

大陆发动机集团

Continental Motors



大陆发动机混合动力推进系统战略及展望

Nov. 2017

Beijing

大陆发动机集团坚信：航空煤油混合动力推进系统将为中国通用航空杜绝铅排放、降低碳排放的目标提供绝佳的解决方案，也将为欧盟 2050 年前实现航空领域与 1990 年相比降低 75% 碳排放和其他污染物排放的目标作出重大贡献。



1 大陆发动机产品介绍

2 EASA/CAAC/FAA 认证航空煤油产品 CD100 and CD300 Series

3 航煤混合动力系统优势

4 航煤混合动力的概念应用


5 展望

1.1 大陆发动机产品系列


Gasoline

Experimental


Certified




O-200 Series
100hp




IO-240 Series
125hp
FADEC Versions Available




IO-360 Series
200 to 225hp
Unleaded In Development




TSIO-360 Series
200 to 225hp




IO-550 Series
280 to 310hp
FADEC Versions Available




TSIO-550 Series
310 to 350hp
FADEC Versions Available




O-470 Series
225 to 230hp




IO-470 Series
225 to 260hp




IO-520 Series
285 to 300hp




TSIO-520 Series
285 to 325hp




GTSIO-520 Series
375hp



O/IO-320/340 Series
150-170 HP




O/IOX-360/370 Series
180-205 HP




IO-540 Series
260-300 HP

Jet Fuel


Under Development




CD100 Series
135 to 155 HP




CD200 Series
230 HP




CD350 Series
280 to 350 HP



CD 300 Series
300 HP



CDR-200 Series
245hp

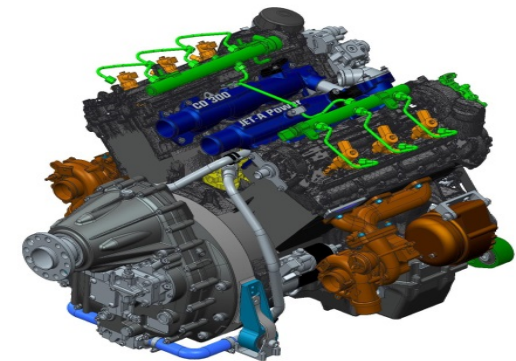
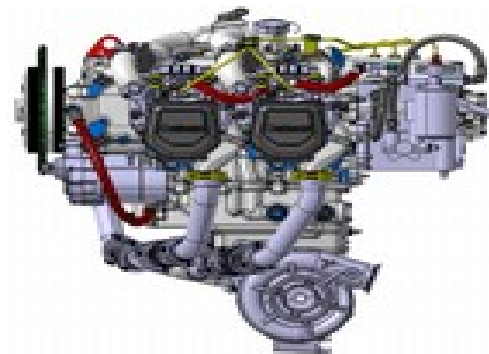


CD 400 Series
350+ hp



1.2. 航煤发动机 (Jet-A) Engines

Engine Code		CD135	CD155	CD170	CD230	CD265	CD300
Engine Type	[-]	I4, DOHC	I4, DOHC	I4, DOHC	O4, Push Rod	O4, Push Rod	V6; DOHC
Power Take Off	[HP]	135 @ 2300	155 @ 2300	170 @ 2300	230@2200	265@2500	300 @ 2300
Power Cont.	[HP]	135 @ 2300	155 @ 2300	155 @ 2300	230@2200	250@2500	272 @ 23000
BSFC	[g/kWh]	226 / 0,371	238 / 0,391	TBD	216 / 0.355	216 / 0.355	216 / 0.355
Weight	[kg/lbs]	134 / 295	134 / 295	TBD	199 / 440	199 / 440	260 / 573
Critical Altitude	[ft]	8000	8000	10000	8000	10000	10000
Status	[-]	Production	Production	Development	Certified	Development	Certified



