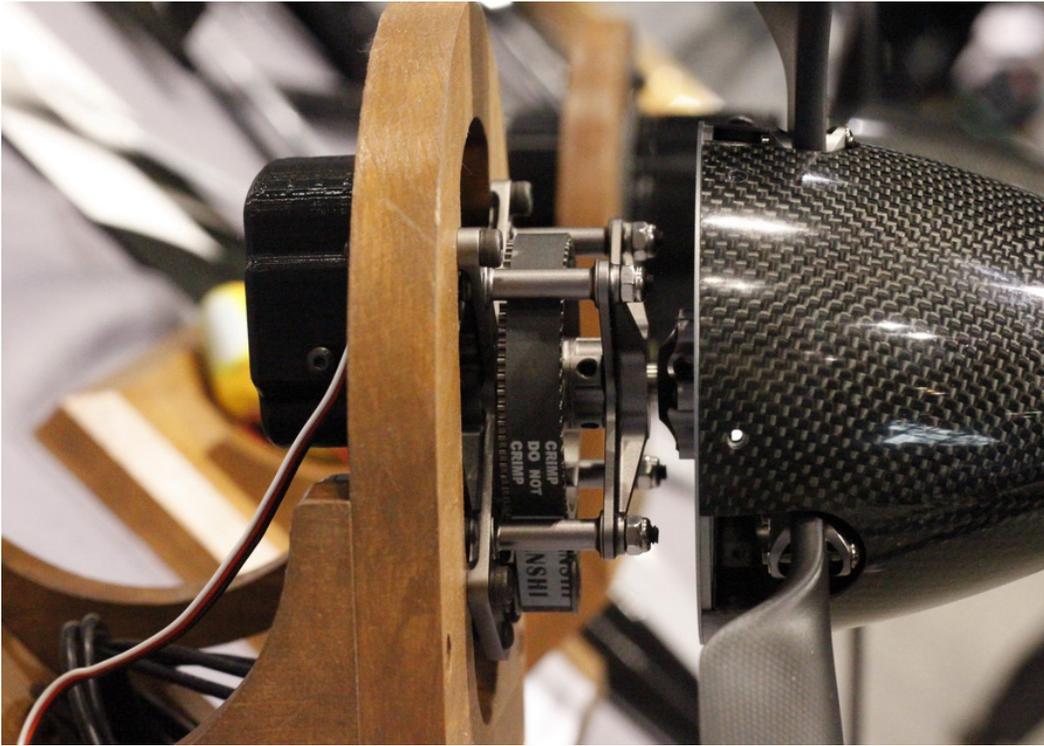
Maxx Products International (MPI) Himax brushless motor.



The MPI alternator is on left, and you can also see it mounted at the end of the engine output shaft. In this configuration, the twin cylinder 2-stroke-cycle, carbureted engine drives an alternator that powers an AC brushless electric motor for propulsion. The black frame between the pistons shows a piston-controlled porting arrangement with a Walbro carburetor. MPI displayed this unit with alternator at Xponential 2018.



MPI Himax
contra-rotating
propeller system.



MPI belt-drive variable pitch propeller system detail.



MPI direct drive variable pitch propeller system.

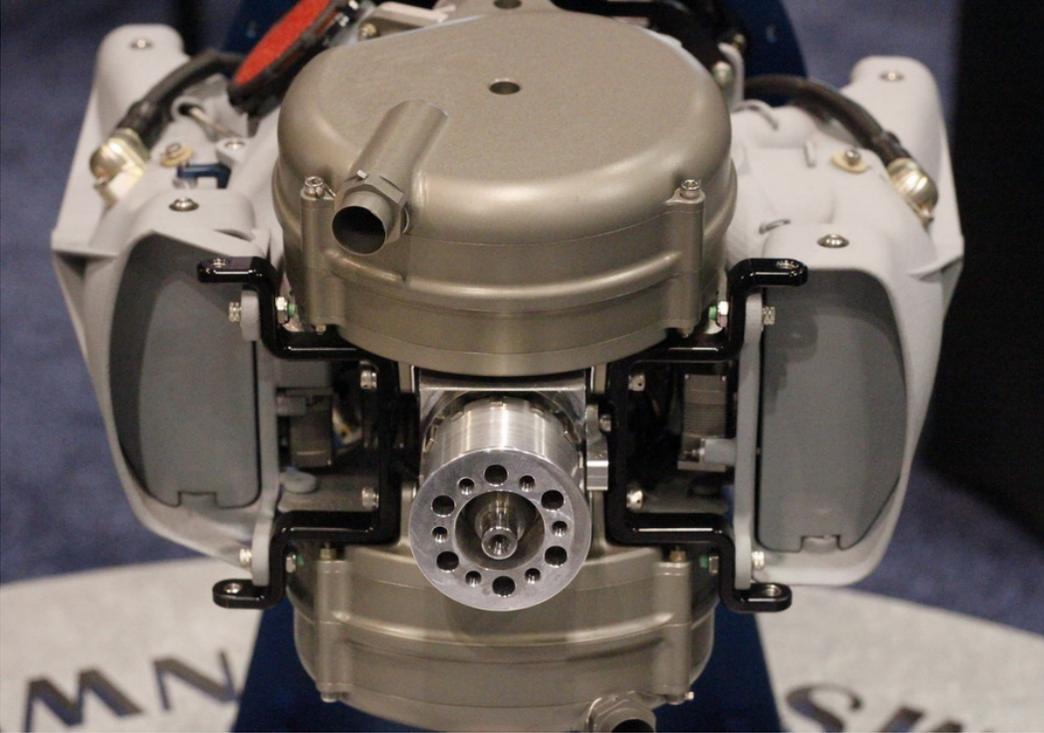


MPI Falcon propellers.

MPI provides a variety of power systems, including brushless motors, gas engines, and hybrid power systems in which engines generate electric current that powers electric propeller pods. MPI also offers an exceptional line of propellers for tractor, pusher and contra-rotating propeller systems. The contra-rotating electric power plant is based on their HIMAX Brushless motor. The linear design places the motors in line with one another, with the shaft of the rear motor placed inside the shaft of the front motor resulting in a nicely streamlined package with no complicated gear box and a small part count.

While the contra-rotating motors, propellers, and rotor blades are available off the shelf, other items are custom-built per customers' applications. Off the shelf items are available for customization within a 6- to 8-week turnaround, notes MPI President Jarvis Yeh. The HIMAX brushless motors are maintenance-free, dustproof and waterproof. The built-in centrifugal fan provides cooling, and the heavy-duty design ensures a rugged motor. In-flight-adjustable variable pitch propeller units are available from MPI as well. The company said it is unaware of any competing variable pitch propellers available in this size category.

