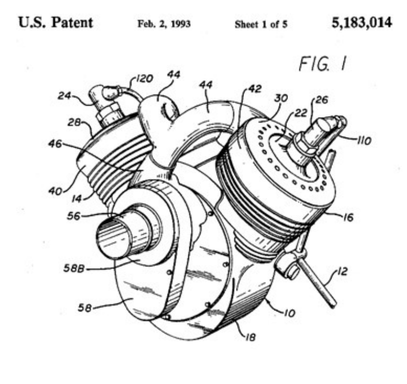
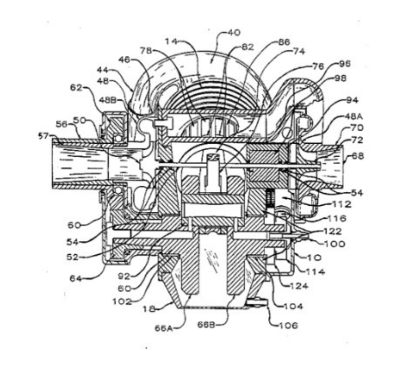
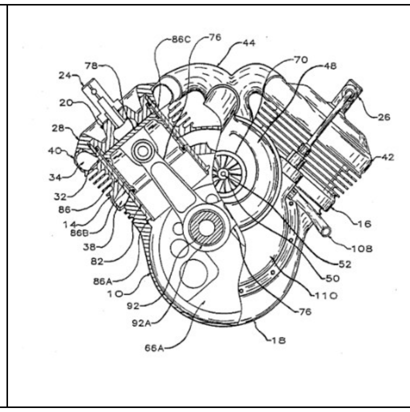
LIMITED EDITION OF GSE, INC. ENGINE CATALOG

1. GSE ENGINE CATALOG

Original micro turbo-compound engine patent for UAV propulsion 1987.		
		

The following pages shows a few of the GSE, Inc. engines that are available for development both commercially or as a DOD asset. Feel free to contact us with any questions you may have.

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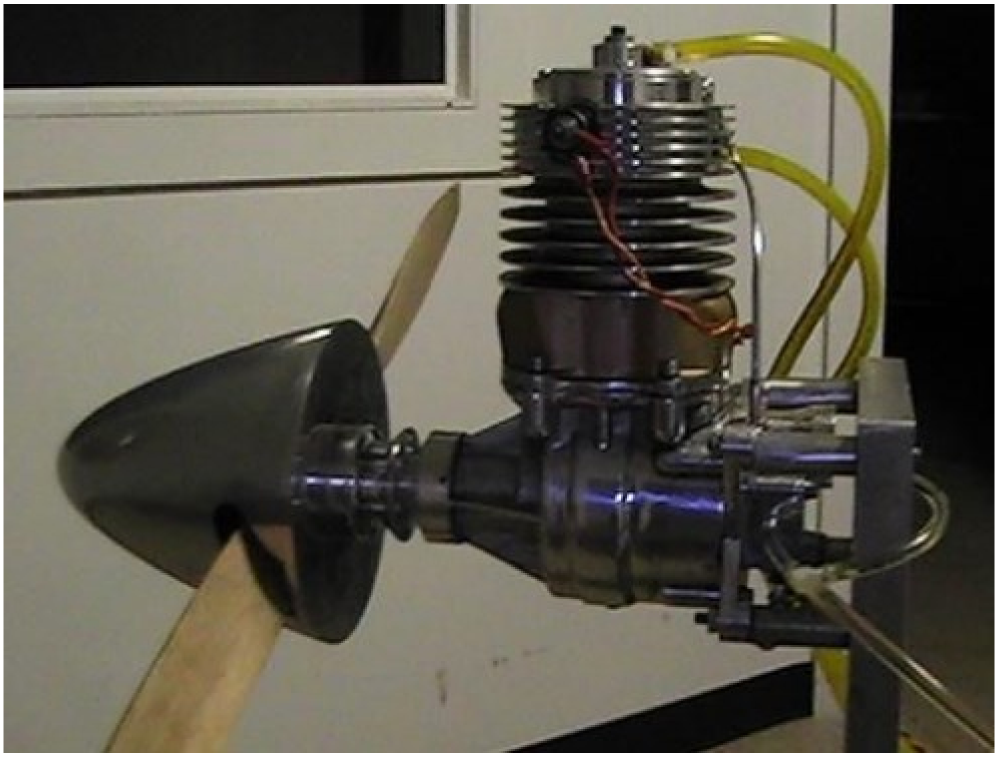
1.1. Group I Engine Catalog (1~15hp)

ZDZ-80 / 2-Cycle / 4.2 shp



Engine Type / Configuration	Air Cooled / Single Cylinder
Bore x Stroke = Displacement	46.5mm x 46.5mm = 79cc (4.74in^3)
Induction / Supercharge	Naturally Aspirated
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	4.2 hp @ 5500 RPM / BMEP = 64 psi
Surface / Volume Ratio	2.63 in^2 / 4.74 in^3 = 0.55:1
Fuel Consumption / Cruise	0.56 lbs/hp-hr @ 5500 RPM
Specific Power	4.2 hp / 4.74 in^3 = 0.886 hp / in^3
Specific Weight	4.2 hp / 4.5 lbs = 0.93 hp / lb
Specific Volume	6.3L x 4.5W x 8.5H = 30hp / ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 8

Premise:

The ZDZ-80 is a materials test rig engine for the purpose of developing multi-fuel combustion system strategies. It has a modest port timing and square bore stroke ratio while the rotary disc inlet valve enables good breathing for high-speed operation. The engine is naturally aspirated and fitted with a high silicon (17%) billet aluminum piston. The fuel is metered by an integral rotary plunger pump design as illustrated above. The liquid cooled cylinder head eliminates localized hot spots between the injector tip and the combustion chamber which is critical for turbine jet fuel operation.

