

UAV Engines in the next decade - Turbine Engines, Piston Engines and the newly Combat Proven Rotary Engine

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A Lecture at the 6th Symposium on Jet Engines and Gas Turbines

Haifa, Nov. 16, 2006

The Hermes 450 UAV, powered by R802



Engines for UAV's

UAV Type	Engine Type	Power Range (HP)
Micro	Electrical	1
Mini	Piston (2X2)	1 – 20
TAC, CR/LE	Rotary (WANKEL)	20 - 90
MALE	Piston (4X4)	90 - 250
MALE	Turbo-Prop	250 - 500
HALE/ TCUAV	Turbo-Jet/Fan	above 500

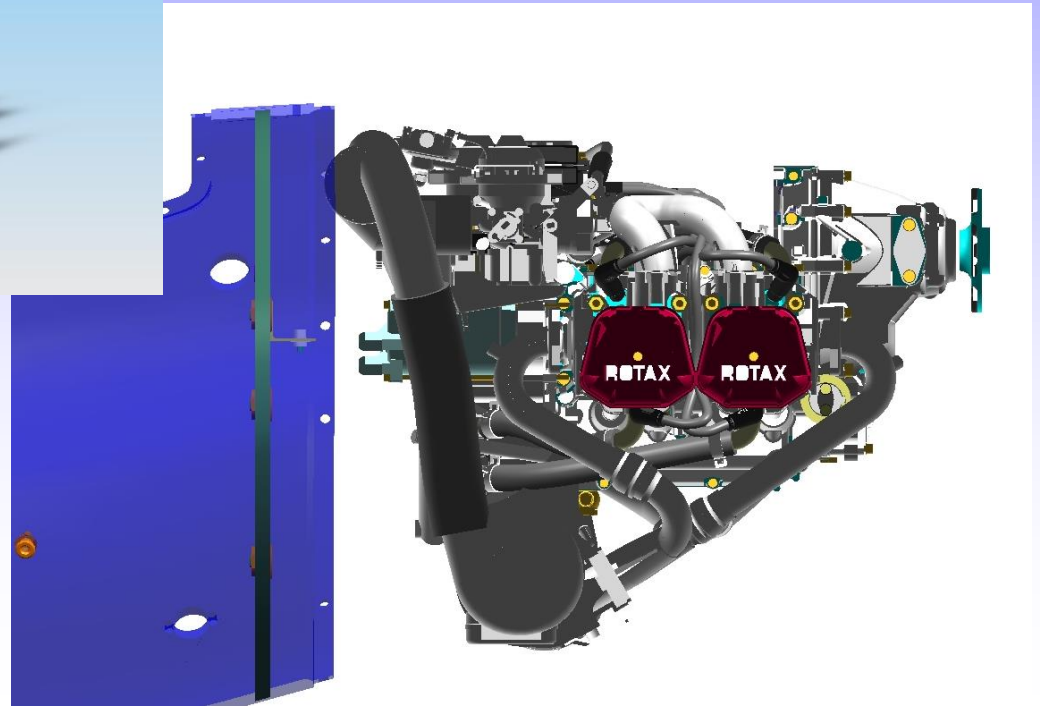
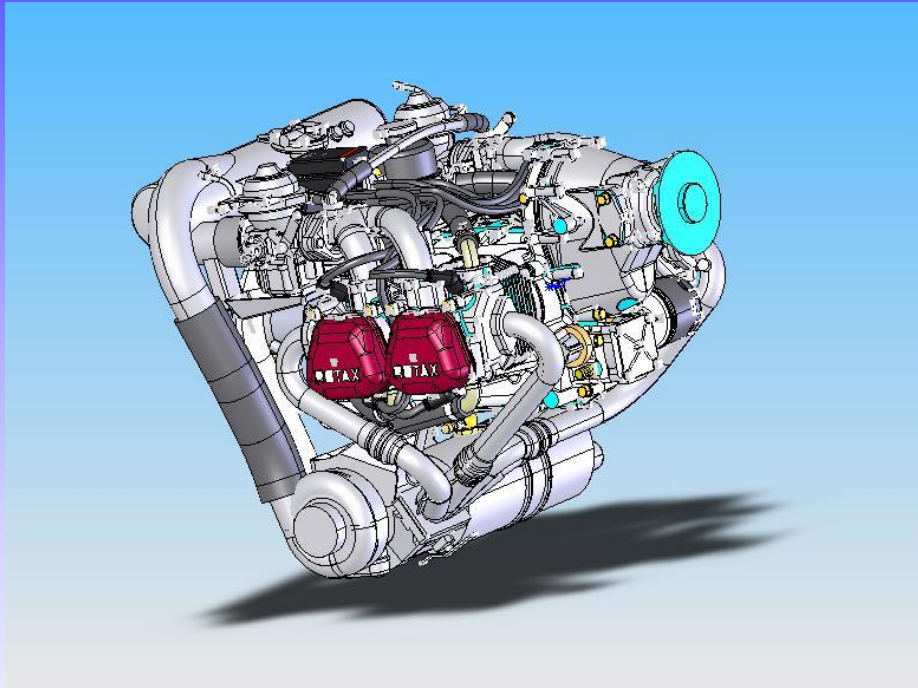
UAV Models & Engines (e.g.)