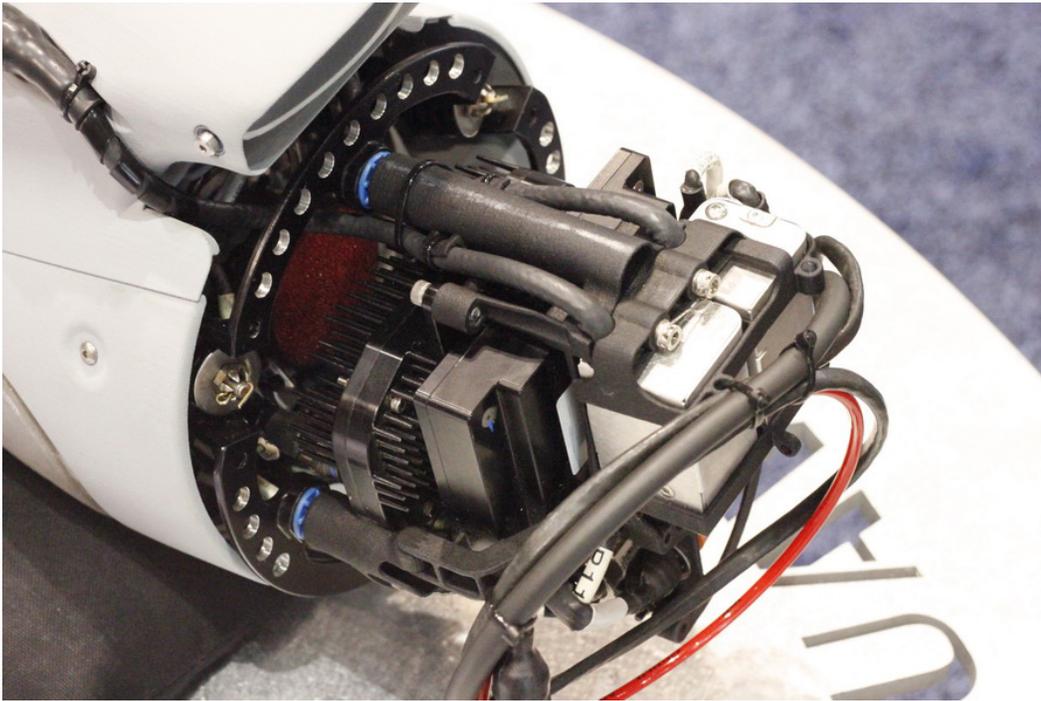
NORTHWEST UAV, #2427



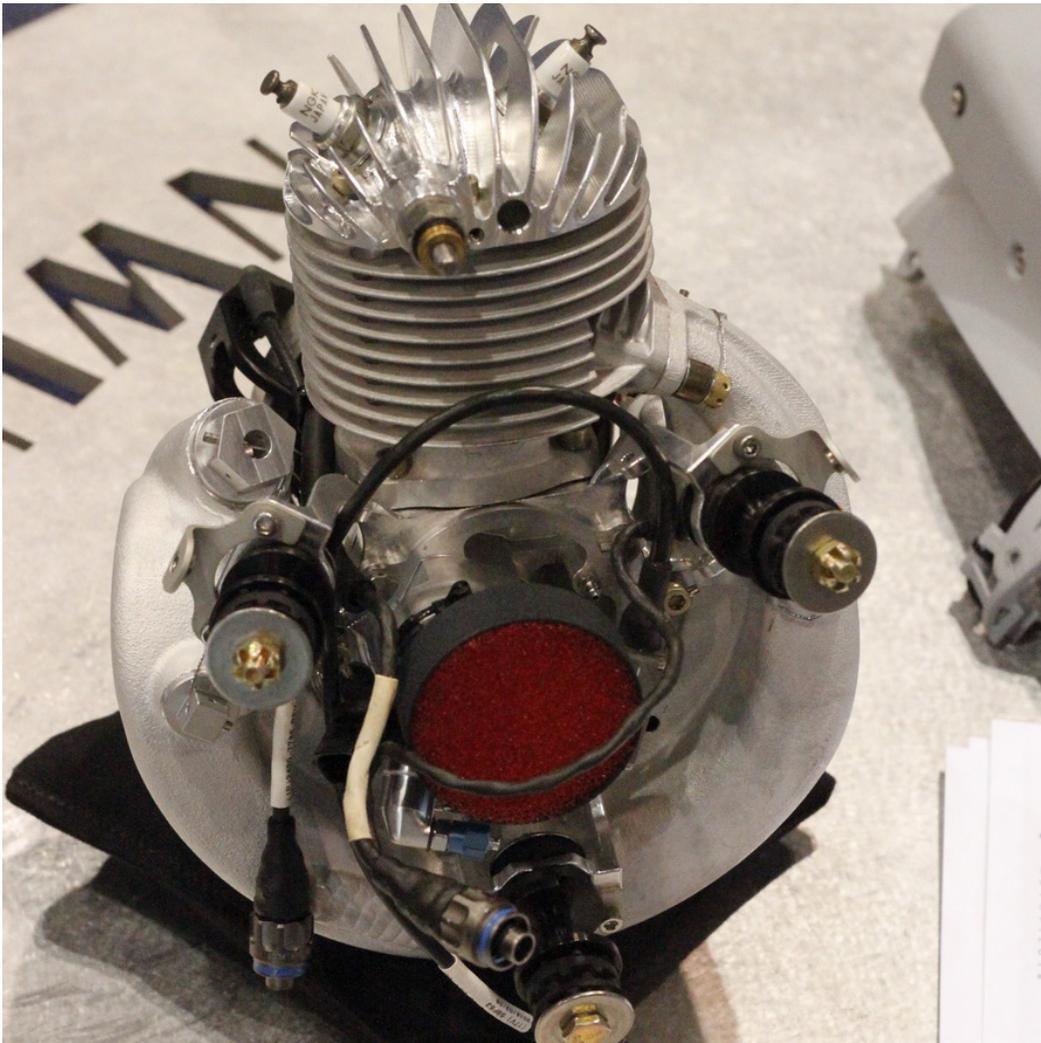
The Northwest UAV engine is the core of a system that can be a single or a twin, and cowled as appropriate.



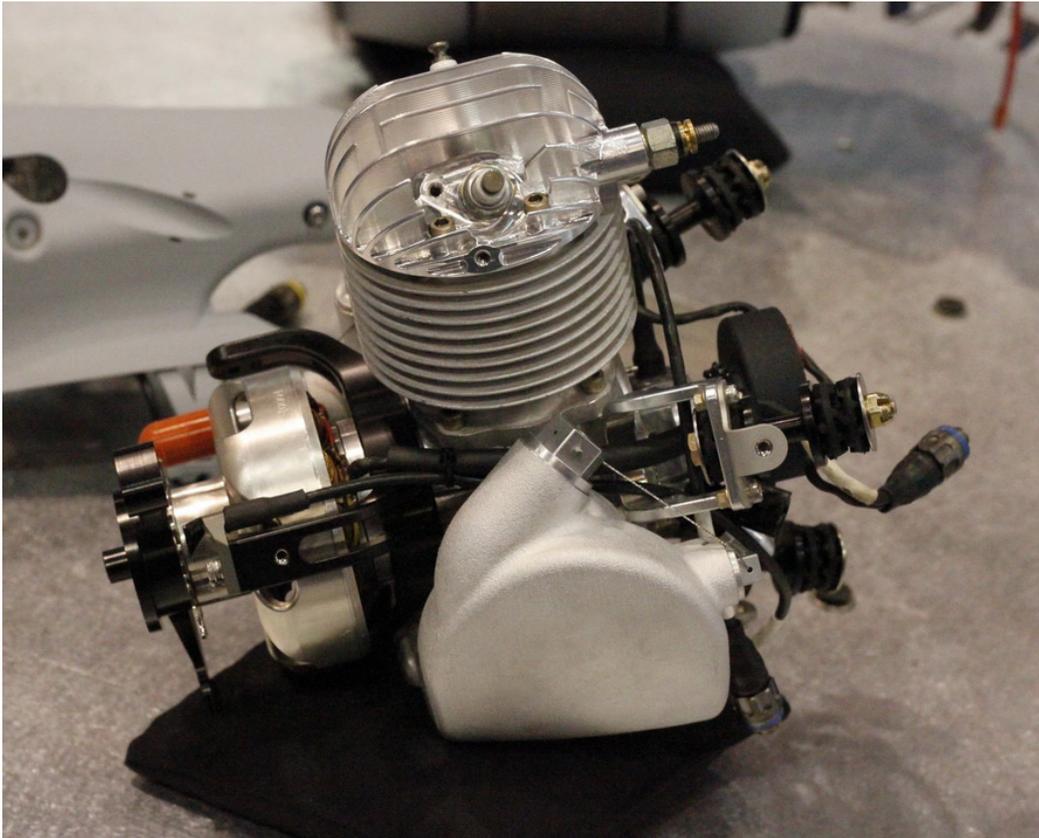
Side view of the Northwest UAV power plant exhibited at Xponential 2019.



Northwest UAV engine detail.



Single cylinder Northwest UAV power plant with anti-vibration mounting lugs.



Side view of a Northwest engine configuration.