I = Inline; V – V-Type; O - Opposed

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航煤混合动力系统优势

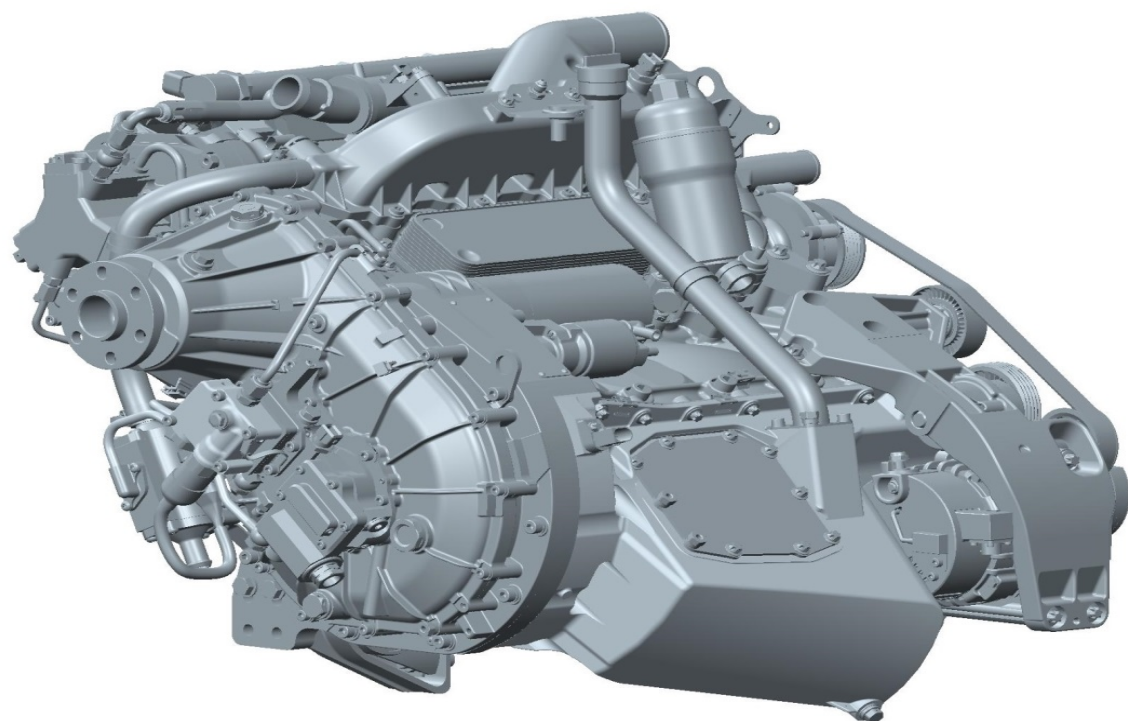
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航煤混合动力的概念应用

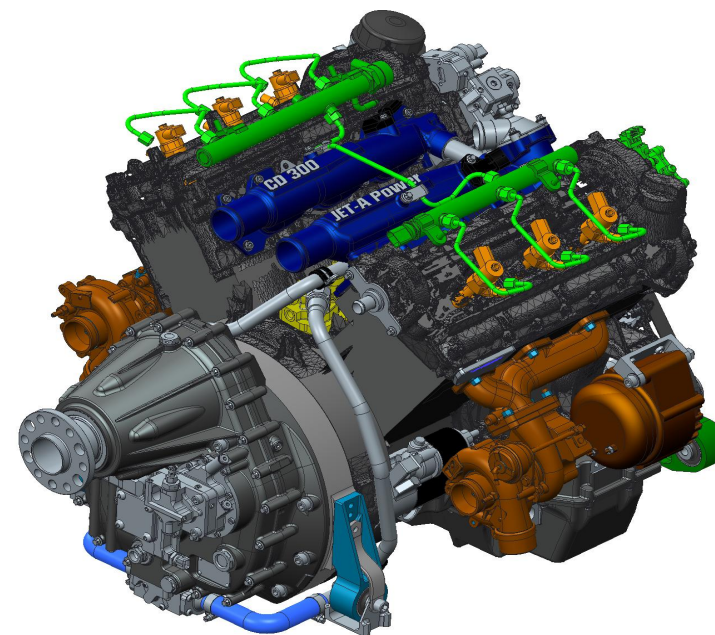
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展望

EASA /CAAC /FAA certificated Engines



CD 100 Series



gr-Darst(+)

