HYBL H16

Colin looks at new name to the turbine scene, HYBL and puts their first engine, the H16, to the test

TURBINE PACKAGE CONTENTS

HYBL H16 Turbine
Fuel Pump
Xicoy ECU (Electronic Control Unit)
HDT (Hand Data Terminal)
FOD (Foreign Object Damage) Guard
Leads
Instruction Manual
Turbine Logbook

The first I knew of this company was when I saw their stand at the 2014 JetPower show in Germany, where they were showing their first turbine, the H16. This new turbine is nominally of 17 kg thrust so inhabits a popular segment of the market, and I was delighted that HYBL Turbines were able to allow us to test one of the first production examples for this article.

Delivered in a substantial heavy-duty cardboard box with a white foam inner, the H16 is supplied complete with the popular Xicoy ECU and matching Hand Data Terminal, HP Tech fuel pump, FOD Guard and leads, as well as a length of PTFE tubing. No other fuel line is supplied, and there are no connectors included, whilst the ECU battery has also to be supplied by the new owner, a 7.4 V 4000 mAh LiPo pack being recommended.

A very comprehensive English language manual was supplied with the engine, together with a separate logbook, where run times, fuel consumed and other details can be noted, the use of this being highly recommended in the instructions.

The turbine itself is of slightly different appearance to some other turbines, and has a machined main case with a light grey matt finish, this including a protruding stop ring that is designed to seat against the mounting straps to ensure security of the turbine and eliminate any possibility of the engine sliding forward within the straps at high power settings.

The front cover is nicely anodised in a dark grey colour as is the very neat starter motor cover, the starter being attached to the main section of the engine with two metal supports. Interestingly the reason for using two supports rather than three is to avoid compressor blade resonance, which would occur at around the full power rpm level if three supports were used – with only two supports the resonance can only occur at rpm's well above the maximum the engine will reach.

AUTHOR:
COLIN STRAUS
PHOTOGRAPHER:
COLIN STRAUS

The complete H16 package contains the turbine, ECU, HDT, fuel pump, cables and manuals etc

The H16 has a very clean external appearance, with the thermocouple and kerostart igniter being internally installed

Safety

One very unusual feature is the integrated containment ring produced from Kevlar, and which is installed around the rear of the engine surrounding the turbine wheel. Safety is clearly of vital importance when operating a model turbine engine, and with a background in full size aviation turbines HYBL take this very seriously, the use of this containment ring being a good example, even though the turbine wheels are designed and manufactured to very high standards, with each one having full X-Ray and capillary inspection.

The instructions continue the theme with a great deal of space being dedicated to safe installation, operation and maintenance of the engine, as well as covering the use of bypasses, exhaust duct size and positioning and even the use of an external containment ring if required.

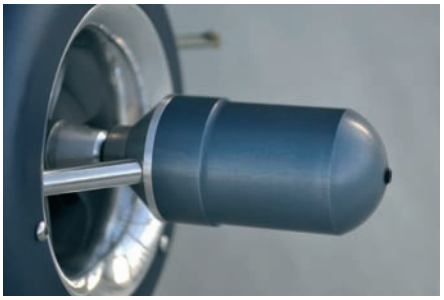
There are a total of three connections to the turbine, two of these being electrical via the well known green Multiplex style connectors, the third being the single fuel input through a neat rotatable connector, unusually a length of PTFE tubing is supplied to fit this connector to ensure that any heat soak from the engine will not affect the tubing being connected.

As can be deduced by the use of a single fuel input, the H16 has the fuel and kerostart valves hidden under the front cover, meaning a faster and simpler installation of the engine. As is common these days, the thermocouple and igniter are installed internally, giving the engine a very clean and uncluttered external appearance.

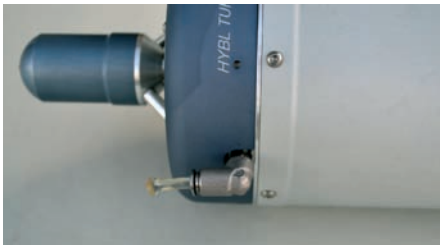
The instructions suggest the use of pieces of thick paper between the mounting straps and the engine case to make sure that the case remains unmarked when the straps are tightened, the stop ring on the main case making this possible, as without this I would be concerned that the turbine could slide forward when the throttle is opened.