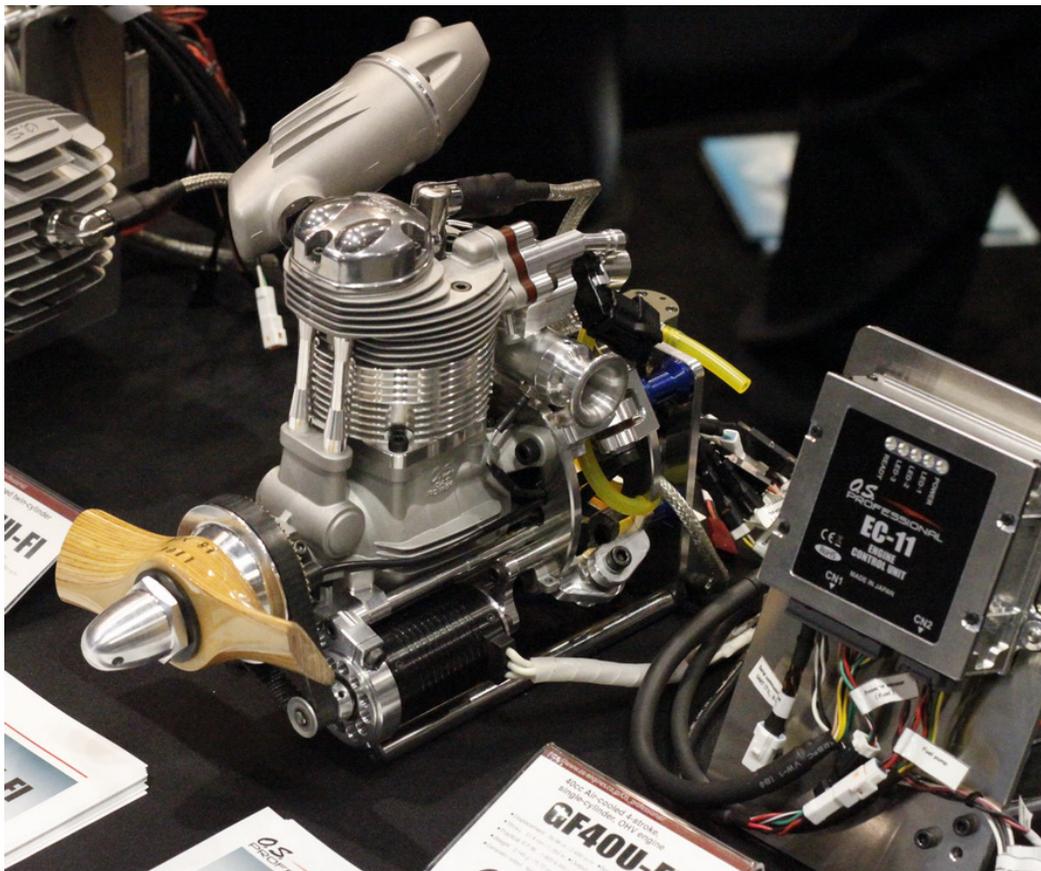
Northwest UAV has built more than 13,000 propulsion systems, accumulating more than 1 million flight hours. Their Commercial Off The Shelf (COTS) offerings have over 100 systems operational, with more than 15,000 actual combat hours.

This year, Northwest showed two engines designed from the ground up as UAV engines. The Northwest 44 is a 44-cc, 2-stroke heavy fuel engine. Along with dual ignition, an engine pre-heat circuit and aviation grade components, it has a 300-watt generator, lots of 3D-printed parts and a uniquely shaped muffler precisely designed to conform to the cowl. The muffler is so efficient that the engine is quieter than the propeller, the company said. The cowl is 3D printed so it can fit any airframe based on a custom order. All parts are aviation-grade components. The cowl contributes to the temperature control of the engine by using automatic dampers to control airflow around a sizable cooling-fin. A pre-heat circuit can warm the engine before starting. The engine operates in extreme hot and cold environments.

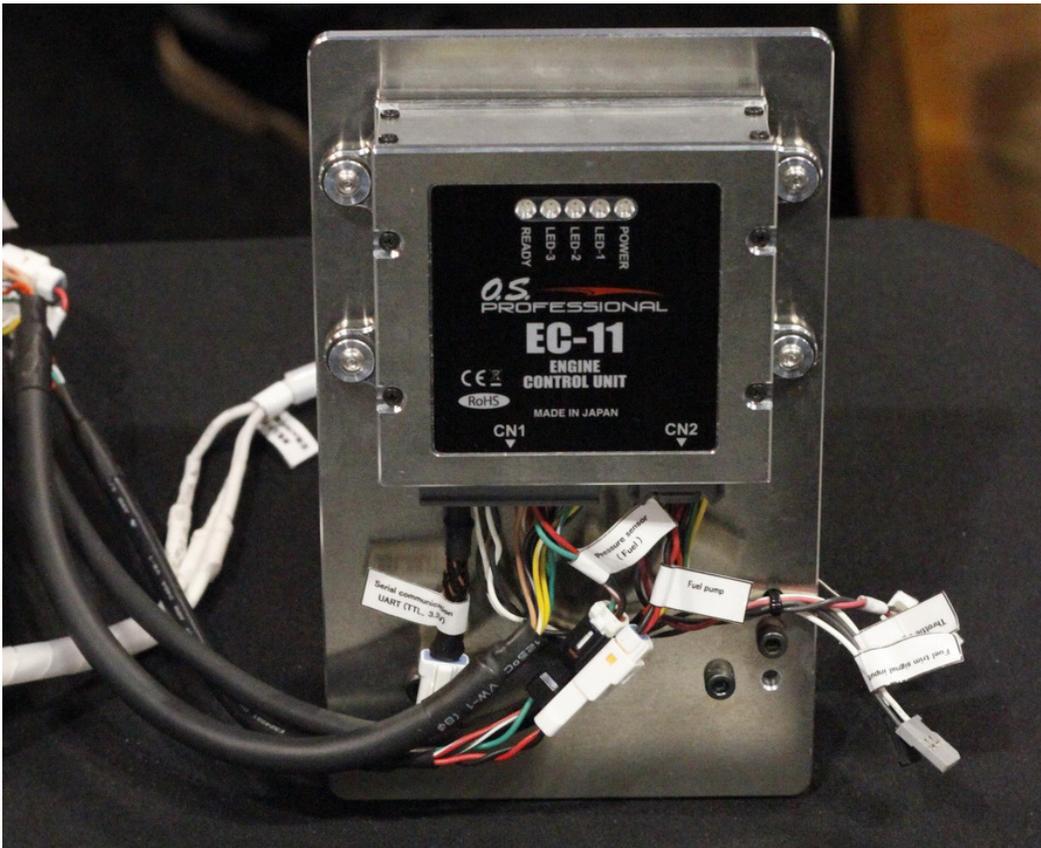
Vibration control is engineered right into the engine. The electronics suite can be mounted on the engine or remotely mounted in the airframe, increasing installation flexibility. The electronics package includes data

logging features available through a maintenance port. After flight, the port can download up to 31 parameters of engine operation. The data can then be sent to Northwest and analyzed for anomalies by the engineers. These engines are designed to be FAA certifiable and are specific to UAVs in the 55-pound, fixed wing category using aviation grade materials and components. The entire system is designed with electromagnetic interference (EMI) protection in mind to protect signal integrity and payload operation. According to Jeff Ratcliffe, Northwest UAV CTO, it is "... about taking the (design) load off the airframe manufacturer and simplifying operations in the field." Northwest's 88 Twin version of the 44 can support an optional 750-watt generator. Both engines can be configured as either tractor or pusher configuration as required owing to the 3D-printed muffler and cowling. Northwest is also a distributor of the Rotron Rotary.

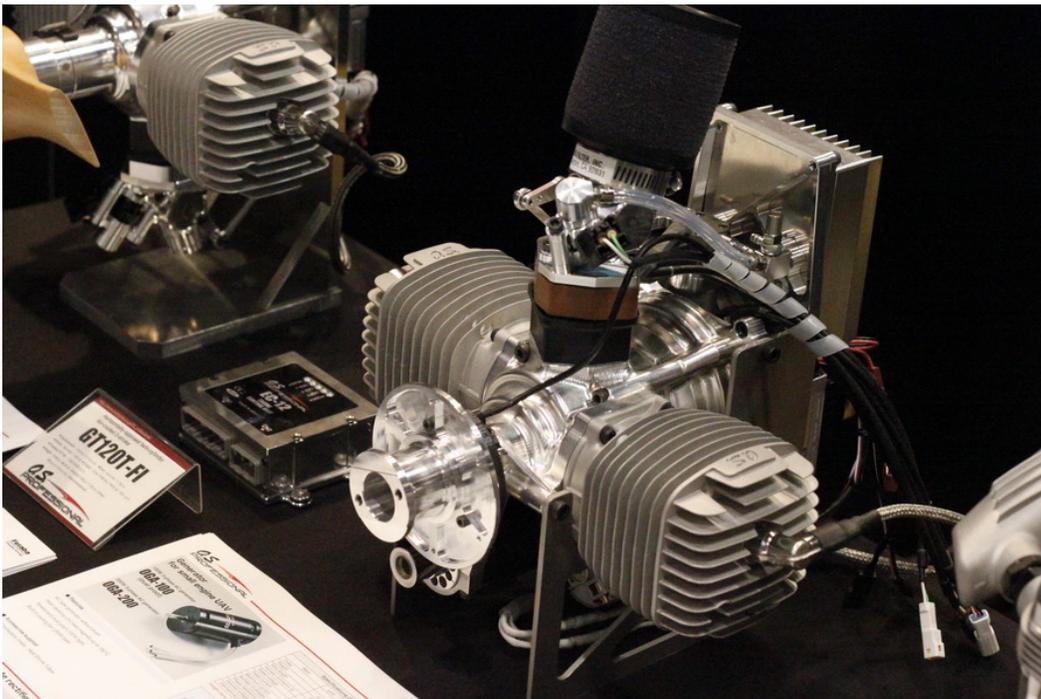
[O.S. ENGINES, #2038](#)