SV-24 / 4-Cycle / 1.85 shp

SV-24 / 4-Cycle / 1.85 shp (Continued)

Engine Type / Configuration	Air Cooled / 4-Cycle Single Cylinder
Bore x Stroke = Displacement	32mm x 30mm = 24cc (1.44 in^3)
Induction / Supercharge	Crankcase Supercharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	1.85 hp @ 7,800 RPM / BMEP = 130 psi
Surface / Volume Ratio	1.246 in^2 / 1.44 in^3 = 0.86:1
Fuel Consumption / Cruise	0.78 lbs / hp-hr @ 75% Load
Specific Power	1.85 hp / 1.44 in^3 = 1.28 hp / in^3
Specific Weight	1.85 hp / 2.25 lbs = 0.82 hp / lb
Specific Volume	3.6L x 2.9W x 3.9H = 112 hp / ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/JP-10/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 7

Premise:

The purpose-built sleeve valve (SV-24) engine is crankcase supercharged and represents a direct heavy fuel replacement to the popular 3W-24cc engine. It has 3 inlets and 2 exhaust ports controlled by the common sleeve valve resulting in maximum trapping efficiency and low thermal losses for high fuel efficiency. The compactness and lightweight construction make it an ideal candidate for either Group I hand launch UAS and/or portable power generation of 350~500 watts.

SIV-250 / 4-Cycle / 5.8 shp


SIV-250 / 4-Cycle / 5.8 shp (Continued)

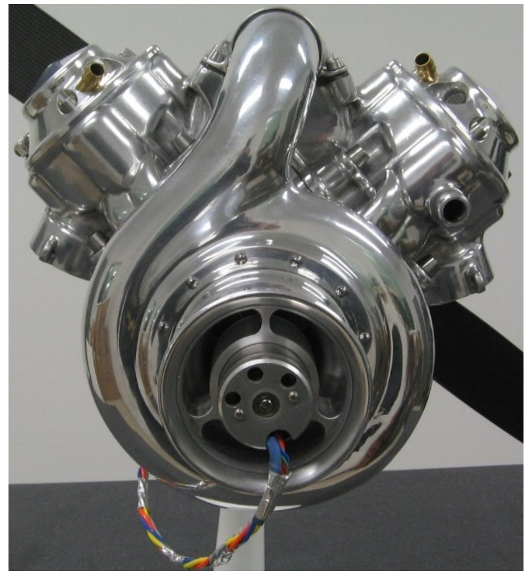
Engine Type / Configuration	Air Cooled / 4-Cycle V-Twin (60 Degree) Sleeve Valve
Bore x Stroke = Displacement	(42mm x 36mm) x 2 = 100 cc (6 in^3)
Induction / Supercharge	Crankcase Supercharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	5.8 hp @ 7,500 RPM / BMEP = 204 psi
Surface / Volume Ratio	2.147 in^2 / 6 in^3 = 0.36:1
Fuel Consumption / Cruise	0.52 lbs / hp-hr @ 65% Load
Specific Power	5.8 hp / 6 in^3 = 0.96 hp / in^3
Specific Weight	5.8 hp / 6.25 lbs = 0.928 hp/lb
Specific Volume	7.4L x 6.8W x 7.5H = 26.5 hp / ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 7

Premise:

The SIV-250 is a 60-degree V-twin crankcase supercharged 4-cycle sleeve engine representing the top group I performance in terms of high altitude and low specific fuel consumption. The even fire crankpin geometry has the advantage of maximum volumetric and piston phasing relative to the wide-open port time area afforded by the alternative V-twin 4-cycle valve timing. The engine applications are intended for both fix wing (Scan Eagle) or rotary wing (Flexrotor) Group I UAS.

1.2. Group II Engine Catalog (15~60hp)

SIV-90 / 2-Cycle / Supercharged / 16 shp



Engine Type / Configuration	V-Twin (90 Degrees)/Supercharged 2-cycle
Bore x Stroke = Displacement	(44.5mm x 41.6mm) x 2 = 130cc (7.92 in^3)
Induction / Supercharge	Crankcase / Centrifugal Supercharge
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	16 hp @ 7,800 RPM / BMEP = 102 psi
Surface / Volume Ratio	4.8 in^2/7.92in^3 = 0.606:1
Fuel Consumption / Cruise	0.52 lbs/hp-hr @ 70% cruise
Specific Power	16hp/7.92 in^3 = 2.02 hp/in^3
Specific Weight	16hp/12.85lbs = 1.24 hp/lb
Specific Volume	10.3L x 9.8W x 9.8H = 0.57ft^3 / 16/0.57 = 28hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

Premise:

The original injected 90-degree V-twin (IV-90) was GSE's proposed solution for the original NAVAIR Ultra Endurance Heavy Fuel Engine (UE-HFE) program intended to power the emerging STUAS Boeing/Blackjack (RQ-21) UAS. Increased payload and GTOW lead to the introduction of the centrifugal supercharger (SIV-90) as illustrated here. The result is excess scavenge air delivery for maximum power output at high speeds (7,800 RPM) and altitude flat rating to (18,000 ft). Currently under several DARPA ANCILLARY VTOL platform bids.

