I nuovi sistemi integrati di gestione e controllo dei motori alternativi

Aula “S. Bobbio”, Scuola Politecnica e delle Scienze di Base – P.le Tecchio
22 Ottobre 2016

ROTAX | BRP

LYCOMING

CONTINENTAL
Continental Motors, Inc.

ROTAX BRP

ROTAX 912 A/F/UL

ROTAX 912 S/ULS

ROTAX 914 F/UL

ROTAX 912 IS/ISC SPORT

ROTAX 915 IS ENGINE

ROTAX BRP

MAIN DATA

ROTAX 915 IS ENGINE

135 HP
4-cylinder
4-stroke liquid/air-cooled engine with opposed cylinders
Dry sump forced lubrication with separate oil tank,
automatic adjustment by hydraulic, valve tappet
Redundant electronic fuel injection, ignition, ECU
Engine management system
Electric starter
Propeller speed reduction gearbox
Air intake system
Turbocharger and intercooler
Target TBO (Time between overhauls) 2,000 hours
Efficiency: 280 - 310 g/kWh BFSC at 5,500 rpm
Service Ceiling of 23,000 feet

LYCOMING

IO-360-M1A

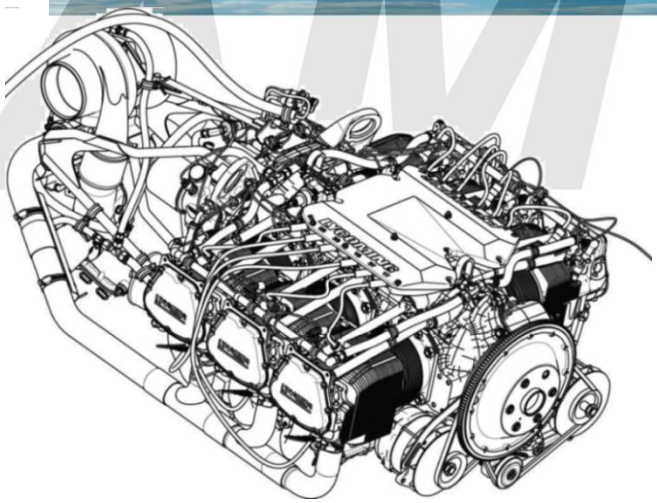
IO-390-A1B6

TEO-540-C1A

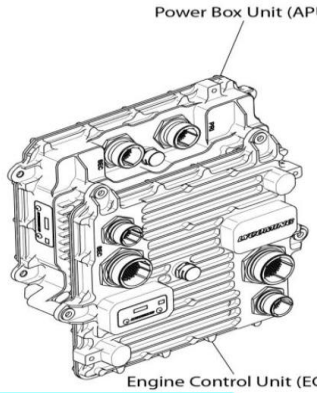
LYCOMING

MAIN DATA

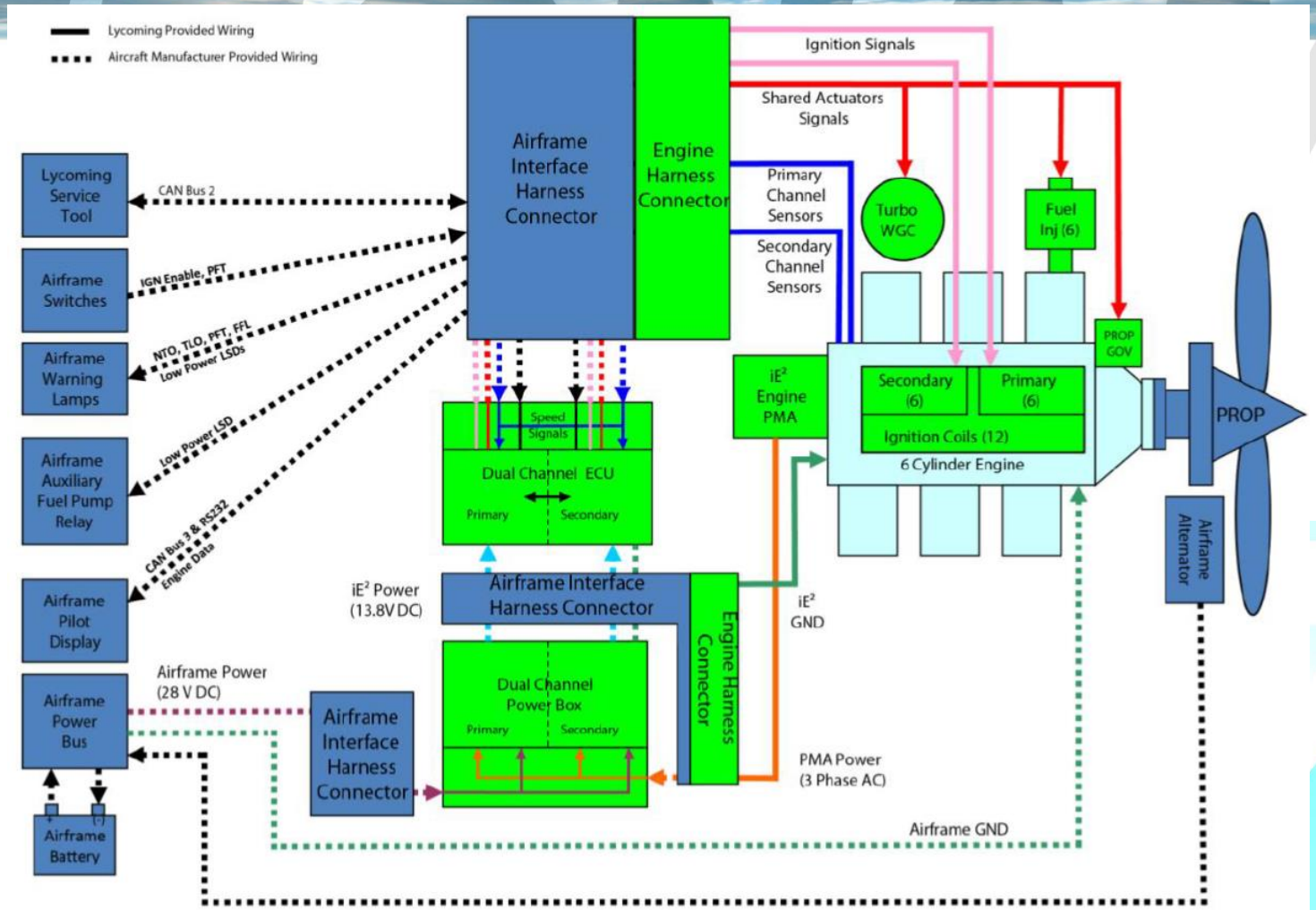
Rated Max. Cont. HP/RPM	375/2575
Performance Cruise (75% Rated)	281/2400
Economy Cruise (65% rated)	244/2200
Fuel Consumption, Cruise (lb/hr)	125 (75% Rated Power) 95 (65% Rated Power)
Propeller Drive Ratio	1:1
Propeller Shaft Rotation	Clockwise
Bore (in)	5.125
Stroke (in)	4375
Displacement (in^3)	541.5
Compression Ratio	7.3:1
Oil Sump Capacity (quarts)	12
Fuel, Aviation Grade, Minimum Octane	100 or 100LL
Fuel Injector, EEC	Electronic
Ignition	Electronic - Variable
Tachometer	Supplied in EEC Data Stream
Starter, Ratio to C'Shaft at BEndix and Rotation	16.556:1 - C'Clockwise
Starter, HET, Geared (24 Volts)	Standard
Alternator Drives	Custom for P2012
Alternator(s)	1x140 Amp each engine, 28 V