UAV Model	Engine Type	Engine Model	Engine Power (HP)
Skylark	Electric	B40-19L	1
Neptune	Piston, 2X2	150D2	15
Aerostar	Piston, 2X2	490IA	38
Harpy	Rotary	731	38
Hermes 180	Rotary	741	38
Shadow 200	Rotary	741	38
Hermes 450	Rotary	802	52
Searcher	Rotary	681	80
Predator	Piston 4X4	Rotax 914	100
Heron	Piston 4X4	Rotax 914	100
Heron 1	Turboprop	PT6	600
Predator B	Turboprop	Honeywell TP331-10	950
UCAV	Turbofan	F404	22,000 lb

UAV Engines Special Requirements

- Long Endurance
 - Mission Length of 20-50 hours!
- Duty Cycle
 - Heavy weight/ High Altitude (completely different than light aviation)
- Compactness
 - High Power/weight ratio, Low Volume
- Simple Maintainability
 - Robustness, lower skills ground crews

Rotax 914

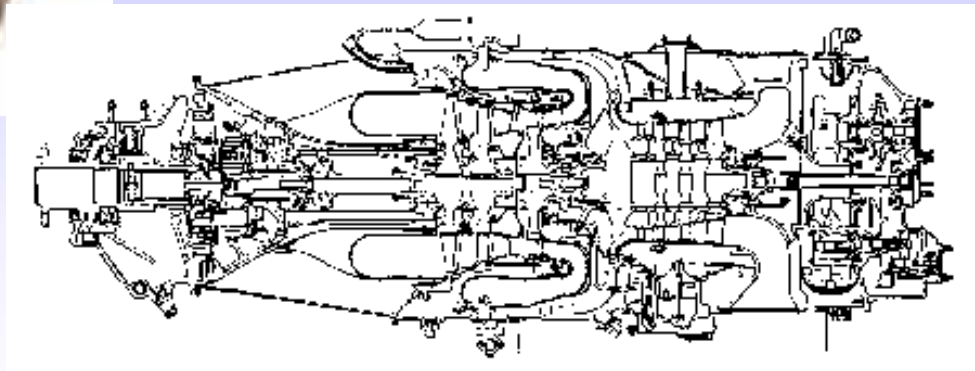


UAV Turboprops (e.g.)