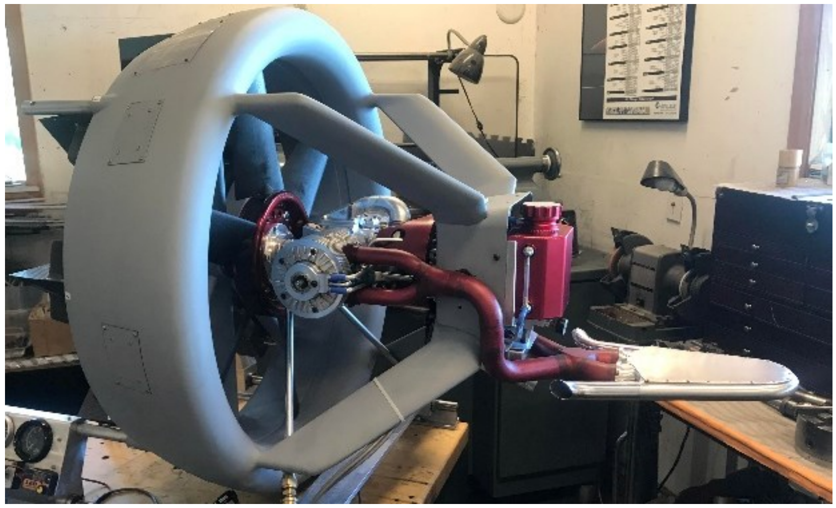
SIV-300 / 2-Cycle / Supercharged / 24 shp


Engine Type / Configuration	V-Twin (80 degrees)/Supercharged 2-cycle
Bore x Stroke = Displacement	(60mm x 54mm) x 2 = 294 cc (18.63 in^3)
Induction / Supercharge	Crankcase / Centrifugal Supercharge
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	24 hp @ 6,800 RPM / BMEP = 95 psi
Surface / Volume Ratio	8.76 in^2/ 18.63 in^3 = 0.47:1
Fuel Consumption / Cruise	0.48 lbs/hp-hr
Specific Power	24 hp/18.63 in^3 = 1.29 hp/in^3
Specific Weight	24 hp/21 lbs = 1.14 hp/lb
Specific Volume	9.8L x 10.4W x 10.7H = 0.63 ft^3 / 24/0.63 = 38 hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

Premise:

The Supercharged Injected 80-degree V-twin SIV-300 was in response to numerous Army FT-UAS and Navy STUAS/DARPA ANCILLARY propulsion needs in the large Group II category. The baseline engine leverages the experience gained from the smaller SIV-90 development. The major design changes have been the incorporation of the 2:1 belt reduction drive along with the crank driven outrunner starter/motor generator. The fuel injection pumps driven on the backside of the half speed reduction drive housing in close proximity to the fuel injector mounted in the head. The design approach aimed at lower production cost from the incorporation of MCOTS components.

SIO-260F / 4-Cycle / Supercharged / 21 shp

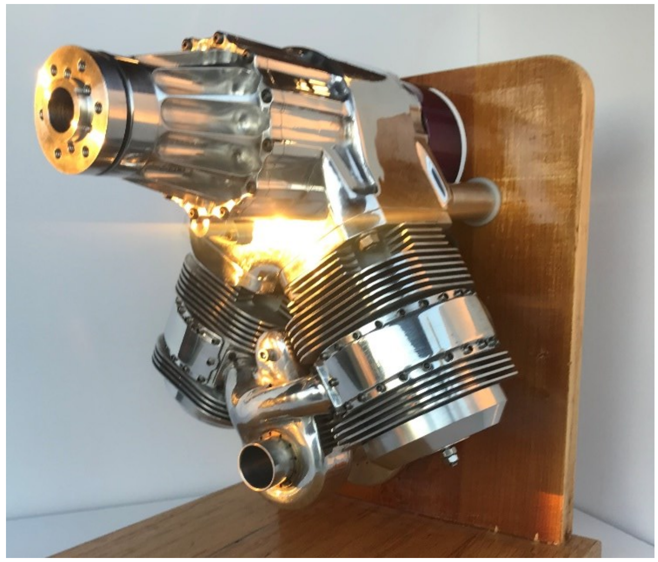



Engine Type / Configuration	Flat Twin (180 degree) 4-cycle supercharged forward facing exhaust
Bore x Stroke = Displacement	(60mm x 46mm) x 2 = 260 cc (15.6 in^3)
Induction / Supercharge	Crankcase / 2:1 / Centrifugal Supercharge
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	21 hp @ 7500 RPM / BMEP = 142 psi
Surface / Volume Ratio	8.76 in^2/15.6 in^3 = 0.56:1
Fuel Consumption / Cruise	0.45 lbs/hp-hr
Specific Power	21hp/15.6 in^3 =1.34 hp/in^3
Specific Weight	21hp/17.6 lbs = 1.19 hp/lb
Specific Volume	10.7L x 15.2W x 6.7H = 0.63 ft^3 / 21/0.63 = 33 hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