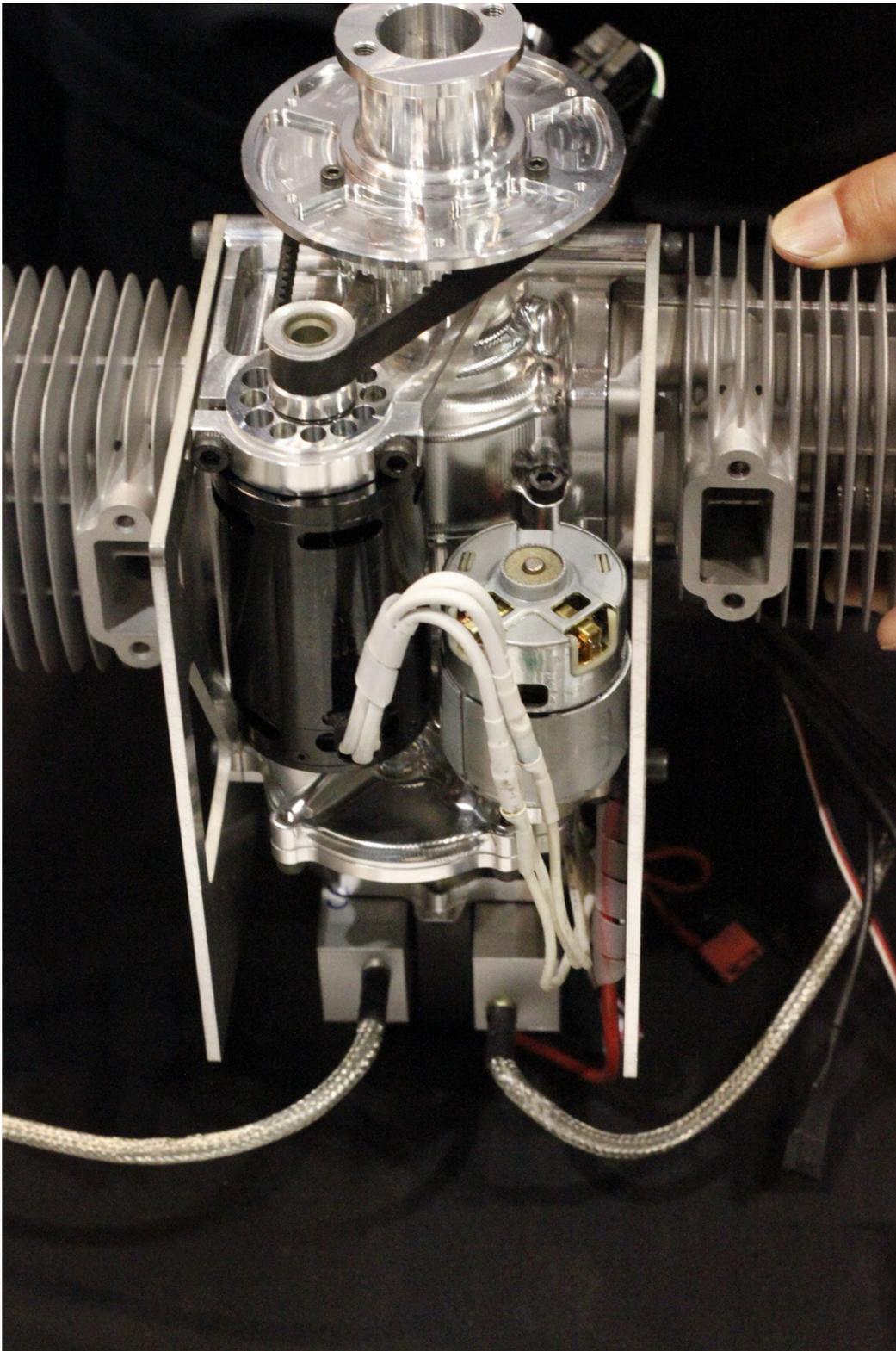
O.S. 40cc 4-stroke
GF40U-FI engine with
Engine Control Unit (ECU).



O.S. ECU detail.



O.S. Boxer twin engine.

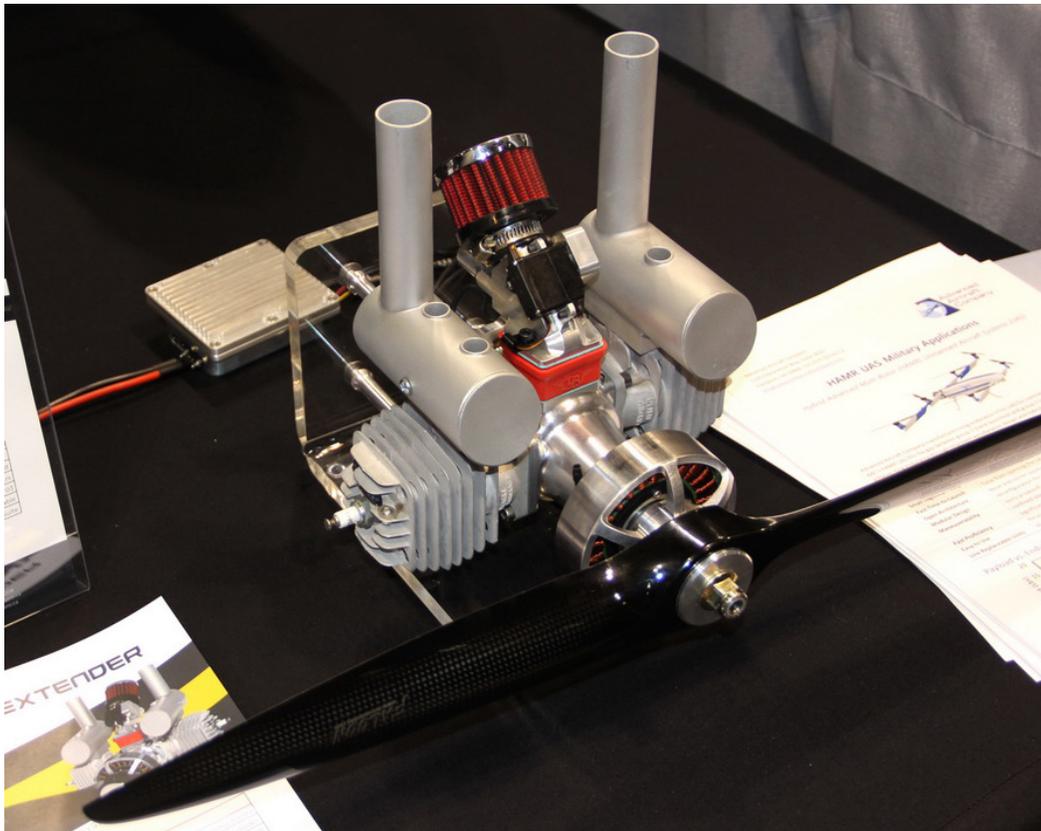


O.S. Boxer twin belt drive generator detail.