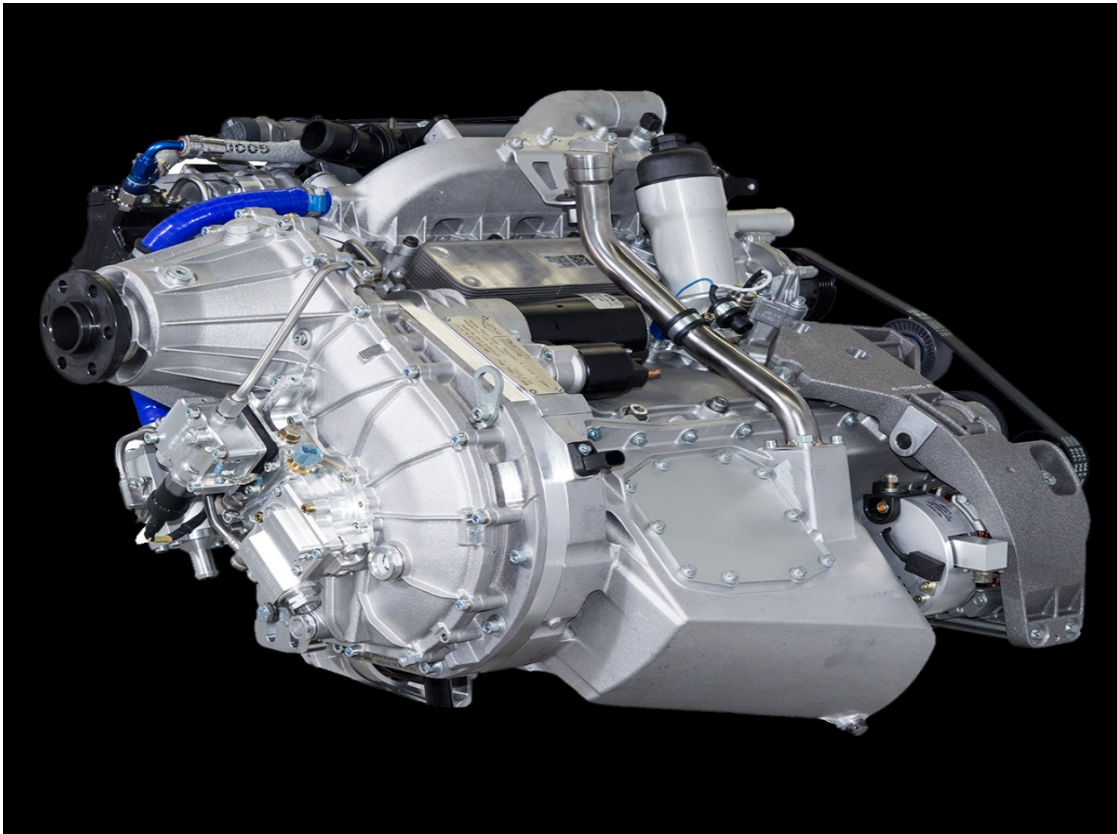
CD 300 Series

2. CD 100 and CD 300 技术参数

		CD100 Series	CD300 Series
Fuel Pressure Max	[bar]	1350	1600
Fuel Types	[-]	Jet – A ; Diesel	Jet - A
FADEC	[-]	D4	D6
RPM Direct drive	[1/min]	3900	3880
RPM Prop. Flange	[1/min]	2300	2300
RPM with gearbox for generator	[1/min]	TBD	TBD
Compression ratio	[-]	18:1	15,5:1
Mass with standard gearbox	[kg]	134	265
Mass with out gearbox	[kg]	114	233