I used thin, double-sided tape on the inside faces of the mounting straps to attach the paper, and at the end of testing the turbine case was completely unmarked, just as the instructions suggested.

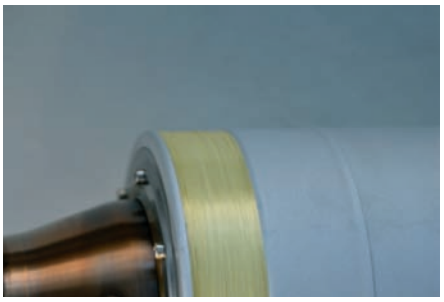
The H16 is supplied complete with a FOD guard and this was used during all testing, so a small thrust increase would be found if run without the guard, although this is not recommended as it is all to easy for a turbine to be damaged due to ingestion of small stones, grit etc when being run, particularly from dirty runways, or when used in models with low positioned air intakes, for example F-16's.



Starter motor cover is machined, as is the remainder of the motor mount, the cover is simple to remove should the motor need servicing/replacement



Very neat rotatable fuel fitting allows the fuel line to be positioning as required by any installation



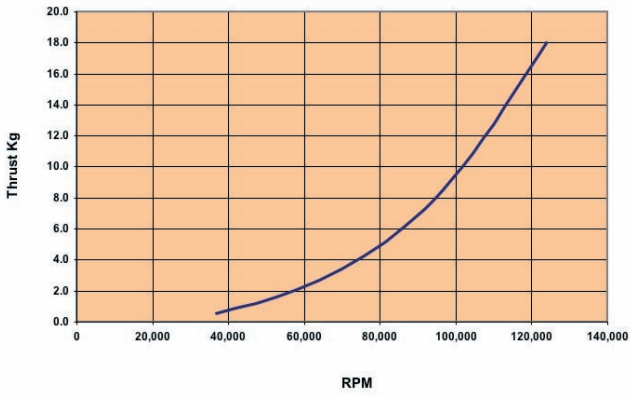
One very unusual feature is this Kevlar containment ring, designed to ensure that in the (unlikely) event of a turbine blade failure the blade(s) are retained within the engine

The HP Tech fuel pump is a compact, well-known and reliable unit

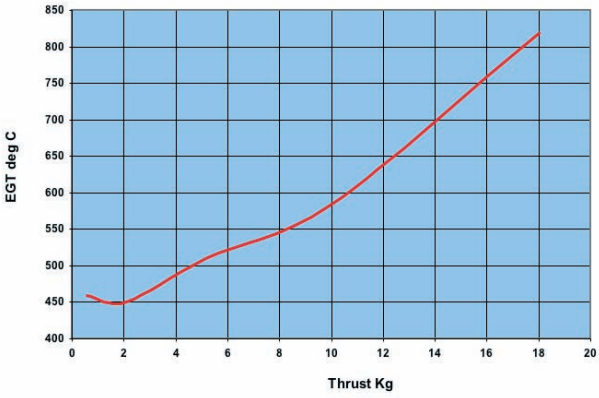
Very precise casting work is evident on the compressor blades

It is difficult to get a good photo inside the tailcone, but the turbine wheel and internal fairing can be seen here