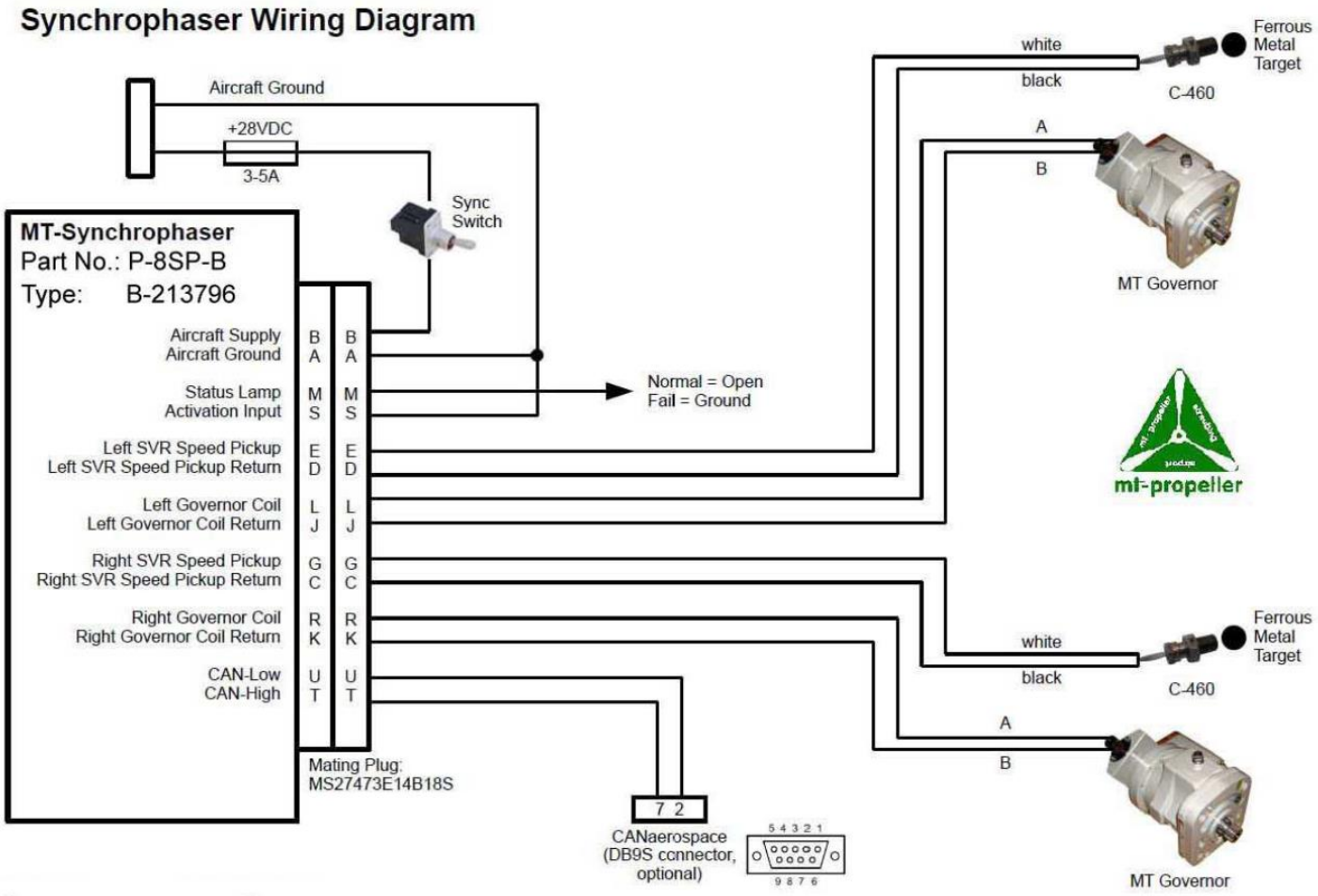
TEO-540-C1A

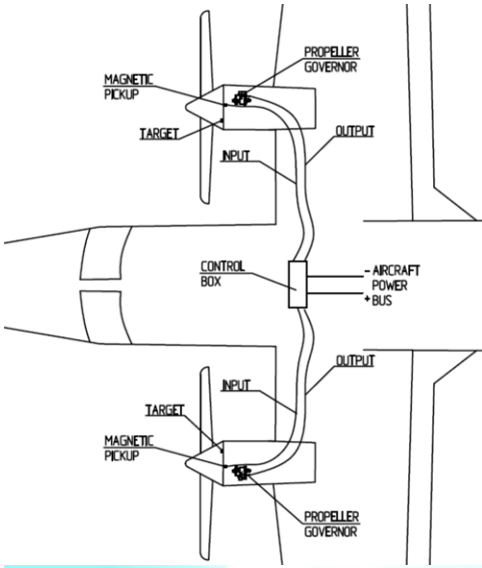


EECS Primary Components



EECS system Overview TEO-540-C1A

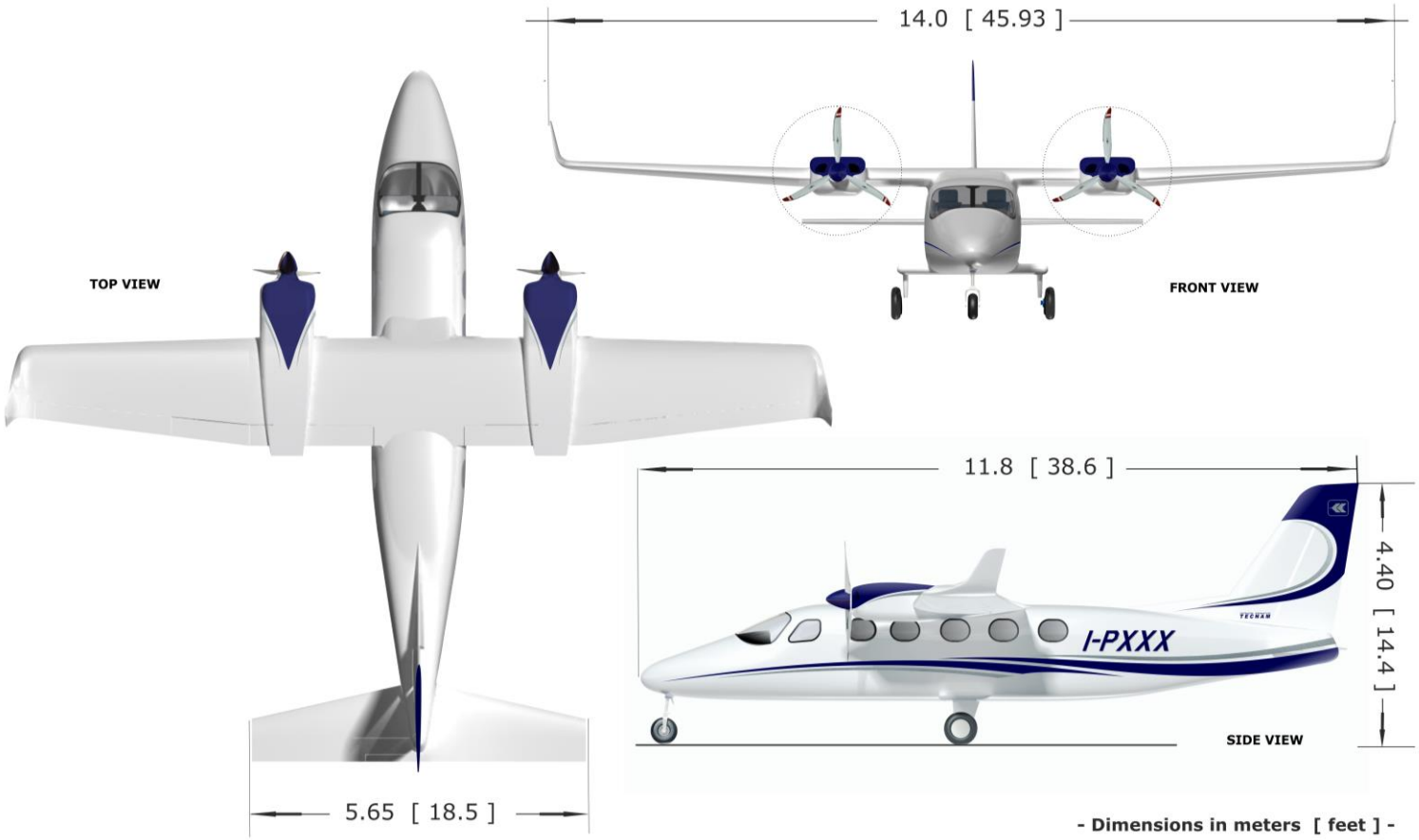




MT-Propeller Synchrophaser wiring diagram

Installation of TEO-540-C1A on P2012 Traveller

P2012 Traveller



Tecnam P2012 Traveller MAIN Data and Estimated Performances with TEO-540-M1A

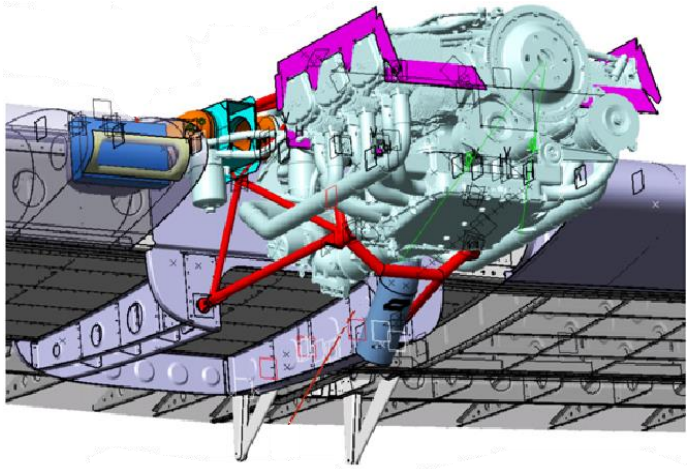
Basic Empty Weight	2250kg	4960lbs
Operational Empty Weight (single pilot and Pilots' Luggage)	2350kg	5181lbs
Maximum Take-Off Weight	3452kg	7610lbs
Maximum Landing Weight	3350kg	7385lbs