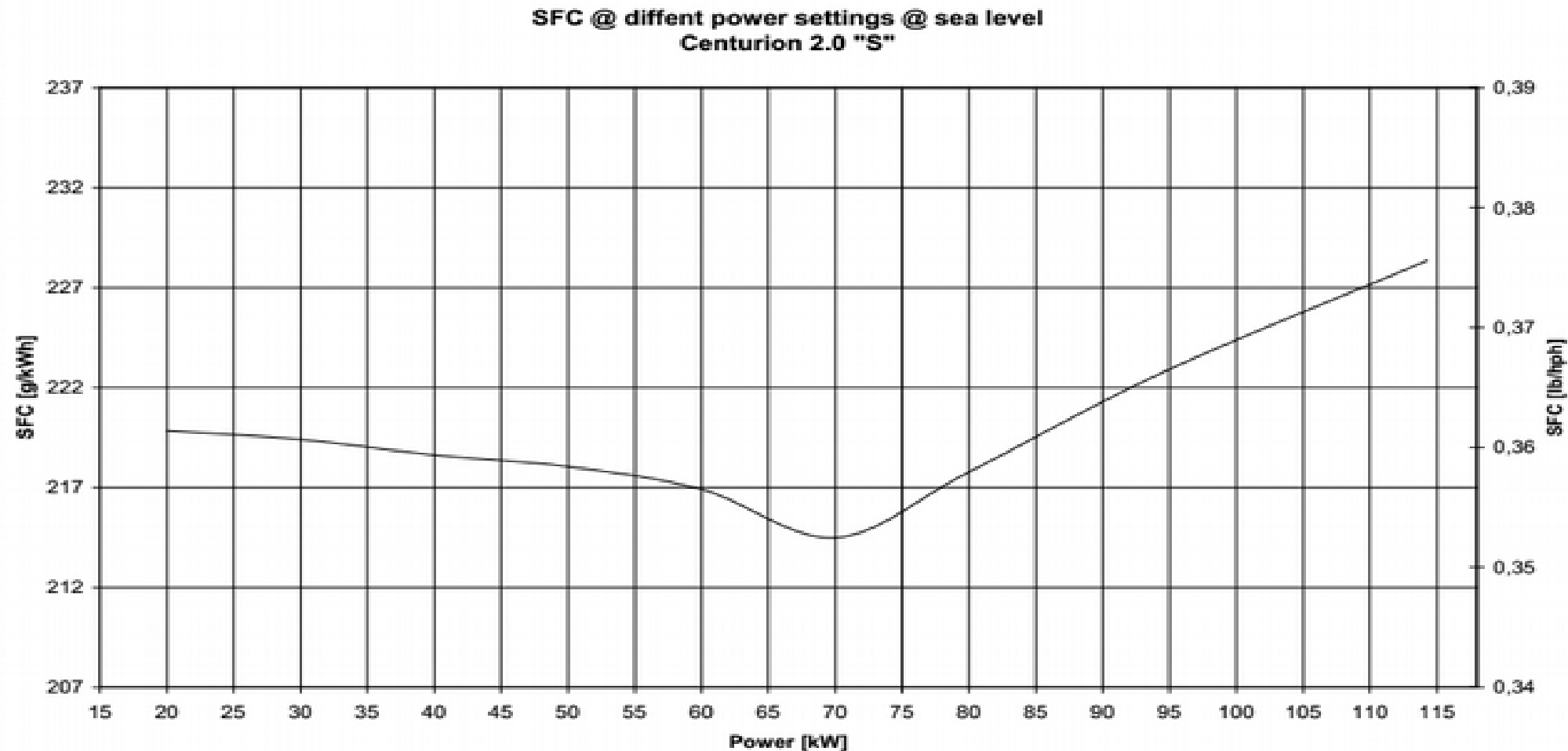
2.1 Continental Motors CD100



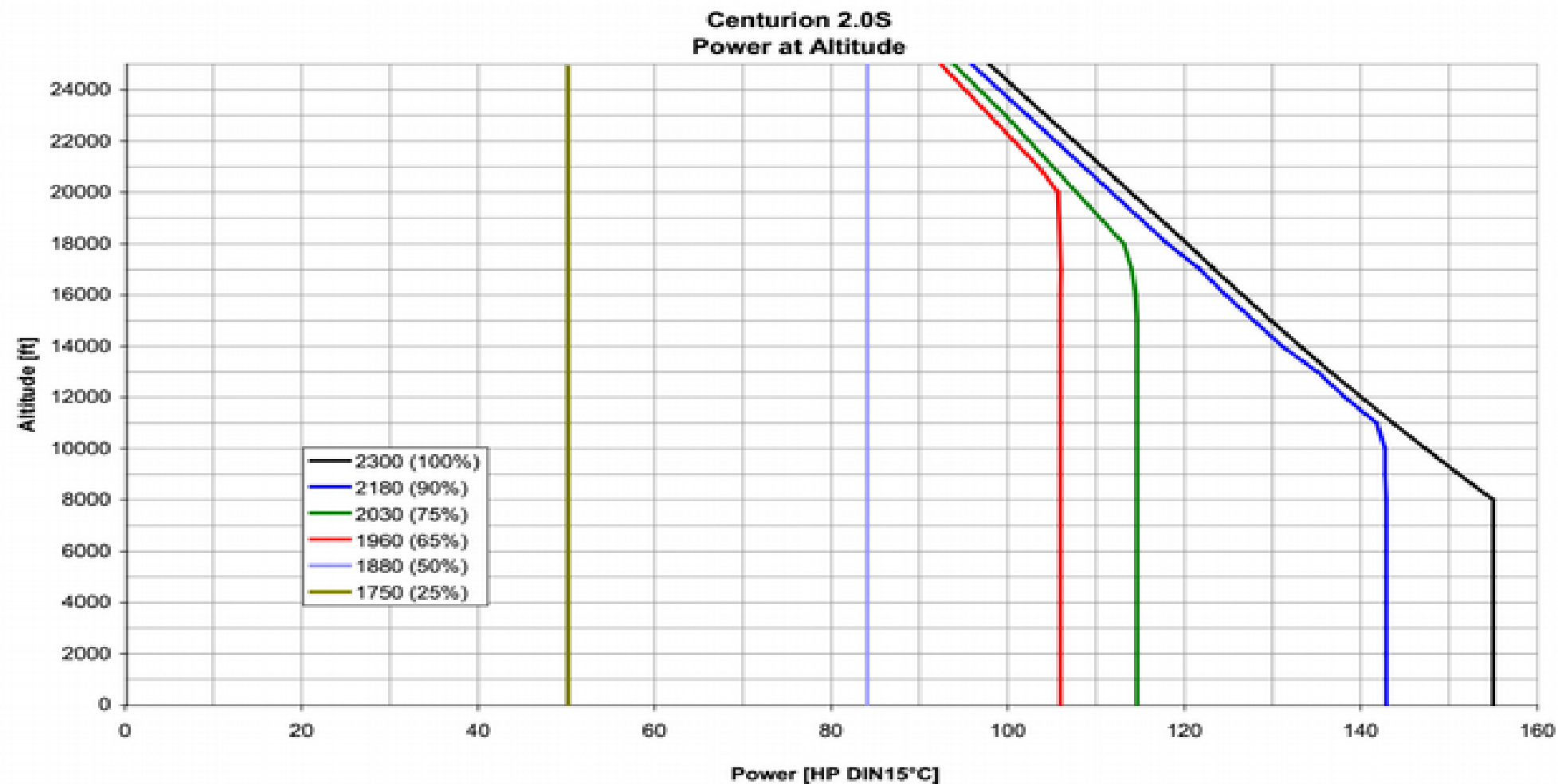
Item	Details
Type of engine	4cylinders, Inline arrangement, DOHC, 4 valves per cylinder
Engine code	CD-155
Displacement	1991 cm ³
Displacement per Piston	498 cm ³
Engine principle	4 stroke Diesel Direct Injection with turbocharger
Power	114 KW (155 HP DIN 15°C) AT 2300 /MIN (3890 /MIN ENGINE)
Torque	473 Nm (280 Nm engine) at 2300 /min (3890 /min engine)
Bore	83.0 mm
Stroke	92.0 mm