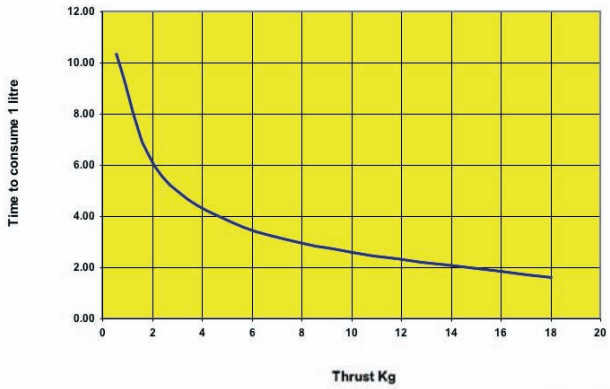
Graph 1
HYBL H16 - Thrust/RPM



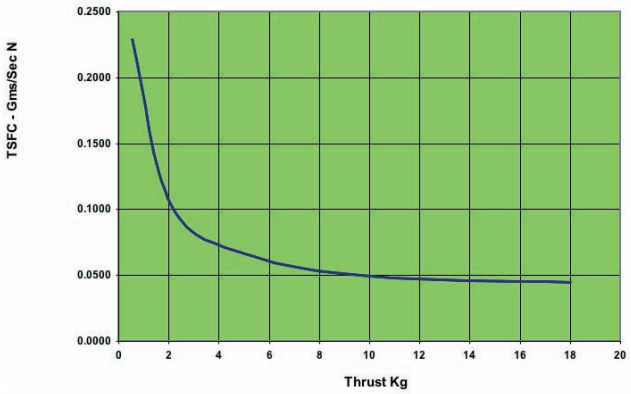
Graph 3
HYBL H16 - EGT Deg C/Thrust

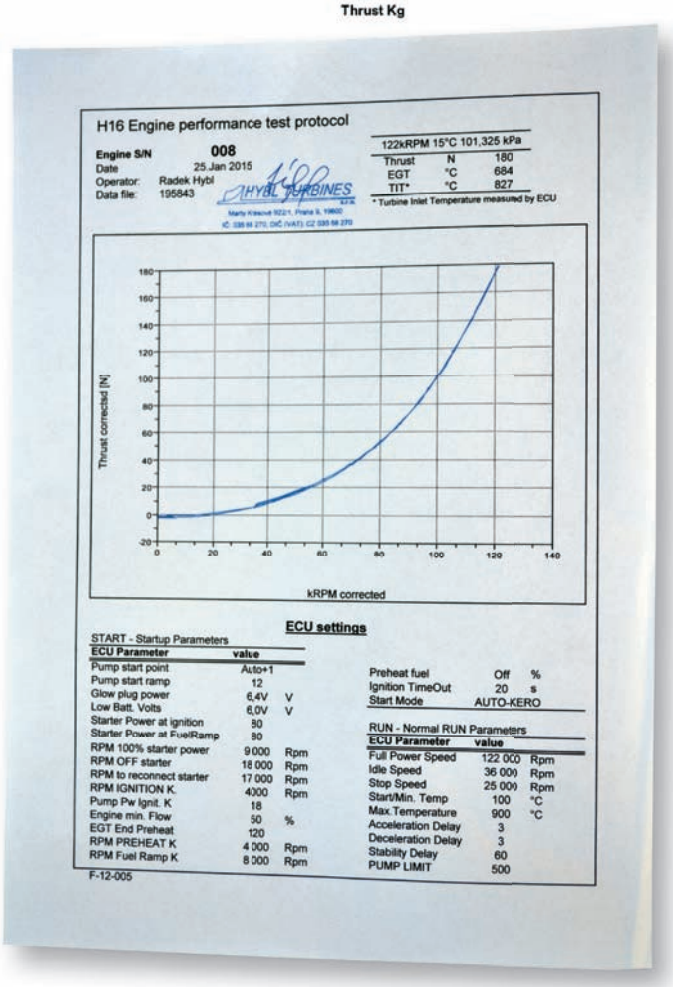


Graph 2
HYBL H16 - Fuel endurance / Thrust



Graph 4
HYBL H16 - TSFC/Thrust





H16 Engine performance test protocol

Engine S/N 008
Date 25.Jan 2015
Operator: Radek Hybl
Data file: 195843

122kRPM 15°C 101,325 kPa

Thrust	N	180
EGT	°C	684
TIT*	°C	827

* Turbine Inlet Temperature measured by ECU

Thrust corrected [N]
kRPM corrected

ECU settings

START - Startup Parameters

ECU Parameter	value	
Pump start point	Auto+1	
Pump start ramp	12	
Glow plug power	6,4V	V
Low Batt. Volts	6,0V	V
Starter Power at ignition	80	
Starter Power at FuelRamp	90	
RPM 100% starter power	9 000	Rpm
RPM OFF starter	18 000	Rpm
RPM to reconnect starter	17 000	Rpm
RPM IGNITION K	4000	Rpm
Pump Pw Ignit. K	18	
Engine min. Flow	50	%
EGT End Preheat	120	
RPM PREHEAT K	4 000	Rpm
RPM Fuel Ramp K	8 000	Rpm

Preheat fuel	Off	%
Ignition TimeOut	20	s