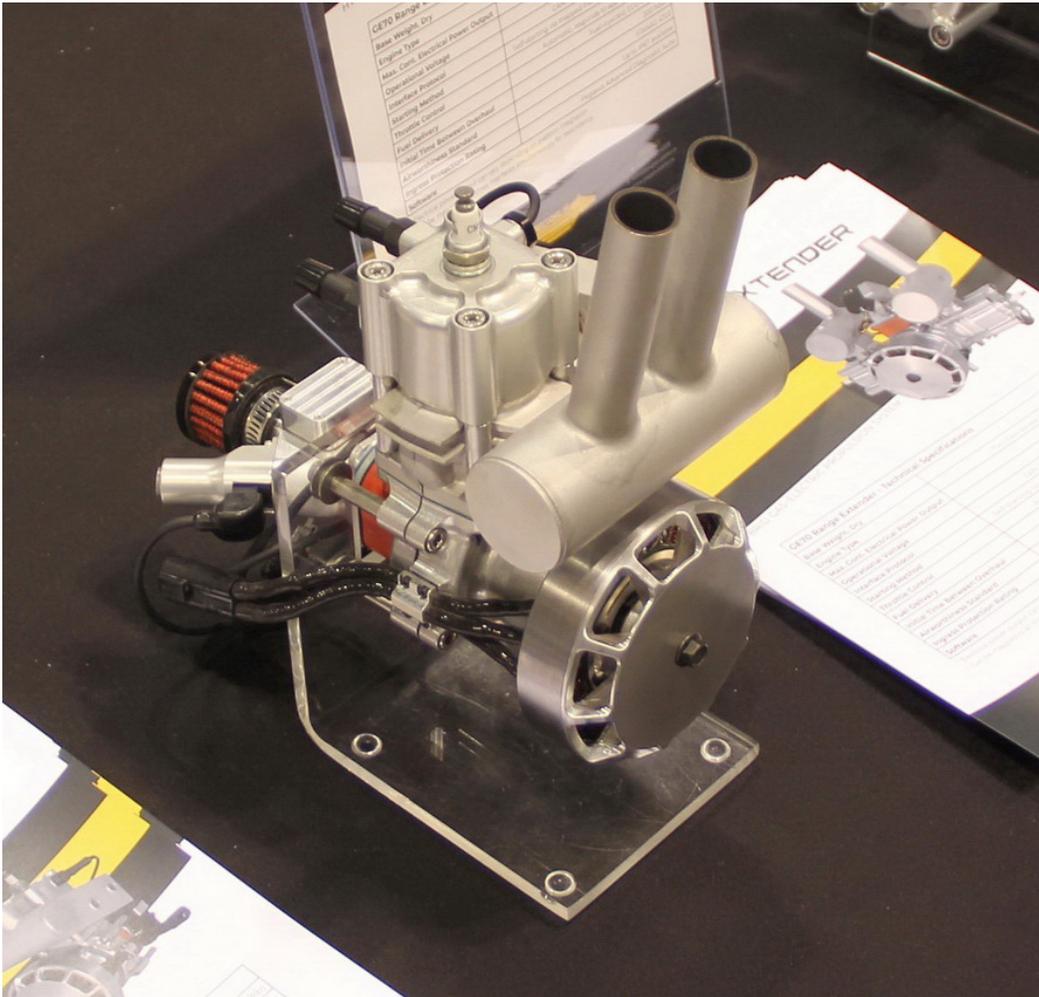
O.S. Engines Professional is the O.S. Engines line of single and multi-cylinder engines for both fixed wing aircraft and helicopters. With a broad range of sizes and types, O.S. is well poised to meet demand in the UAV market. They make 2 and 4-stroke engines and mount options for a

generator, starter and smart engine control unit (ECU) with downloadable data. O.S. introduced the 40-cc 4-stroke GF40U-FI engine at the show. This fuel injected, air-cooled, single cylinder engine produces 2.66 hp in a 75.71-oz. package. Offered with it is a matching 100-watt generator with a regulator/rectifier capable of providing any voltage between 6 and 28 volts. Since there are not many fuel pumps in this size range, O.S. said it designed a proprietary vane pump to provide the necessary pressure for the fuel injection system. The latest ECU incorporates sensors for atmospheric pressure, intake air temperature, fuel pressure, intake manifold pressure, RPM, cylinder head temp, and engine temperature. All these parameters can be streamed in real time or stored for later retrieval.

[PEGASUS AERONAUTICS, #4221](#)

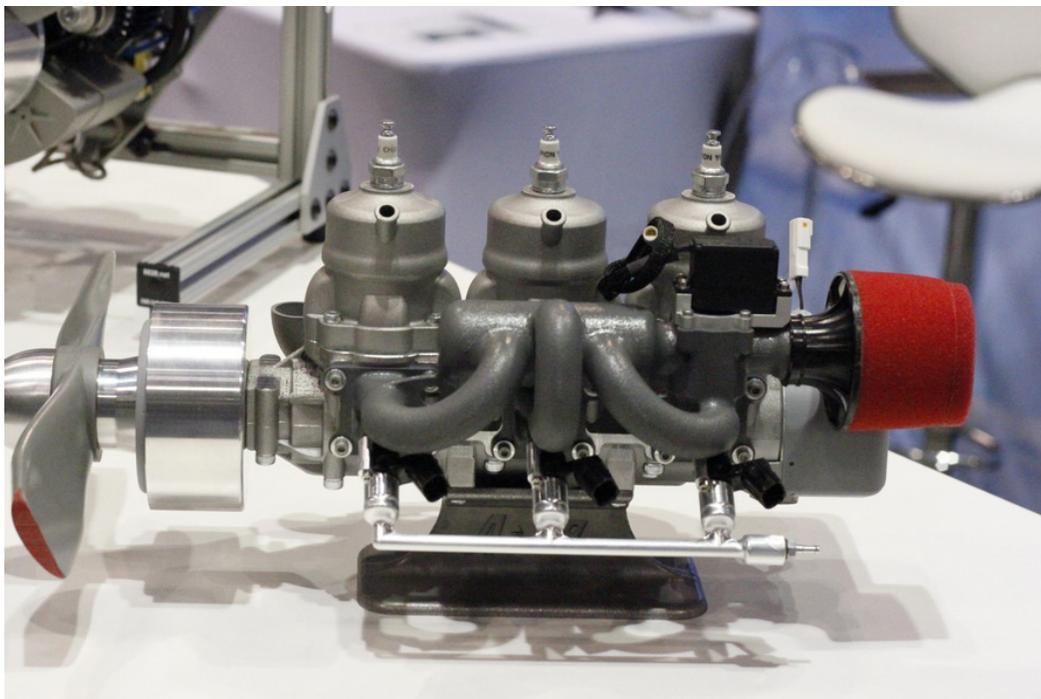


Pegasus Aeronautics
GD70 70cc Range
Extender.

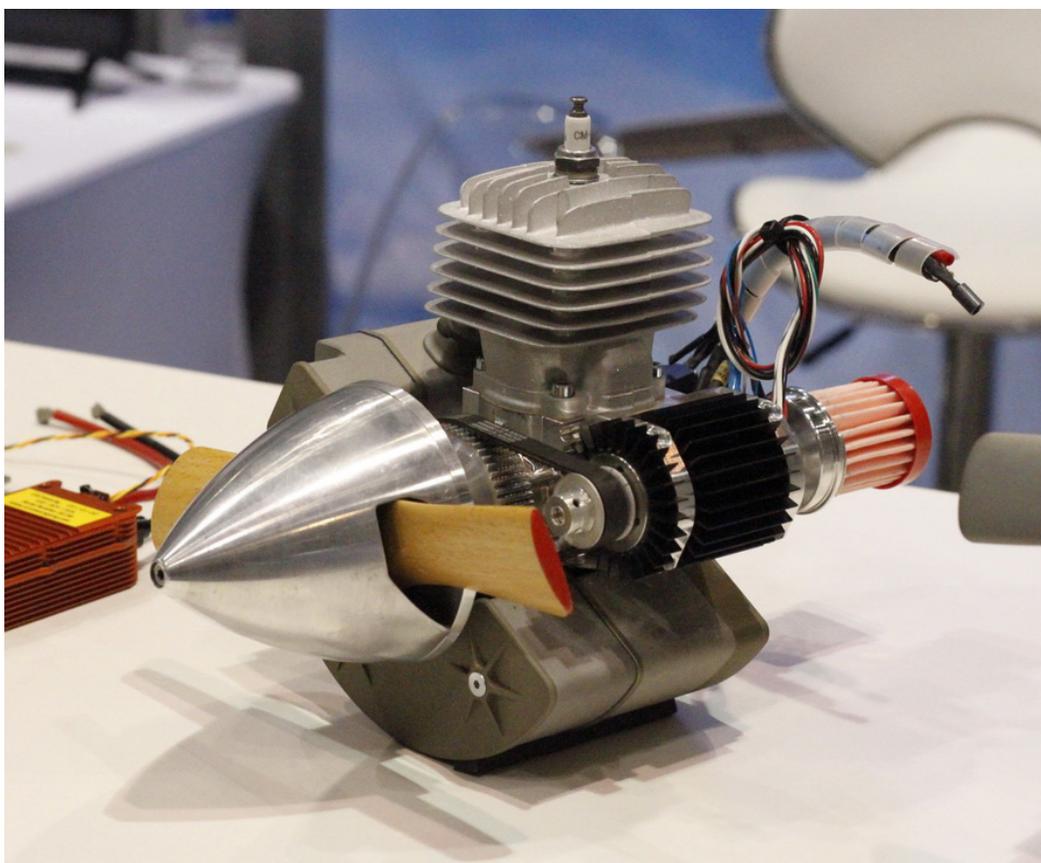


Pegasus GE35 35cc
Range Extender.