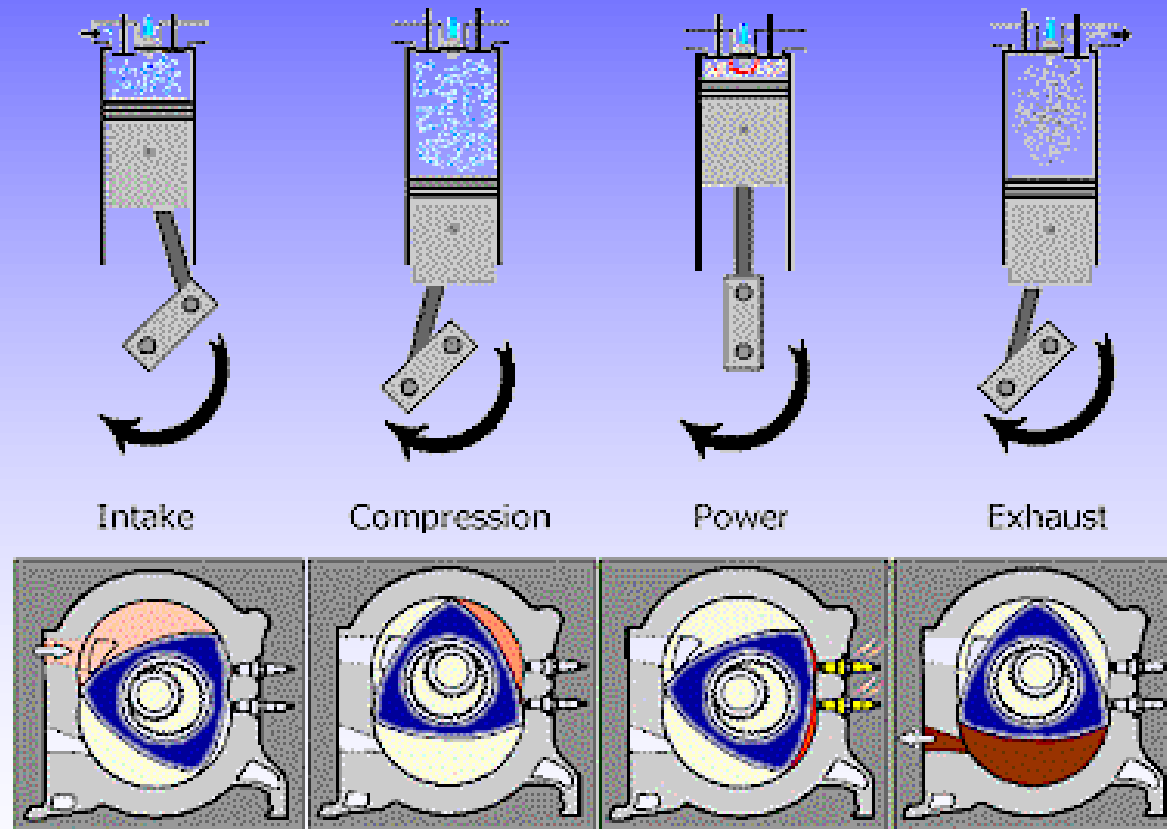
TP331-10



PT6



Wankel – Vs – Piston Principle

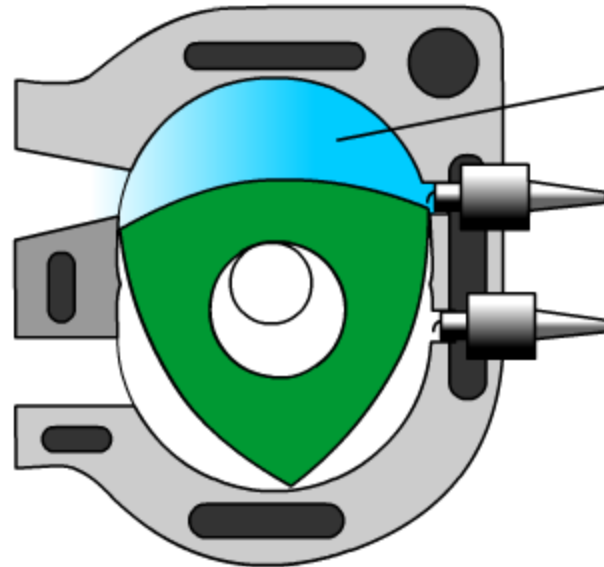


How Rotary Engines Work



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Intake



Intake Stroke

Exhaust

click here for
full animation

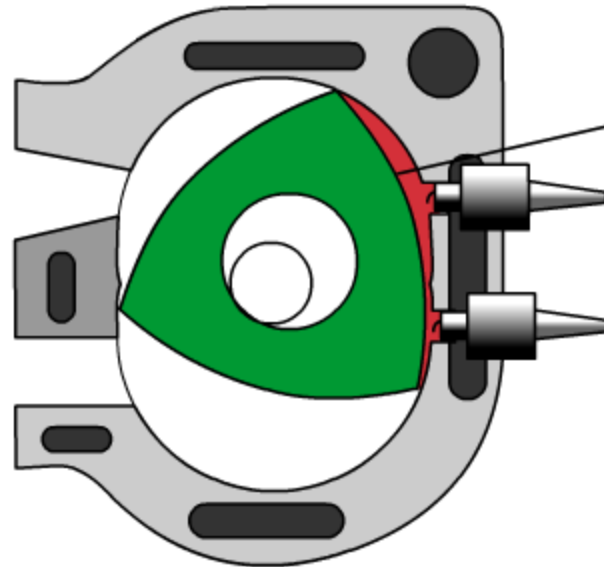


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How Rotary Engines Work

Intake

Exhaust



Compression
Stroke



continue