Premise:

The Supercharged Injected Opposed (SIO-260F) is a compact, lightweight flat opposed aircraft engine currently being developed for the Northrop V-BAT FT-UAS candidate. The frontal area being kept to the absolute minimum so as not to impede air flow through the ducted fan arrangement. The tuned exhaust is facing forward and collects into the muffler discharging reward. This 4-cycle sleeve valve has both external supercharge from the gear driven centrifugal blower as well as the internal 2:1 crankcase delivery ratio to the cylinders. Weight is kept to a minimum by the billet CNC mono-block cylinders and heads. The thin wall sleeve valves have required special tooling to achieve round cylinder bores.

SIV-540 / 4-Cycle / Supercharged / 25 shp



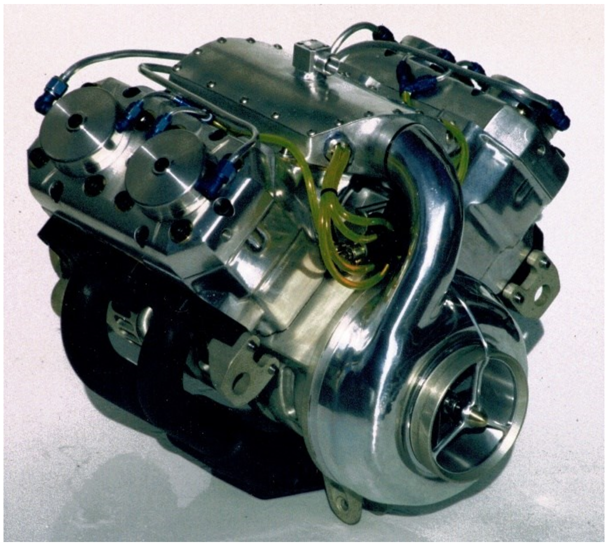
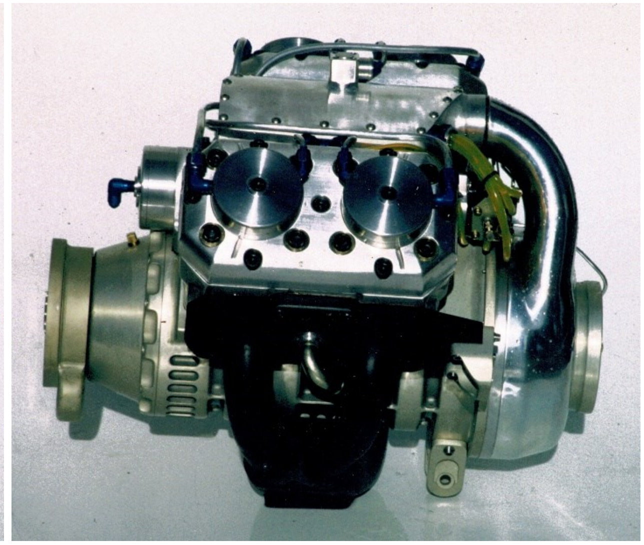
Engine Type / Configuration	V-Twin (60 degree) 4-cycle Supercharged
Bore x Stroke = Displacement	(60mm x 48mm) x 2 = 540cc (16.2 in^3)
Induction / Supercharge	Crankcase / 2:1 / Centrifugal Supercharge
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	25 hp @ 7800 RPM / BMEP = 153 psi
Surface / Volume Ratio	8.76in2/16.2 in^3 = 0.54:1
Fuel Consumption / Cruise	0.48 lbs/hp-hr
Specific Power	25 hp/16.2 in^3 = 1.54 hp/in^3
Specific Weight	25 hp/21.8 lbs = 1.15 hp/lb
Specific Volume	9.3L x 8.2W x 9.1H = 0.396 / 25hp/0.396 = 63hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

Premise:

Similar in operation to the flat opposed SIO-260F, the even fire 60-degree Turbocharged Injected Vee (TIV-540) is a more compact variation. The primary balance weights are built into the single piece billet crankshaft, while the sleeve valves are phased 180 degrees apart and share the same overlapping crankcase volume. This engine was built for the Boeing RQ-21 Blackjack Navy STUAS aircraft but has been relegated to a low priority now that the DARPA ANCILLARY program has redefined the larger VTOL aircraft.