Start Mode	AUTO-KERO	

RUN - Normal RUN Parameters

ECU Parameter	value	
Full Power Speed	122 000	Rpm
Idle Speed	36 000	Rpm
Stop Speed	25 000	Rpm
Start/Min. Temp	100	°C
Max.Temperature	900	°C
Acceleration Delay	3	
Deceleration Delay	3	
Stability Delay	60	
PUMP LIMIT	500	

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Each engine is supplied with its own performance spreadsheet, in this case the engine proved to have a maximum thrust within 2.0% of that shown on the spreadsheet

Testing

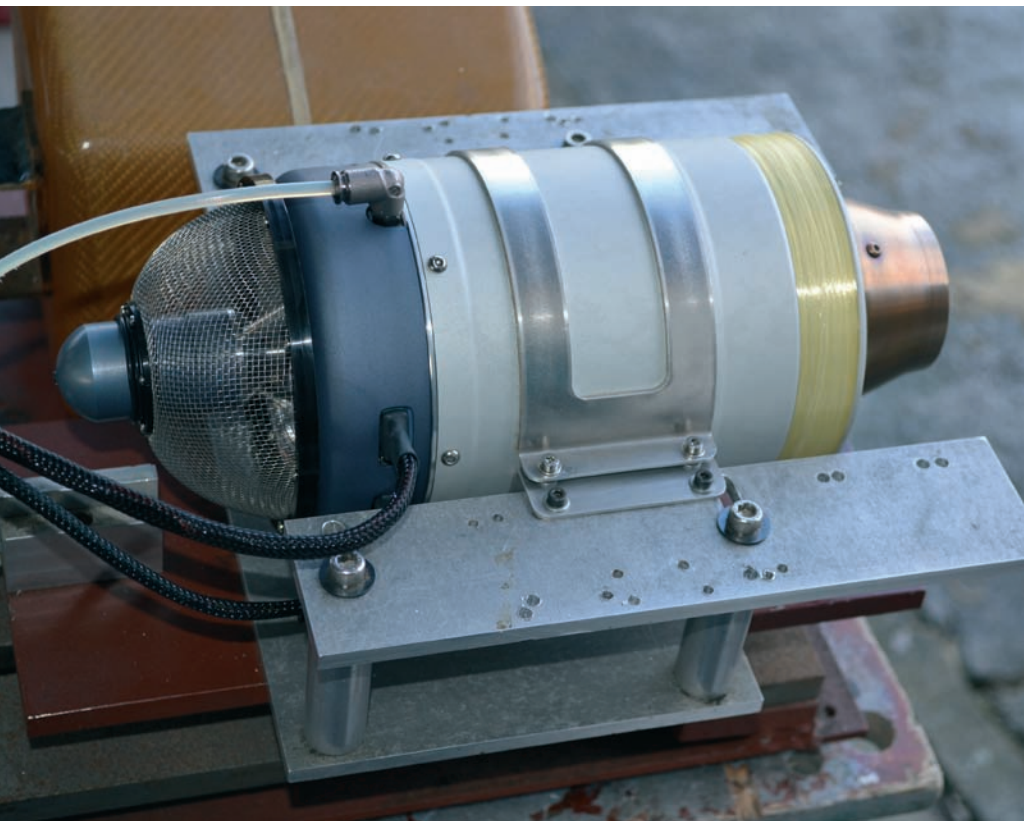
Fitting the engine onto the test rig took very little time, and with all connections made and the ECU programmed to the transmitter we were ready for a first start, once the fuel line had been primed with fuel. The start itself proved very simple, taking just under 1 minute before the engine was at idle and control passed to the transmitter. No significant flaming was seen during the start procedure, as was the case on subsequent starts, these also being clean and smooth.