click here for
full animation



Mazda RX8 Wankel powered Car



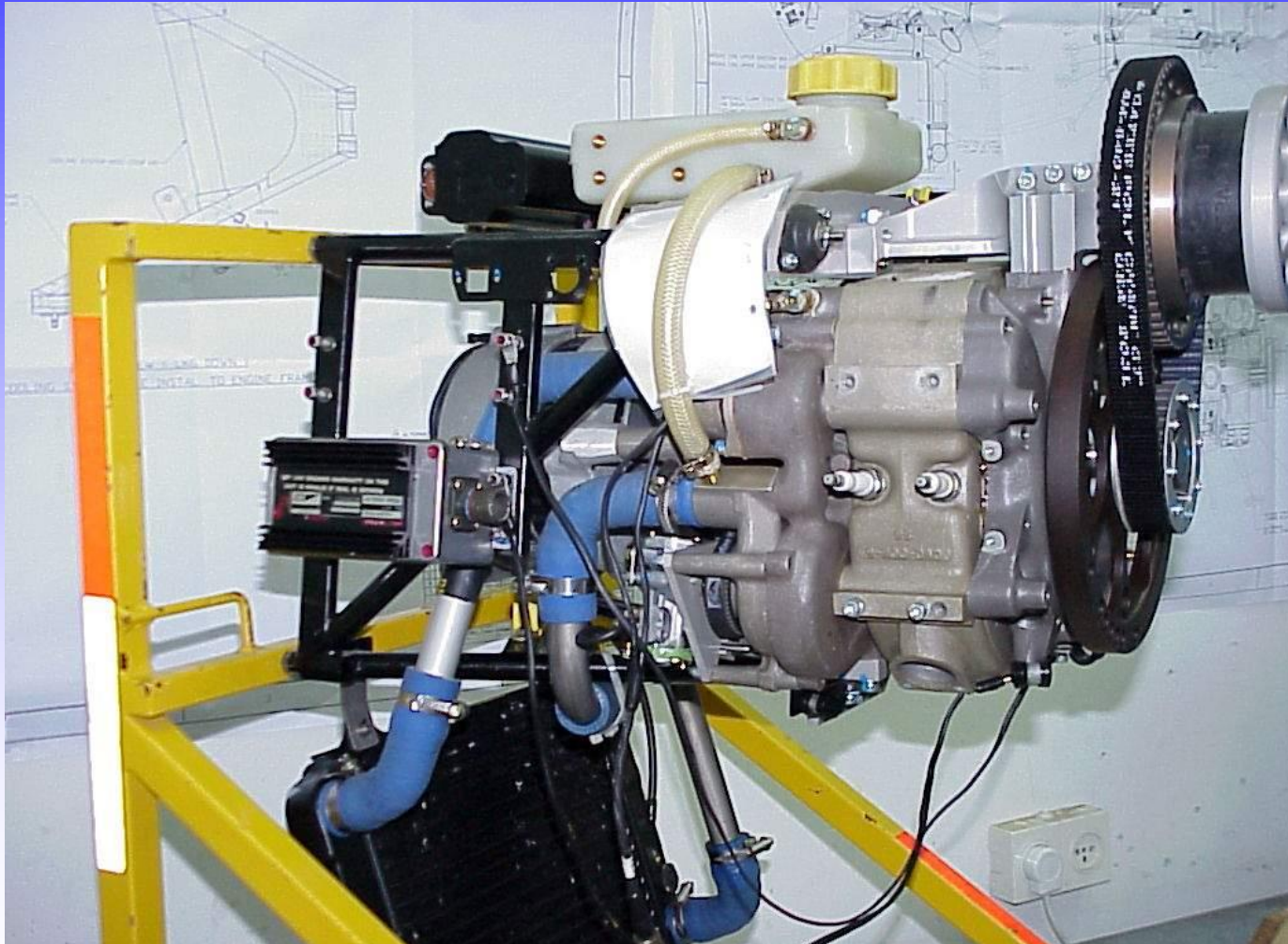
The new NRV 588 Norton Motorcycle unveiled on October 2006



Rotary (Wankel) Engines in Israeli UAVs

Engine Model	Power (BHP)	Application
681	80	IAI, MLT, Searcher
802	52	Elbit/ Silver Arrow, Hermes450
741	38	Elbit/ Silver Arrow, Hermes180
731	38	IAI, MLT, Harpy

802



AR741 Wankel (Rotary) Engine



Rotor



Rotor Housing (trochoide)