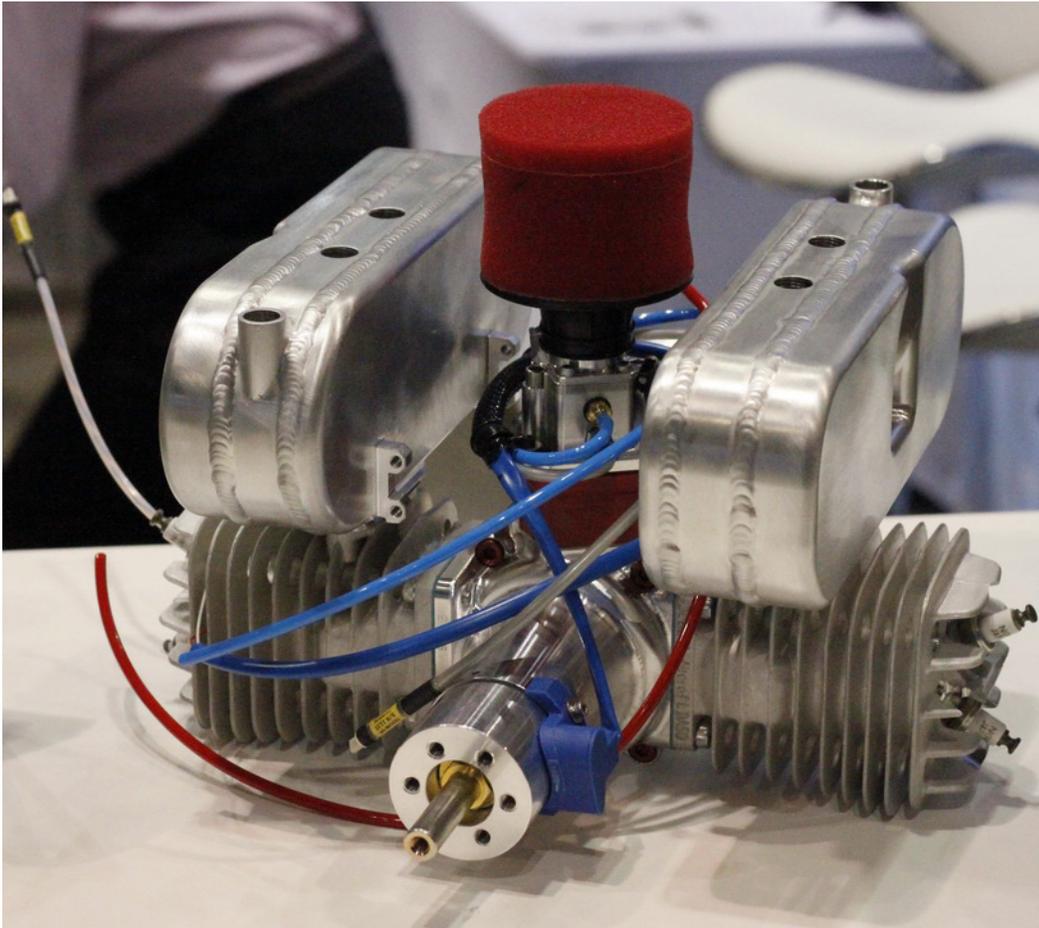
Located in the Kitchener-Waterloo region of Ontario, Canada, Pegasus was founded by a team of University of Waterloo engineers to address the challenges of designing heavy-lift UAVs with improved endurance. Pegasus Aeronautics has developed gas-electric hybrid power trains that leverage heavy fuels to overcome the logistical challenges associated with battery-powered vehicles. Pegasus said it has the highest power-to-weight ratios in the industry, as well as most efficient fuel consumption. Pegasus power units include a comprehensive diagnostic suite and operate in a wide variety of climates. Vehicle designs include fuel injection, advanced power management, self-monitoring onboard diagnostics and liquid cooling.



Power4Flight Cobra A99 3-cylinder, 2-stroke, liquid cooled, fuel injected engine with 3D printed heads, crankcase, cylinder and exhaust.



Power4Flight B29i EFI UAV Engine.



Power4Flight B100i
EFI Twin.

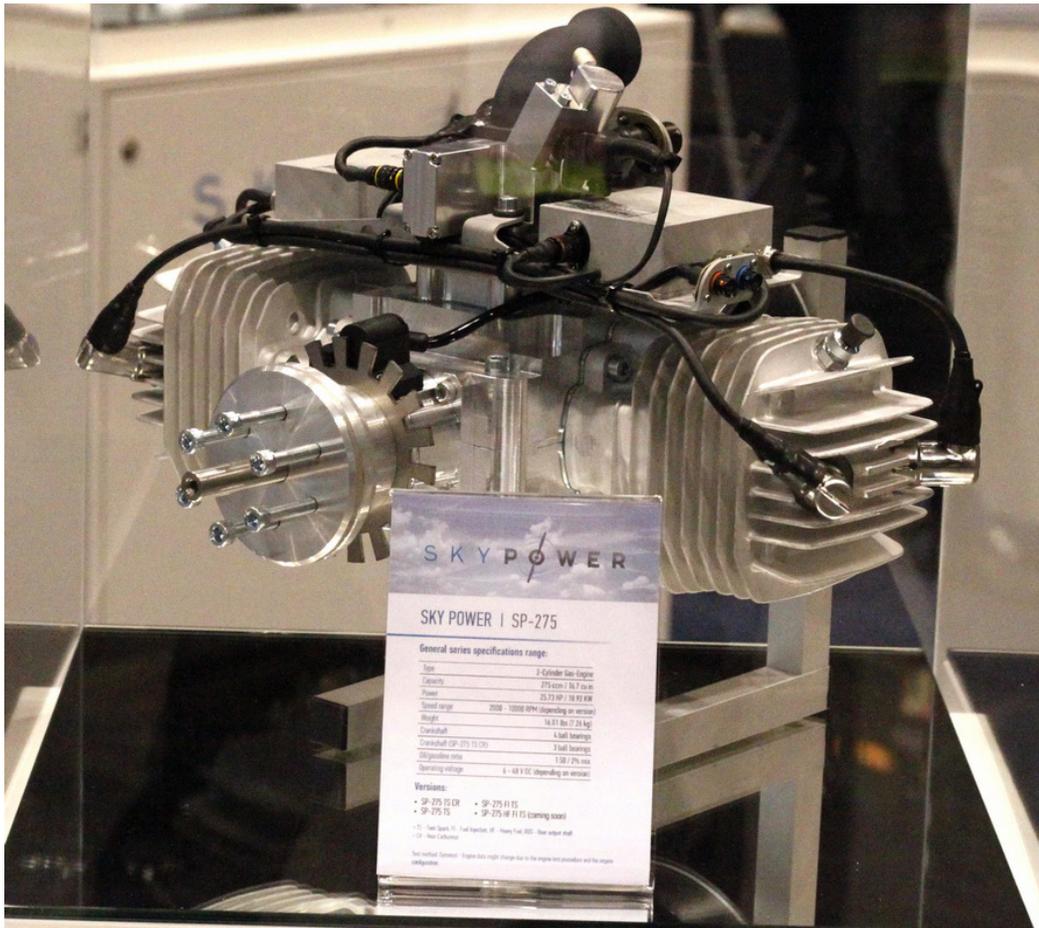
Located at Hood River, Ore., which could be called the “Silicon Valley” of the UAV world, is Power4Flight. It is a designer and system integrator of UAS power systems. Says Chuck Simmons, Principle Power Train Engineer at Power4Flight: “We solve the hard problems.” Currently under development in partnership with Cobra Aero is the Cobra A99. This is a 3-cylinder, 2-stroke, liquid cooled, fuel-injected engine with 3D-printed heads, crankcase, cylinder and exhaust. All the electronics, software and hardware are designed from the ground up for UAV implementations. The package includes the Intelliject ECU, an electronic fuel injection system, the Currawong self-priming fuel pump, EFI sensors, power generator/ starter, and an active control cooling system. The system includes onboard data, flight and maintenance data logging. The engine is also plug and play, with the Piccolo autopilot and communicates using CAN or serial communications.