Ramp Weight	3470kg	7650lbs
Maximum Zero Fuel Weight (9 passengers + single pilot + luggage)	3363kg	7414lbs
Wing Loading	136kg/m^2	27,8lbs/ft^2
Power Loading	4,6kg/hp	10,1lbs/hp
Payload (max fuel + single pilot)	656kg	1446lbs
Fuel Capacity	446kg / 620lt	983lbs / 160USGal

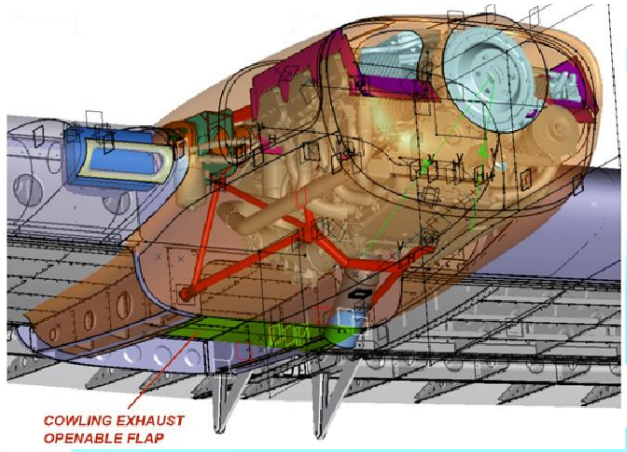
Cruise Speed (TAS 75%)	172kts @ 6000ft 174kts @ 8000ft 177kts @ 10000ft	
Cruise Speed (TAS 65%)	162kts @ 6000ft 165kts @ 8000ft 167kts @ 10000ft	
Stall Speed (Take-Off Configuration)	65kts	
Stall Speed (Landing Configuration)	60kts	
VMC	74kts	
Ceiling	25000ft	
Rate of Climb	1600ft/min	
Rate of Climb (Single Engine)	400ft/min	