Eccentric Shaft

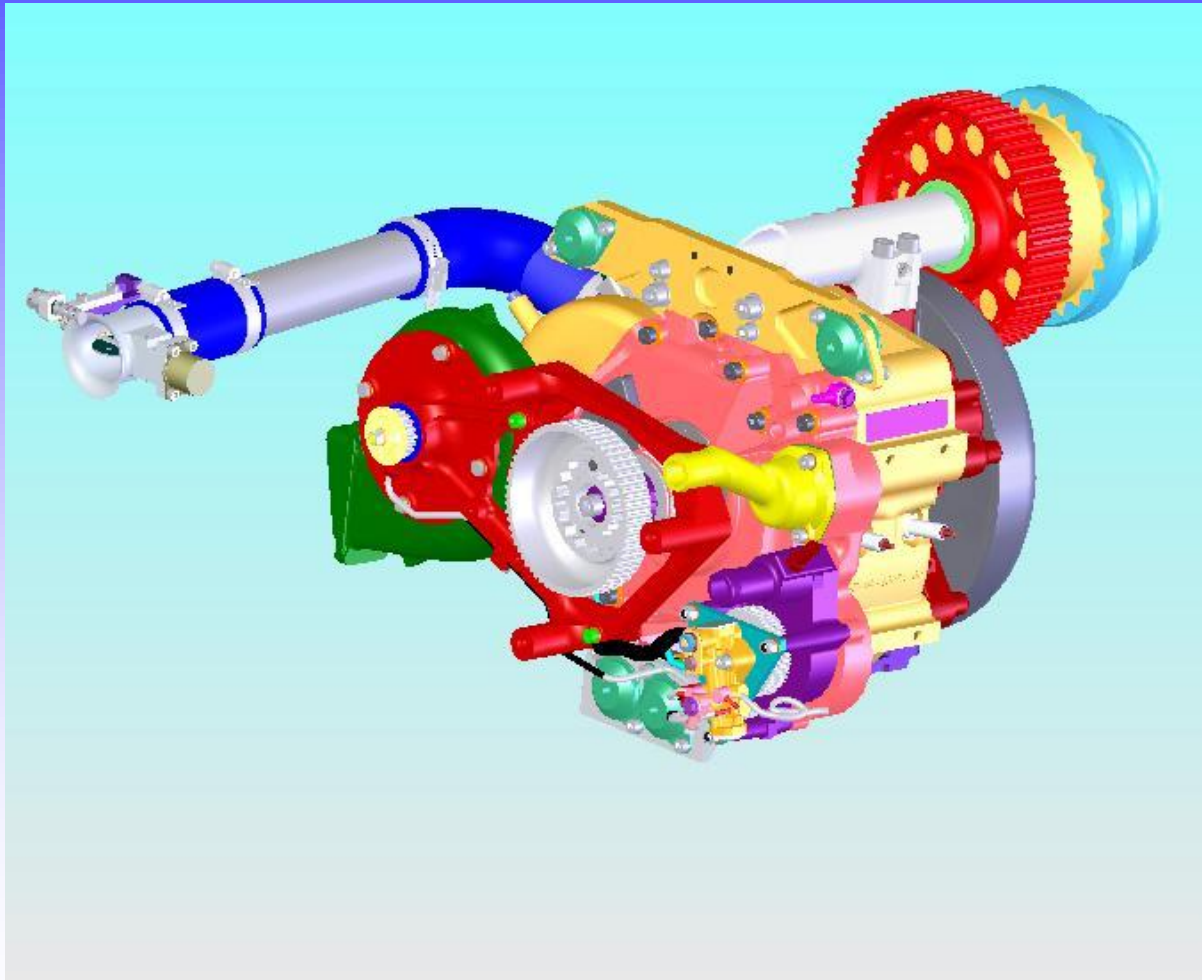


Enhanced Performance 802 Engine (802W)

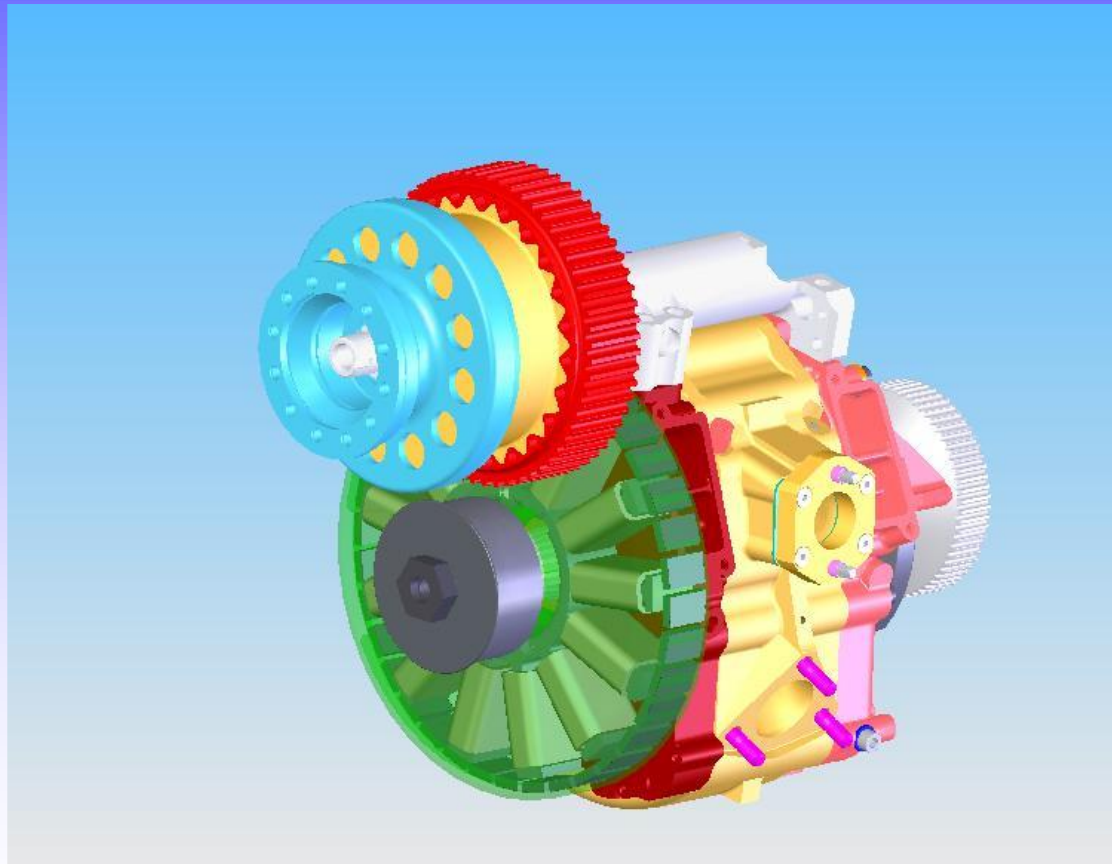
- Design-
 - Longer Chamber, displacement increase from 294 cc to 350 cc.
 - EFI
 - Starterator
- Outcome-
 - Higher Power (70+ -vs- 52)
 - Better SFC (0.45 –vs- 0.55)
 - Outstanding Power/Weight(*) Ratio (~1.6 -vs- 1.3)