Sky Power HKZ200 rotary engine.



Sky Power SP-28 1.71 cu in gas engine.

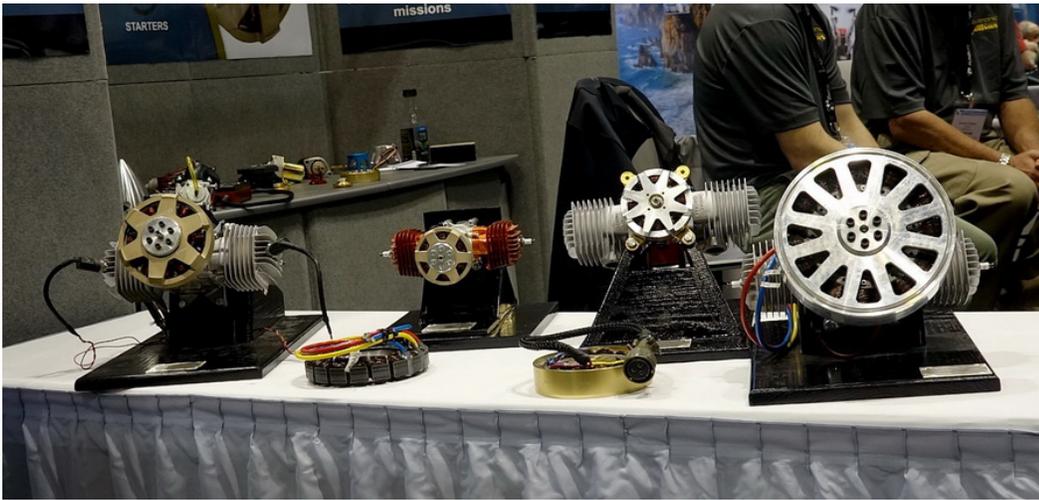


SkyPower SP-275 twin gas engine.

A leading manufacturer of Wankel and 2-stroke internal combustion engines for UAVs, Sky Power designs and manufactures drone power plants in Germany. Sky Power offers custom design and engineering services, and notes that extending the capacity of internal combustion engines is one of its corporate objectives. Sky Power now offers consulting, workshops and project management that caters to a customer’s specific project stage.



Sullivan UV assorted starter/alternators.



Sullivan starter/
alternators mounted on
representative engines.

Sullivan designs and manufactures electrical power systems that feature high power density and efficiency. These include starter-alternators, hybrid propulsion systems and power-regulating electronics. Designs span from 100W to 10kW, with custom designs “in as little as 10 weeks.”

[TATTU BATTERY, #4304](#)



TATTU 24,000 mAh battery.



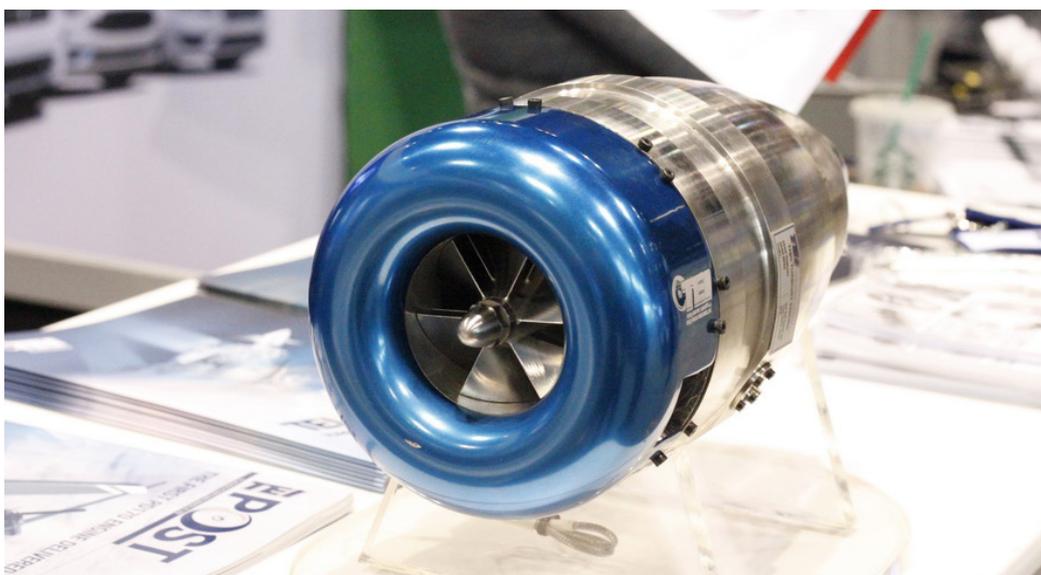
Ruggedized TATTU battery.

Well known in the industry, Tattu's innovative reputation precedes the company. Tattu's latest battery offering can be used with any DC power source owing to the built-in balancing system that takes care of all the diagnostic, charging and discharging duties. This built-in system eliminates the need for a balancing charger. In addition, the LED display on the battery pack shows charging state of the batteries. The LED will also show any internal faults such as a cell with dangerously low voltage. Custom solutions are available as well, since Tattu is a manufacturer and distributor.

[TEI, #3504](#)



TEI's large scale UAV engine for Predator-scale vehicles.



TEI turbine drone power plant.

Back in 1985, the Turkish Armed Forces Foundation and Turkish Aeronautical Association established TEI, a joint venture with Turkish Aerospace Industries and GE. The large engine is a “Predator size” UAV propulsion system. Exhaust gases spin a turbine wheel at high speed, inducting air at super-charged pressures. The smaller UAV turbine shows that TEI continues its R&D developing new technologies.

[THUNDER POWER, #3702](#)



Thunder Power 259Wh
LiPo drone battery.



Thunder Power 148Wh
LiPo drone battery.



Thunder Power charger/balancer.

Since 2003, Thunder Power RC has been a world-leader in the advancement of Lithium Polymer (LiPo) battery power and charging solutions for a wide variety of UAV/UAS, RC and other applications. Continuing to set industry-leading standards in performance, reliability and value is why so many pilots, drivers and professionals worldwide choose Thunder Power RC LiPo batteries, the company said.

[T-MOTOR, #4238](#)



T-MOTOR demo motor mounted with prop.



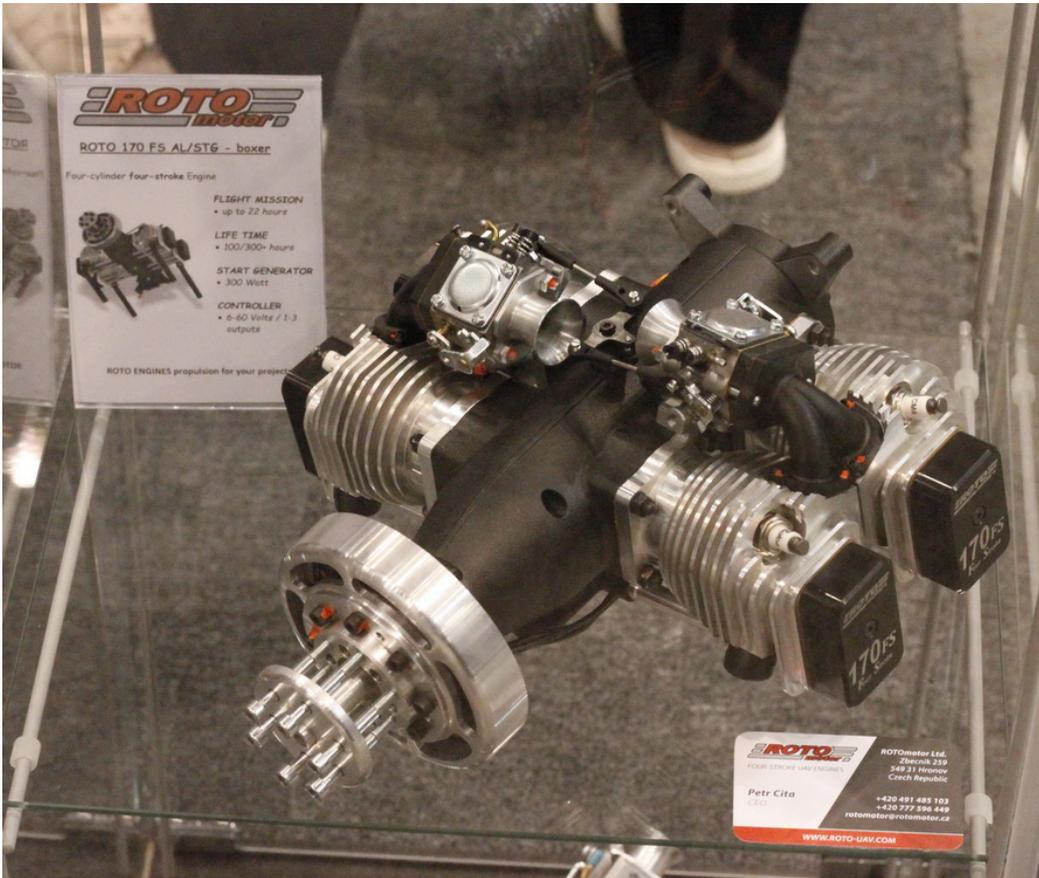
T-MOTOR demo motor mounted with prop.