Take-Off Distance	561m	1841ft
Landing Distance (50ft obstacle)	506m	1660ft
Take-Off Run	430m	1411ft
Landing Run	267m	876ft
Accelerate-Stop Distance	570m	1870ft
Range (9 passengers, single pilot + luggage)	820km	445nm

Engine typical installation

Interface with airframe typical problems:

1. Instrumentation;
2. Baffles and Seals – Cooling test;
3. Oil Coolers, hoses and Lines;





Instrumentation

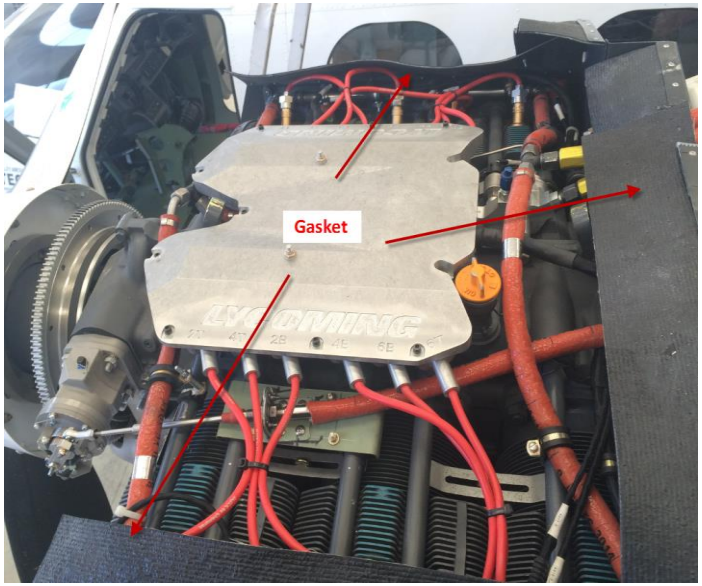
nr	DESCRIPTION
1	A/P mode controller Garmin GMC 710
2	Garmin GDU 1050 PFD1 (10”)
3	Mid Continent MD 302 back up EFIS
4	Garmin GDU 1250 MFD (12”)
5	Garmin GDU 1050 (10”)
6	ELT remote switch