(*) Weight includes Buildup and propeller

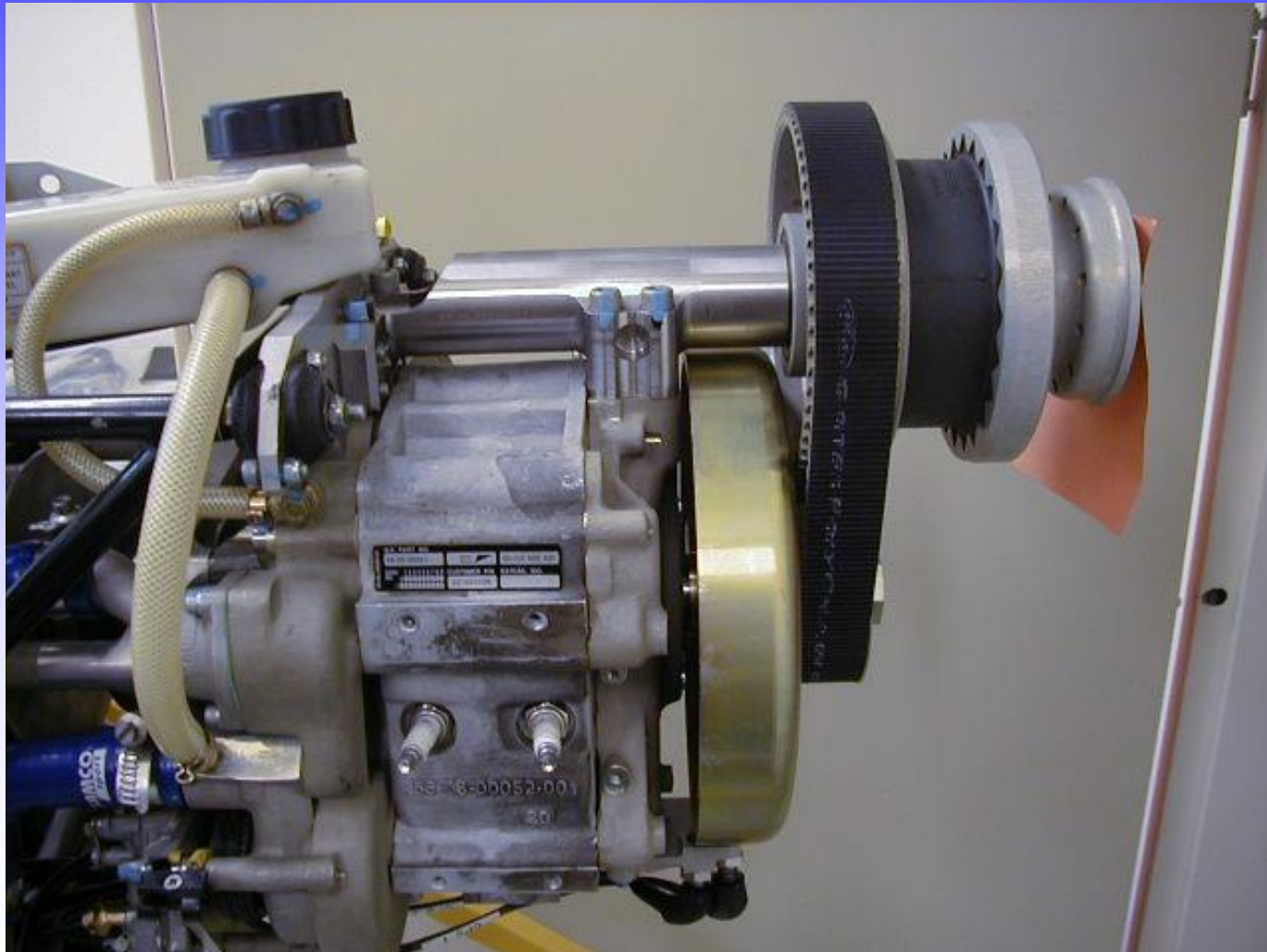
The 802W CAD View



802 Starterator, schematic



802W Engine Demonstrator