1.3. Group III Engine Catalog (75~250hp)

SIV-4307 / 2-Cycle / Supercharged / Turbocharged / 72 shp

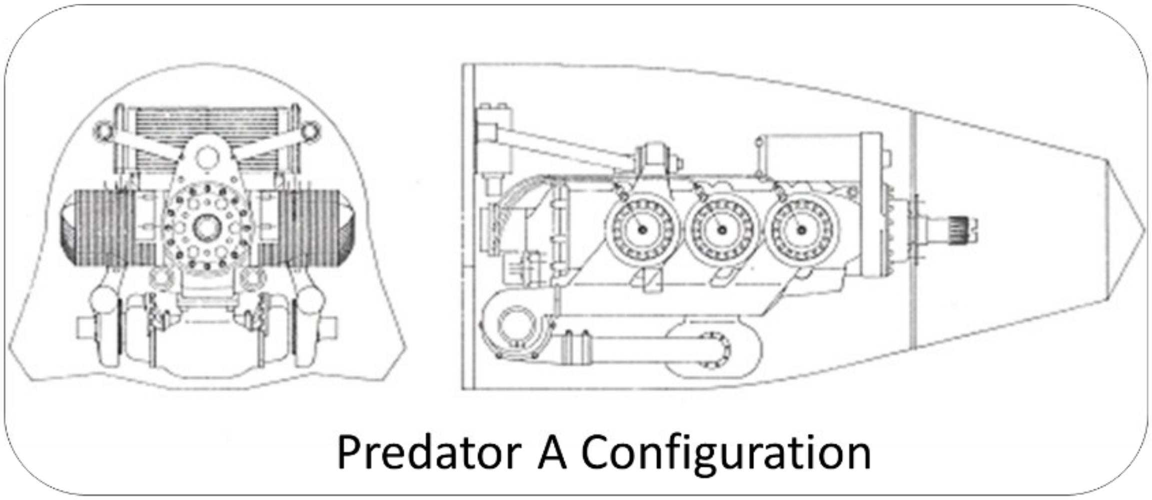



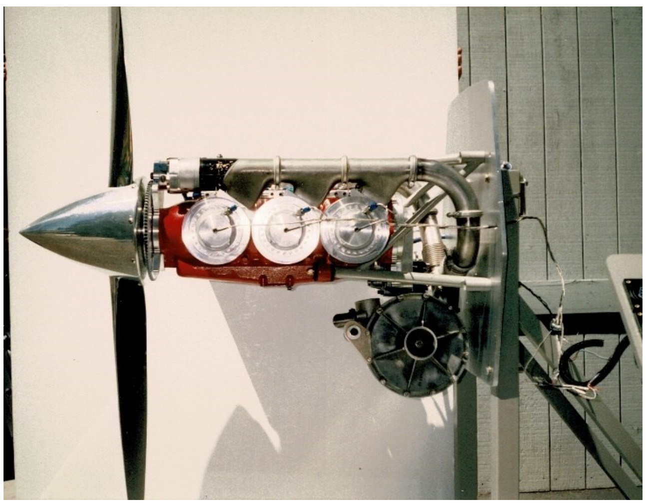
Engine Type / Configuration	V-Four (90 Degree) Supercharged 2-cycle
Bore x Stroke = Displacement	(78mm x 72mm) x 4 = 1,376 cc (82 in^3)
Induction / Supercharge	Centrifugal Supercharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	72 hp @ 4200 RPM / BMEP = 83 psi
Surface / Volume Ratio	29.6 in2/82 in^3 = .361:1
Fuel Consumption / Cruise	0.46 lbs/hp-hr
Specific Power	0.878 hp/in^3
Specific Weight	72hp/84lbs = .86hp/lb
Specific Volume	14.2L x 12.1H x 15.6W = 1.55 ft^3 / 72/1.55 = 46.5hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

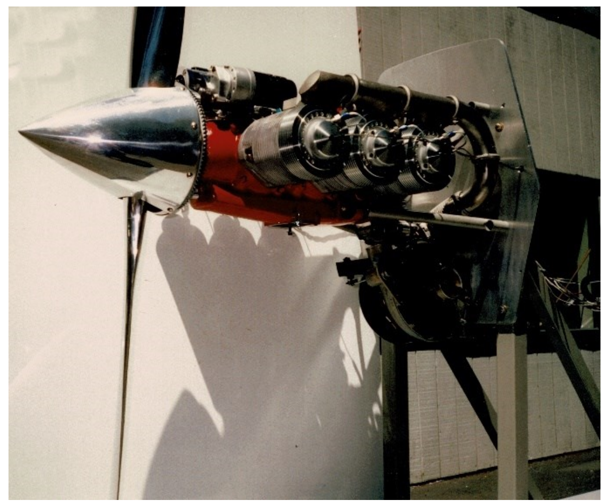
Premise:

The current SIV-4307 was based on the joint tactical HFE requirement in 1996. After demonstrating our high-speed multi-fuel combustion system on a MCOTS engine, the call came for a purpose-built engine in the 60~70 hp range to ensure UAS STOL capability. As a Compression Ignition (CI) engine much time was spent on the robust size of the roller bearing elements to operate at elevated peak pressure. Good fuel consumption was the best trait of the CI variation, whereas the potential to convert to the modern CHSI ignition would significantly improve the power/weight by some 20~25%.