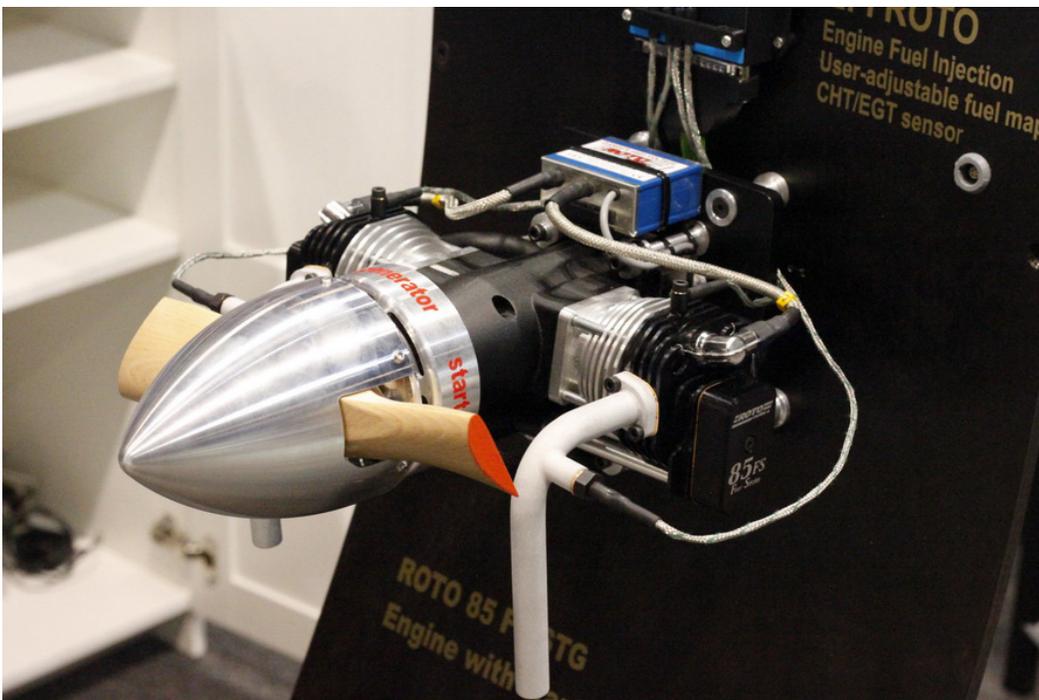
T-MOTOR U15 II KV80
brushless motor.

TIGER MOTOR (T-MOTOR) is staffed by a team of professionals specializing in motors, ESCs and propellers used in industrial, agricultural and commercial UAV applications at any needed scale. The company said it places emphasis on safety in its systems design, and on great customer service and support. T-MOTOR also offers OEM/ODM services.

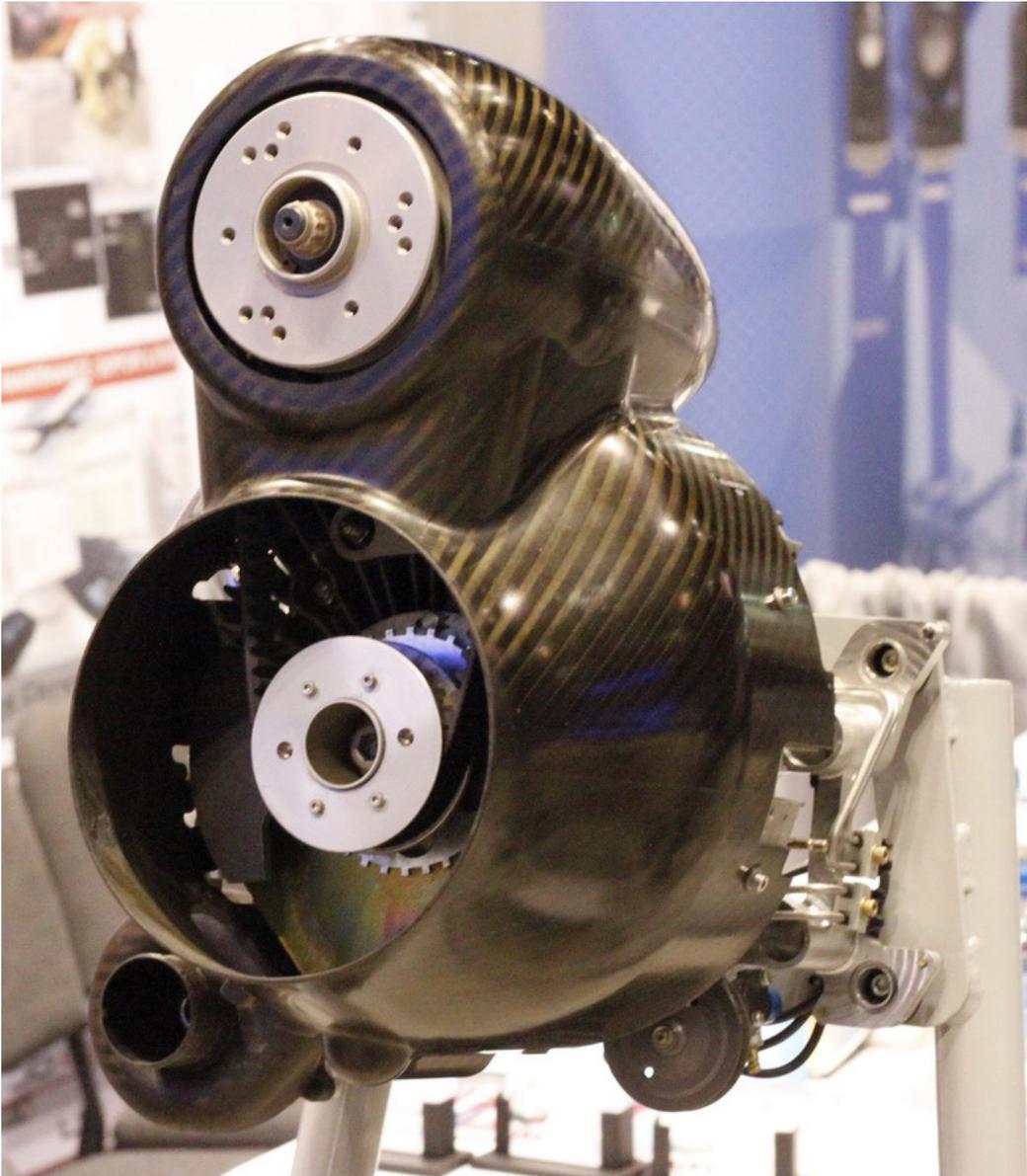
UAV ENGINES, LTD., #935



UAV Engines ROTO 170 FS AL-STG BOXER opposed quad engine boasts flight times of up to 22 hours.



UAV Engines ROTO 85 power plant with fuel injection.



UAV Engines shrouded belt drive.

UAV engines was originally established in 1992 to develop Wankel engines for UAVs. Today, thousands of the company's various engine models are in use in over 30 types of aircraft, summing to over 1million total flight hours, globally. With ISO accreditation, and audited by Lloyds Register, the company also operates full dynamometer and test stand facilities.

NOT AT THE SHOW

3W:



3W double-sparked dual Wankel shown at the 2018 Xponential.

Note: Photos by Lucien Miller, Mark Essenburg and Thomas Atwood. Copyright © 2019



The new 3W-180 SRE Hybrid Wankel Rotary UAV Engine

Although 3W did not exhibit at Xponential 2019, in the last year this venerable company that has served RC and UAV markets for decades, did announce the interesting, new 3W-180 SRE Hybrid Wankel Rotary UAV Engine.

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