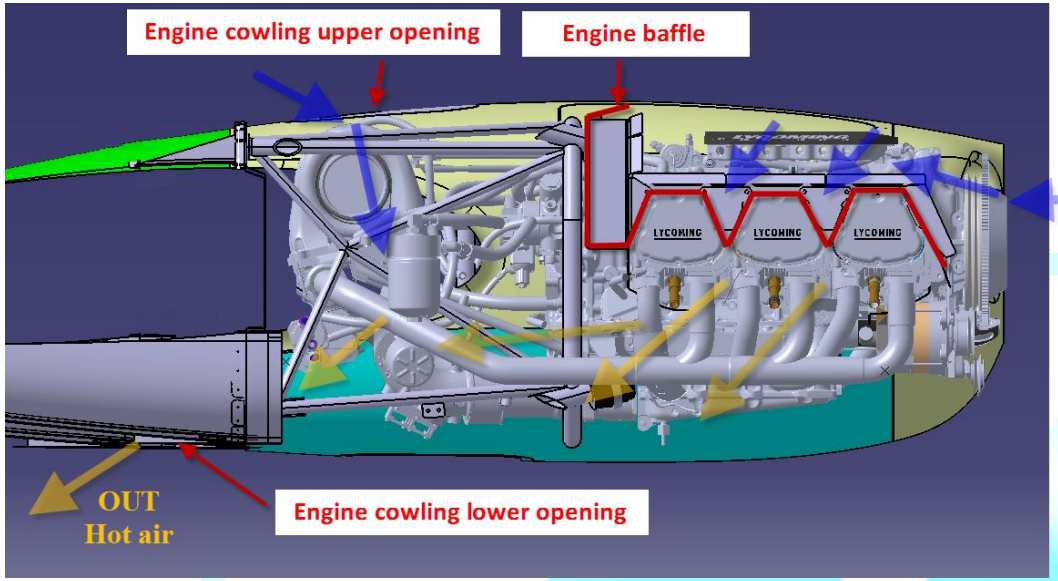
nr	DESCRIPTION
7	Anti-ice fluid Q.ty Indicator (TKS System)
8	Annunciator Panel
9	Digital Audio Panel Garmin GMA350c
10	(optional) GCU 477 FMS
11	Trim position Indicators

TOP CABIN

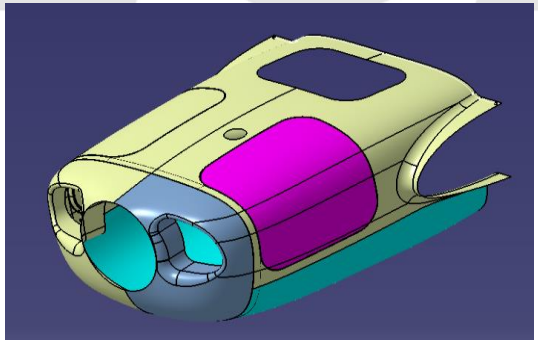
nr	DESCRIPTION
14	LH ECU Switches
15	Engine LH Starter
16	Anti-Ice switches
17	External Lighting switches
18	Engine RH Starter
19	Internal Lighting switches
20	RH ECU Switches
21	Fuel Selectors
22	Storage pockets

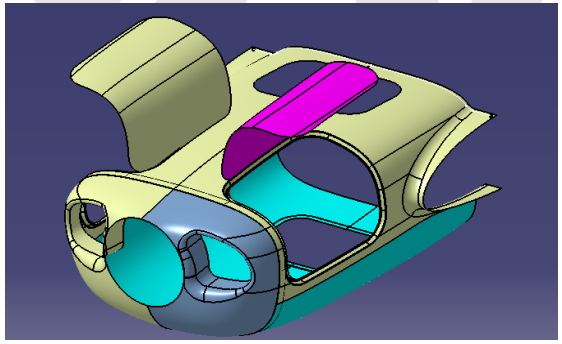
Baffles and Seals – Cooling test
CHT LIMIT