TIO-625 / 2-Cycle / Turbocharged / 125 shp





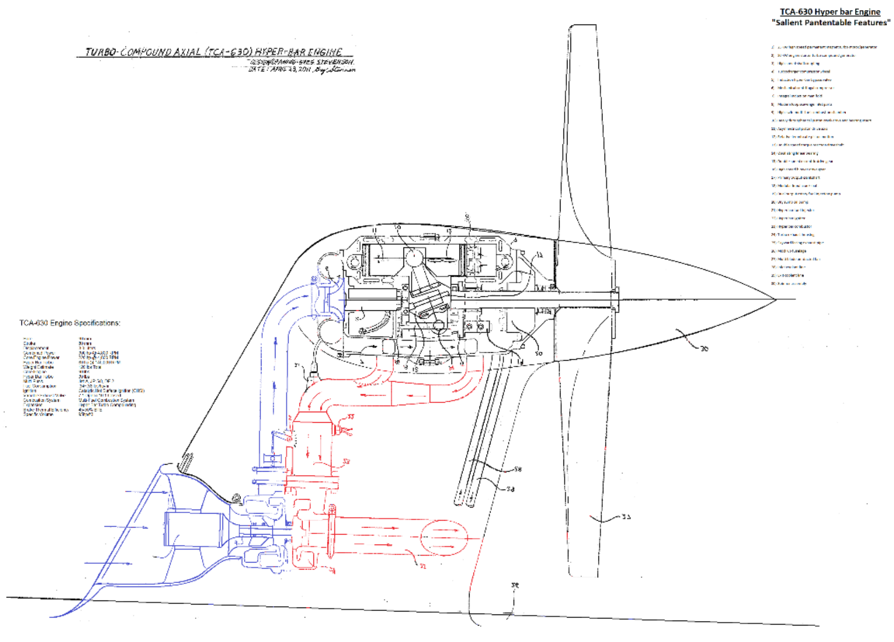


Engine Type / Configuration	Flat-Six (180 degree) Turbocharged 2-cycle
Bore x Stroke = Displacement	(81mm x 79.3mm) x 6 = 2,454 cc (150 in^3)
Induction / Supercharge	Turbocharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	125 hp @ 4,100 RPM / BMEP = 81 psi
Surface / Volume Ratio	47.9in2/149.7in3 = 0.32:1
Fuel Consumption / Cruise	0.44 lbs/hp-hr
Specific Power	125hp/150in^3 = 0.83hp/in^3
Specific Weight	128lbs/125hp = 1.02 lbs/hp
Specific Volume	22.4L x 27.8W x 9.1H = 3.27ft^3 / 125/3.27 = 38hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

Premise:

The turbocharged injected opposed flat six-cylinder engine (TIO-625) was an internal GSE IRAD project aimed as a direct replacement to the gasoline Rotax 914 engine used to power the original Predator MQ-1 aircraft. Once the Army bought into the medium endurance aircraft program the Air Force Predator morphed into the Army Grey Eagle UAS. Although GSE TIO-625 engine was presented to General Atomics, the support funding never materialized. The engine is virtually ½ the weight of the competing automotive based TAE-125 diesel engine.

TCA-630H / 2-Cycle / Hyper-Bar Compound Turbocharged / 175 shp

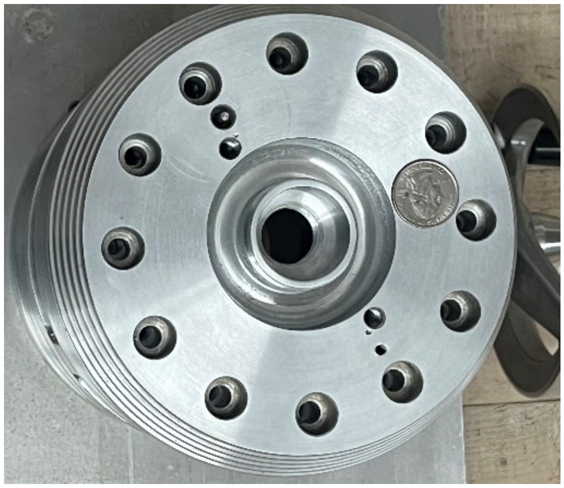


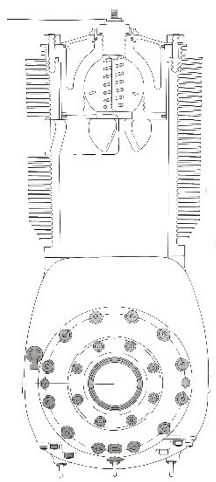
Engine Type / Configuration	Axial opposed cylinder / even fire supercharged six
Bore x Stroke = Displacement	(92mm x 76.2mm) x 6 = 3,059 cc (186 in^3)
Induction / Supercharge	Hyper-Bar Turbocharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	175 hp @ 3,600 RPM / BMEP = 110 psi
Surface / Volume Ratio	0.33:1
Fuel Consumption / Cruise	0.45 lbs/hp=hr
Specific Power	175hp/186 in^3 = .94hp/in^3
Specific Weight	175hp/108lbs = 1.62 hp/lb
Specific Volume	12.8 dia x 21.5L = 1.6ft^3 / 175/1.6 = 109hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 5

Premise:

The turbocharged compound axial 630 engine was an advanced combine cycle engine study based on the industry desire to marry the virtues of the turbine and piston engine together. (See illustration above the engine specification table). An innovative breakthrough in the axial Z-crank mechanism resulted in uniform piston accelerations while providing the torque reaction through the lemniscate pin geometry. The torque reaction being a double speed eccentric proportion to the Z-crank angle while also providing a robust high speed quill drive for the centrifugal supercharger. The hyper-bar turbocharger assembly being imbedded in the root of the pylon mount with the fuel driven combustor built into the manifold. Perhaps the closets example of having the frontal area and compactness of the gas turbine, while retaining the part load fuel economy of the Diesel.