SilverArrow

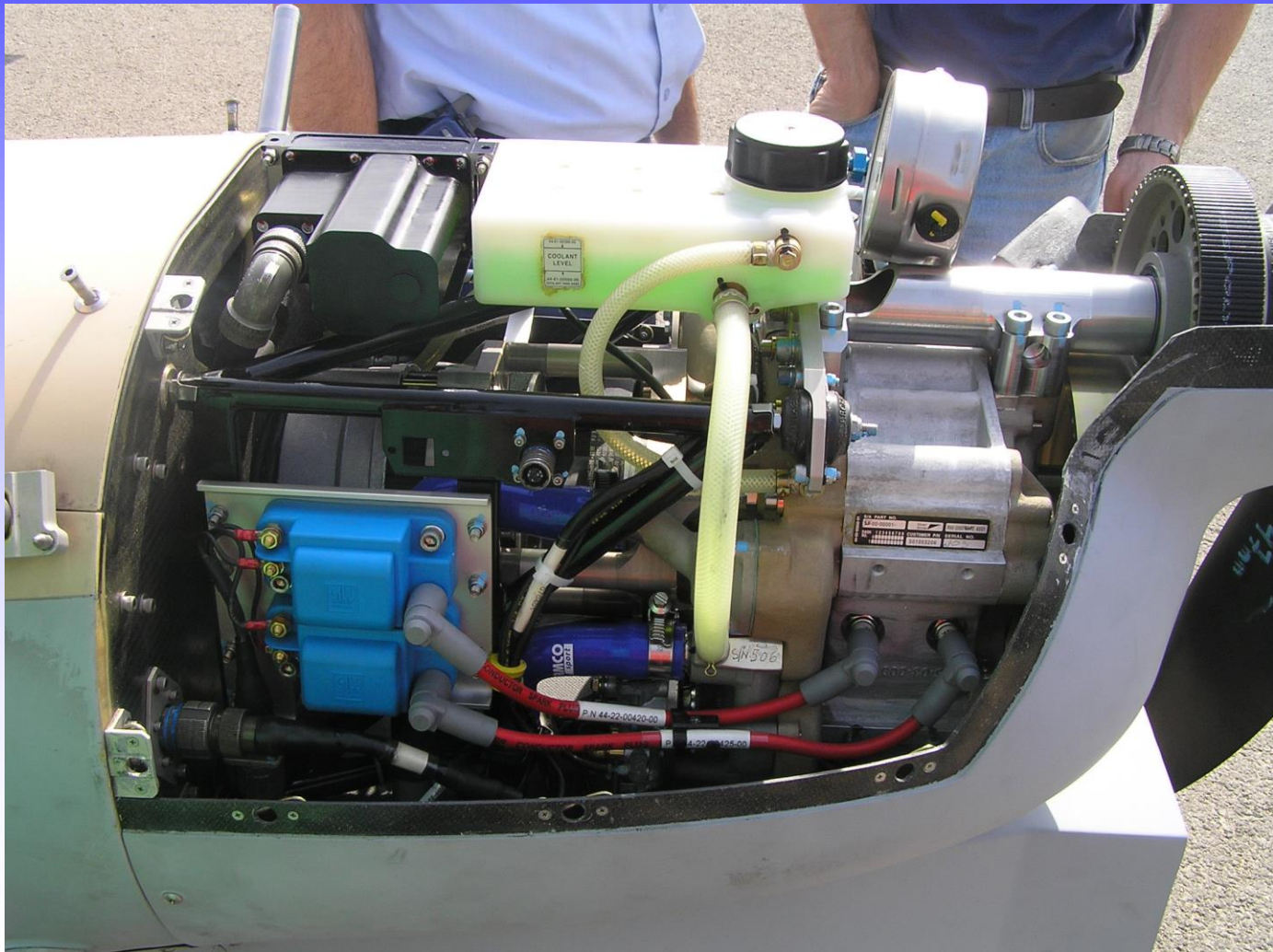
A Subsidiary of



10 Roviansky St. Rishon LeZion 75706, Israel

UAV ENGINES PLANT (UEP)