Baffles and Seals – Cooling test
CHT LIMIT - Engine cowling design

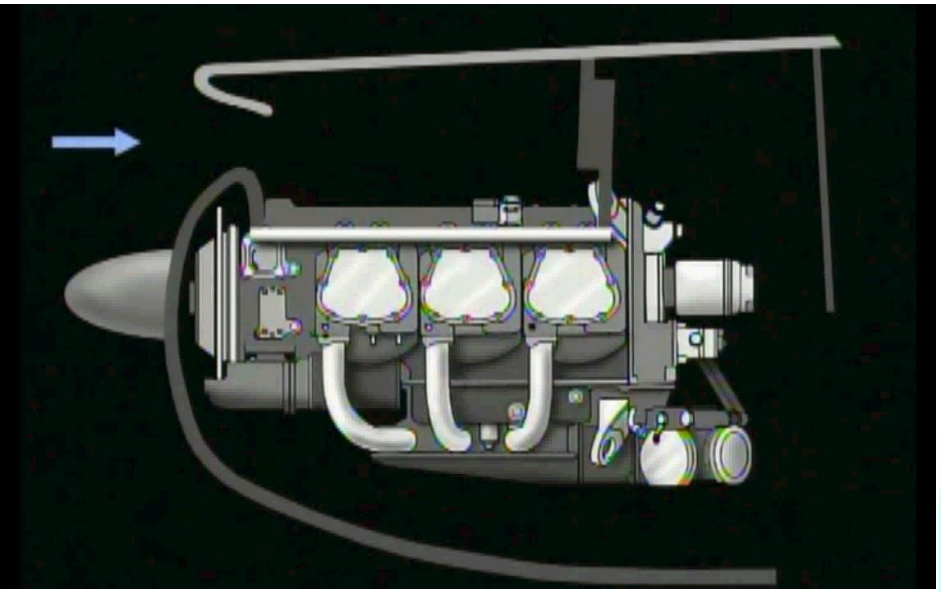


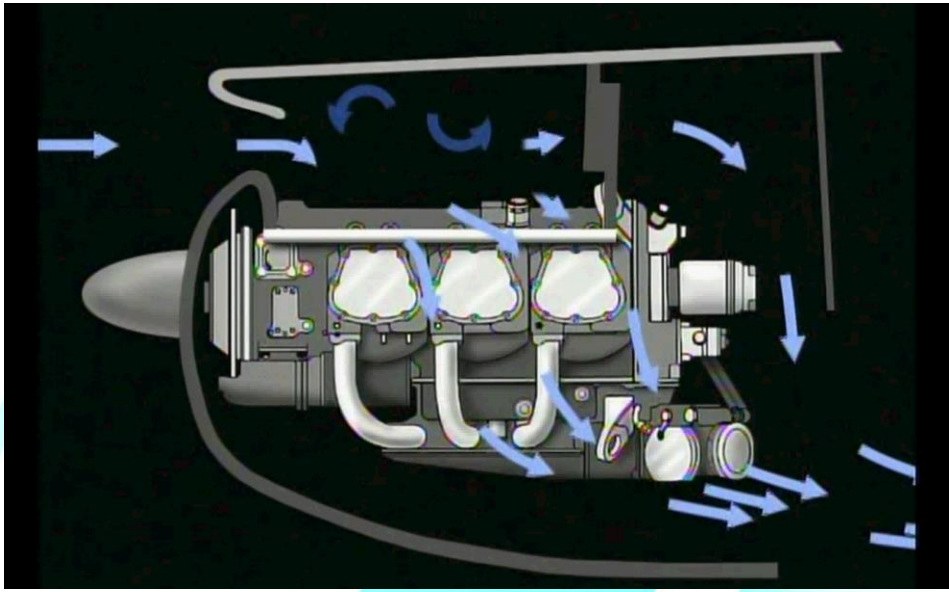


Main 3 design requirements for engine cowlings:

1. **Furnish an adequate air flow on Cylinders;**
2. **Easily accessible for engine inspection by pilot and operators;**
3. **Fire proof proprieties;**