With the engine at idle the test procedure was begun, measurements being taken as normal at fixed points throughout the rpm range. The general engine behaviour was excellent, being smooth and steady at all times, and rpm stability at each measured rpm point was also notably good.

Maximum thrust was measured at a corrected 177.1 Newtons, which is well above the 17 kp (167.1 Newtons) claimed, whilst fuel consumption was also slightly higher than the claimed 470 gram per minute at 497 grams (622 cc). Acceleration and deceleration were both very good, at between 3.5 and 4 seconds, with no sign of compressor stall found.

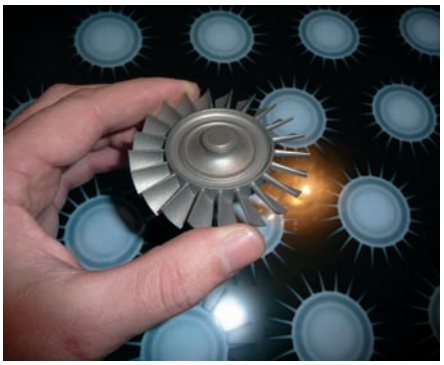
I did note that at full throttle the engine temperature shown on the HDT appeared rather high at 820 degrees, but upon checking this in the manual I found that the H16 is unlike many other turbines in that the temperature is measured directly behind the combustion chamber, as the Turbine Inlet Temperature, not within the tailcone as is more common. This means that the displayed temperature is around 150 degrees higher than it would be if measured within the tailcone, which would in this case result in a temperature more like 670 degrees.

One small problem did occur during the testing process, as after one run the starter motor ceased to operate, although there was no evidence that it had overheated or failed. Checking the manual I noted that there was a section covering checking, maintenance and replacement of the motor, so following this it was the work of a couple of minutes to remove the motor cover to find that the problem was a sticky brush. This was soon cleaned up, and the cover refitted, after which the motor ran perfectly.



On the test rig and ready for the first start of the test session

Under the front cover with the fuel and kerostart valves in view



A close-up of the cast turbine wheel, with a sheet of X-Rays of each turbine wheel in the background

The manual suggested fitting thick paper to the engine mounts to avoid marking the outer surface of the turbine; so heavy brown paper was used during testing

TEST RESULTS

Idle RPM	36,000
Idle Thrust	5.3 Newtons (0.5 Kg/ 1.2 lb)
Idle Temperature	460 degrees Centigrade
Maximum RPM	122,000
Maximum Thrust	177.1 Newtons (18.1 Kg/39.8 lb)
Maximum Thrust Temperature	820 degrees Centigrade
Fuel Consumption at Max Thrust	622ml/min
Fuel Used	Kerosene
Lubricant	Mobil II turbine oil
Fuel/Oil Ratio	5% (20:1)
Weights	
Turbine (inc Mount & FOD Guard)	1707 grams (3.76 lb)
Ancillaries (inc Battery)	380 grams (0.84 lb)
Sizes	
Length	273 mm (10.75")
Diameter	111 mm (4.4")

Summary

The HYBL H16 is a very high quality turbine from a manufacturer new to the scene. It runs very well and has an excellent thrust to weight ratio, comparing the thrust to the weight of engine, ancillaries and 5 minutes of fuel at full power. It does not come with some of the parts other turbines include, such as battery, fuel tubing, filter and receiver connection lead, but in exchange for this the price of the engine is lower than most of the competition, particularly for early customers where a special offer is available (at the time of writing).

The H16 deserves to do well, and I look forward to testing more engines from this young enterprise in the future.

Contacts
www.hyblturbines.cz