802W demonstrator in H450 UAV following maiden flight

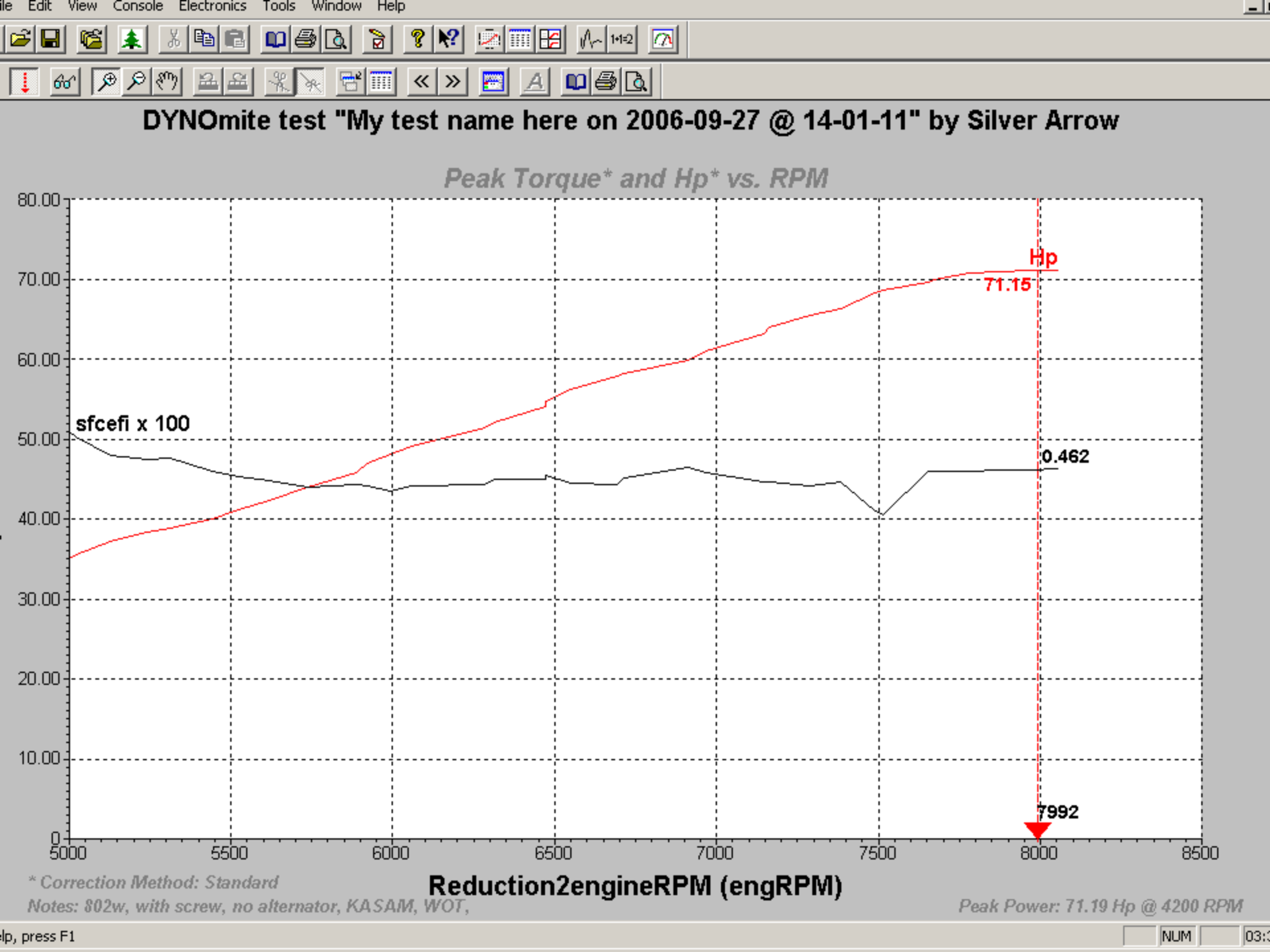


Peak Torque* and Hp* vs. RPM



Notes: 802w 29.47, 57%, 30 deg c, 802 exhaust pipe, NO

Peak Power: 73.80 Hp @ 4200 RPM



Summary

- UAV business volume in a dramatic increase
- The big players in the Engine world did not prepare engines for this market
- Wankel Engines are suitable and advantageous for TAC UAVs
- Academic Research covering Wankel Engines is almost nil