Baffles and Seals – Cooling test
CHT LIMIT – Engine cowling leakage (typical problem)



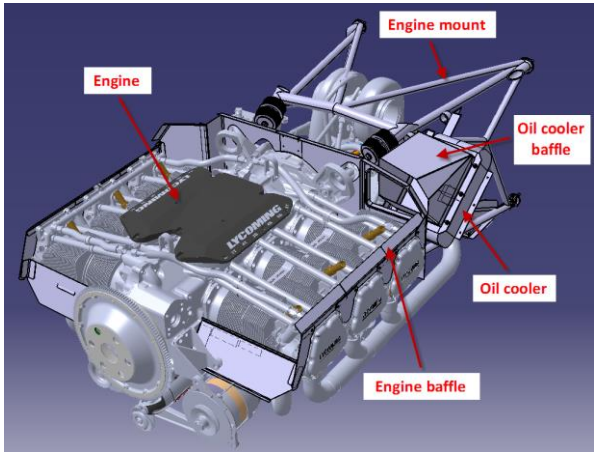


Oil Coolers, hoses and Lines

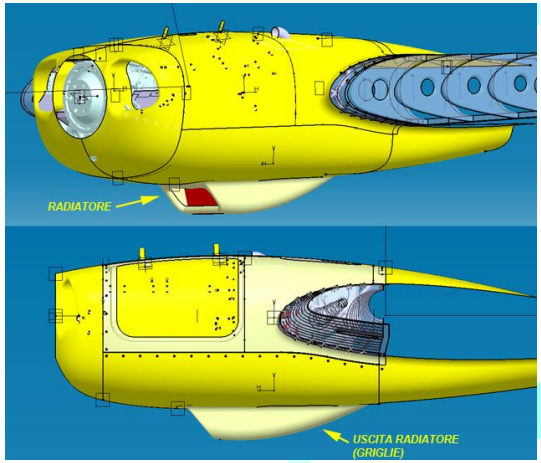
Main 3 design requirements for engine oil coolers position:

1. **Good ventilation in order to reduce the oil Temperature;**
2. **Vibration and inertia load analysis on oil coolers supports;**
3. **Fire proof proprieties;**

XMOD CHANGE for oil coolers position:



Preliminary



XMOD 007

XMOD 063 – Final conf.

Most Important EASA Certification Requirements for airplane equipped with engines pistons:

- **CS 23.1041 - General:**

The powerplant and auxiliary power unit cooling provisions must maintain the temperatures of powerplant components and engine fluids and auxiliary power unit components and fluids within the limits established for those components and fluids under the most adverse ground, water and flight operations to the maximum altitude and maximum ambient atmospheric temperature conditions for which approval is requested, and after normal engine and auxiliary power unit shutdown.

- **CS 23.1043 Cooling tests:**

(a) General. Compliance with CS 23.1041 must be shown on the basis of tests, for which the following apply:

(1) If the tests are conducted under ambient atmospheric temperature conditions deviating from the maximum for which approval is requested, the recorded powerplant temperatures must be corrected under subparagraphs (c) and (d) , unless a more rational correction method is applicable.

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Most Important EASA Certification Requirements for airplane equipped with engines pistons:

- **CS 23.1043 Cooling tests:**

(2) Corrected temperatures determined under sub-paragraph (a) (1) must not exceed established limits.
(3) The fuel used during the cooling tests must be of the minimum grade approved for the engine(s).
(4) For turbocharged engines, each turbocharger must be operated through that part of the climb profile for which operation with the turbocharger is requested.
(5) For reciprocating engines the mixture settings must be the leanest recommended for climb.

(b) Maximum ambient atmospheric temperature. A maximum ambient atmospheric temperature corresponding to sea-level conditions of at least 38° C (100° F) must be established. The assumed temperature lapse rate is 2° C (3.6° F) per 305 m (thousand feet) of altitude above sea-level until a temperature of -56.5° C (-69.7° F) is reached, above which altitude the temperature is considered constant at -56.5° C (-69.7° F). However, for winterisation installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea-level conditions of less than 38° C (100° F).

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Thanks for your time…

For the Tecnam Team, designing and building aircraft isn't just a job, its an extension of our passion for flying.

Paolo Pascale, Managing Director, Tecnam