TIL-360 / 4-Cycle / Turbocharged / 190 shp






Engine Type / Configuration	In-Line 3-cylinder Turbocharged 4-cycle sleeve valve
Bore x Stroke = Displacement	(104mm x 115mm) x 3 = 2,931cc (178.9 in^3)
Induction / Supercharge	Turbocharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	190 hp @ 2,800 RPM / BMEP = 300 psi
Surface / Volume Ratio	39.5in2/178.9in3 = 0.22:1
Fuel Consumption / Cruise	0.34 lbs/hp-hr
Specific Power	190hp / 178.9in3 = 1.06 hp/in3
Specific Weight	190hp / 154lbs = 1.23 hp/lb
Specific Volume	31.8L x 12.4W x 28.8H = 6.57ft^3 / 190/6.53= 29 hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL-5

TIL-360 / 4-Cycle / Turbocharged / 190 shp (continued)

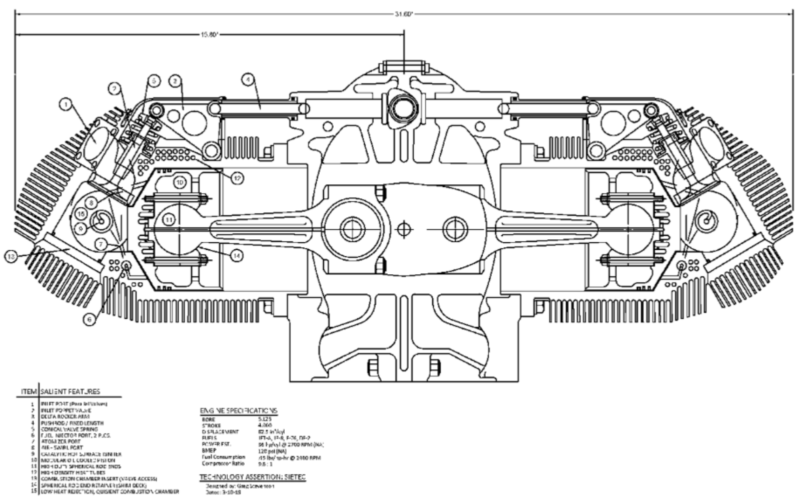
Premise:

The turbocharged in-line TIL-360 is a 4-cycle sleeve valve engine with approximately a three-liter displacement yielding 190 shp. The design premise being an attractive direct drive turbocharged 4-cycle engine to compete with the TAE-155 on the Grey Eagle or the Austro 170 Mercedes Diesel on the Boeing twin engine Orion UAV. Both foreign Aero Diesel engines being owned by AVIC China. Unlike the automotive based Mercedes Diesel engines being limited to 2-liter displacement due to strict OEM tariffs in Germany, the preferred GSE TIL-360 Aircraft sleeve valve engine represents a lighter more compact solution (30% weight improvement {344 lbs. vs 203 lbs.}) while greatly extending the durability. It should also be noted that single cylinder testing of this concept has demonstrated excellent part load fuel economy down to 0.34 lbs./hp-hr[1]. The Orion UAS is the only domestic UAS that truly can compete with the Russian Altius UAS for range and endurance; therefore, if it returns to service, the TIL-360 would be a great upgrade to its powerplant as it would increase the range and endurance even further than it currently is and provide additional payload weight.

[1] (Sir Harry R. Ricardo, 1953 (Reprinted 1962)) Page 337.

1.4. Group IV Engine Catalog (500~900hp)

GSIO-330 / 2-Cycle Opposed 6 / Supercharged / 320 shp



- Retrofit Conversion for Lycoming Engine

Engine Type / Configuration	Flat opposed 6 / 2-Cycle Geared / Supercharged
Bore x Stroke = Displacement	(108mm x 98.4mm) x 6 = 5,408 cc / 330 in^3
Induction / Supercharge	Supercharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	320 hp @ 3,400 RPM / BMEP = 113 psi
Surface / Volume Ratio	85.2 in^2/ 330 in^3 = 0.258:1
Fuel Consumption / Cruise	0.42 lbs/hp-hr
Specific Power	320 hp/330in^3 = 0.97 hp/in^3
Specific Weight	320 hp/410 lbs = 0.78 hp/lb
Specific Volume	42.2L x 32.8W x 21.5H = 18.9 ft^3/320/18.9 = 16.9 hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 5

Premise:

This MCOTS flat opposed six-cylinder engine project was part of a NASA study to convert existing production piston aircraft engine designs. The original geared injected supercharged opposed (GSIO – 330) was based on a popular Lycoming engine. The major conversion being focused on the top end piston/cylinder block assembly for dedicated liquid cooling and engine rigidity. The geared centrifugal supercharger being ideal for 2-cycle scavenge air and the planetary reduction drive enabling the engine the opportunity to make peak power by operating at high speeds. This IRAD project has been reviewed by both Lycoming as well as NASA in terms of an economical technology demonstrator. It also represents a low-cost alternative to Semi-Nomad engine concept with supporting analysis located in the appendix of this document. The real attraction may be the low-cost entry to a production viable (LCAAT) propulsor with a multi-blade ducted fan…

TCIO-1255 / 2-Cycle Opposed 12 / Turbo-Compounded / 900 shp

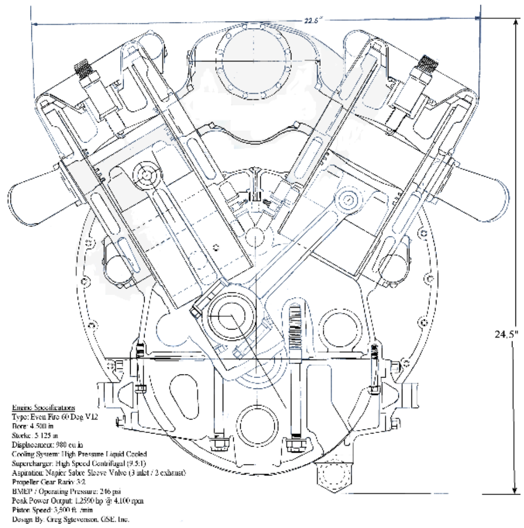
Engine Type / Configuration	Flat opposed 12/ 2-cycle electrified turbo-compound
Bore x Stroke = Displacement	(98.5mm x 115mm) x 12 = 10,576 cc (641in^3)
Induction / Supercharge	Electrified Turbo-Compound
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	900 hp @ 3600 RPM / BMEP = 154 psi
Surface / Volume Ratio	141.5in^2/641in^3 = 0.22:1
Fuel Consumption / Cruise	0.34 lbs/hp-hr
Specific Power	900hp / 641in^3 = 1.4 hp/in^3
Specific Weight	900hp / 648 lbs = 1.39 hp/lb
Specific Volume	49.3L x 32.8W x 21.6H = 20.4 / 900/20.4 = 44 hp/ft^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 6

Premise:

The TCIO-1255 is GSE's most ambitious combined cycle engine to date. This quarter scale Napier Nomad could double the range and endurance of the MQ-9 Reaper. The modern-day electrified version of the Nomad II being the CHSI™ ignition that overcomes the cold start issue as well as the electrified turbo-compounding thereby eliminating the complex mechanical gearing arrangement between the turbine and the crankshaft. The design premise being a lightweight coplanar liquid cooled cylinder block arrangement with exceptionally high structural efficiency with direct tie rods that sandwich the magnesium crankcase. The modern pneumatic injection and CHSI ignition enable the engine to start from cold just utilizing the energized single stage turbo-compressor thereby dispensing with redundant positive displacement blower. The second stage is by means of conventional MCOTS turbochargers which feed into the combustor of the final blow down exhaust turbine thereby extracting the utmost thermal yield from the fuel for best part load efficiency. The high firing frequency provides a power pulse every 30 degrees of crank rotation and is most suitable for direct propeller drive on fixed wing and/or gear reduction drive as required on rotary wing aircraft.

GSIV-980 / 4-Cycle V-12 / Supercharged / 1,250 shp

GSIV-980 Semi-Saber V-12 Supercharged Sleeve Valve Engine



Engine Type / Configuration	V-12 (60 degree) 4-cycle Supercharged Sleeve Valve
Bore x Stroke = Displacement	(114.3mm x 130mm) x 12 = 16,007 cc (980 in^3)
Induction / Supercharge	Compound Differential Centrifugal Supercharged
DFI Multi-Fuel System	Pneumatic Self Injection
Heavy Fuel Ignition	CHSI™
Multi-Fuel Combustion System	Modern Hybrid DI / IDI / M-System
Power Output / BMEP	1250hp @4,100 RPM / BMEP = 246 psi
Surface / Volume Ratio	$15.9in^2/81.3in^3$ = .195:1
Fuel Consumption / Cruise	0.34 lbs/hp-hr
Specific Power	1250 hp/980 in^3 = 1.275 hp/in^3
Specific Weight	1250 hp/638 lbs = 1.96 hp/lb
Specific Volume	42L x 22.5W x 24.5H = 13.4 ft^3/1250/13.4 = 93.3 hp/in^3
Logistical Operating Fuels	DLA Inventory: (JP-5/JP-8/Jet-A/F-24/F-76/Bio-Diesel)
HFE Component Maturity Level	TRL = 5

Premise:

The GSE IRAD works on the high powered supercharged (60 degree) V-twelve geared (GSIV-980) engine is the 1 MW class of hybrid power needed for most EVTOL candidates now beginning to adopt the hybrid propulsion architecture. The even fire liquid cooled sleeve valve engine is exceptionally compact and in fact fits well with the cowling of most turbine-based aircraft engines. The long stroke to bore relation results in low surface to volume ratio for best-in-class fuel consumption. The durability being enhanced by the desmodromic sleeve valve assembly driven by a common cross gear quill shaft located down the middle of the Vee-cylinder bank geometry. Although in an early stage, there is no shortage of commercial applications with current production aircraft as well as the emerging EVTOL category of aircraft looking for a FAA certification path. The production short block assemblies based on the Allision V-12 heritage.