Compression ratio	18:1
Valves per cylinder	2 intake, 2 exhaust
Firing order	1-3-4-2
Max. fuel pressure	1350 bar (19580 psi)
Max. exhaust temperature	800 °C (1472 °F)
Max. manifold Pressure	2350 mbar (69 InHg)
Valve clearance compensation	Hydraulic
Type of cam drive	Chain
Specific Fuel consumption (best economy)	214 g/kWh (0.352 lb/hph)
Specific Airflow	610 kg/h @ Takeoff Power



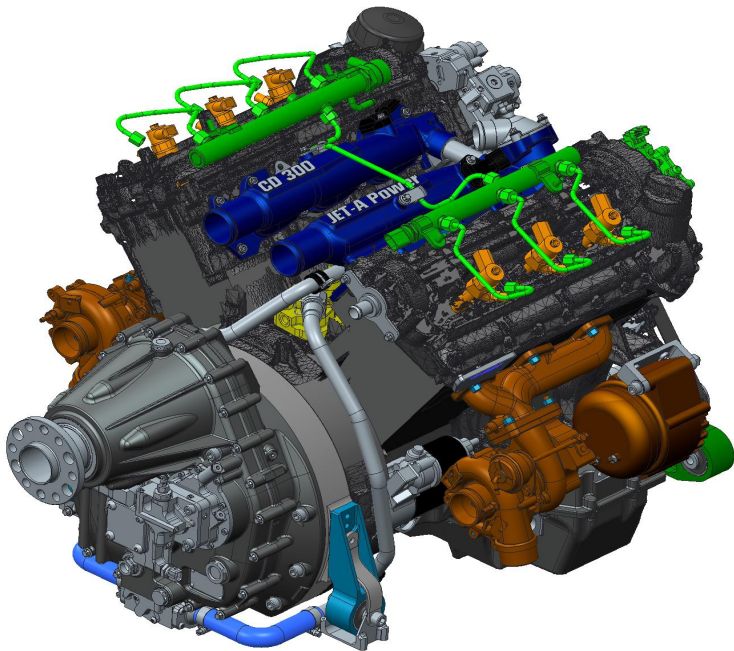
CD 100 Specific Fuel Consumption



CD100 Altitude Performance



2.2 Continental Motors CD300

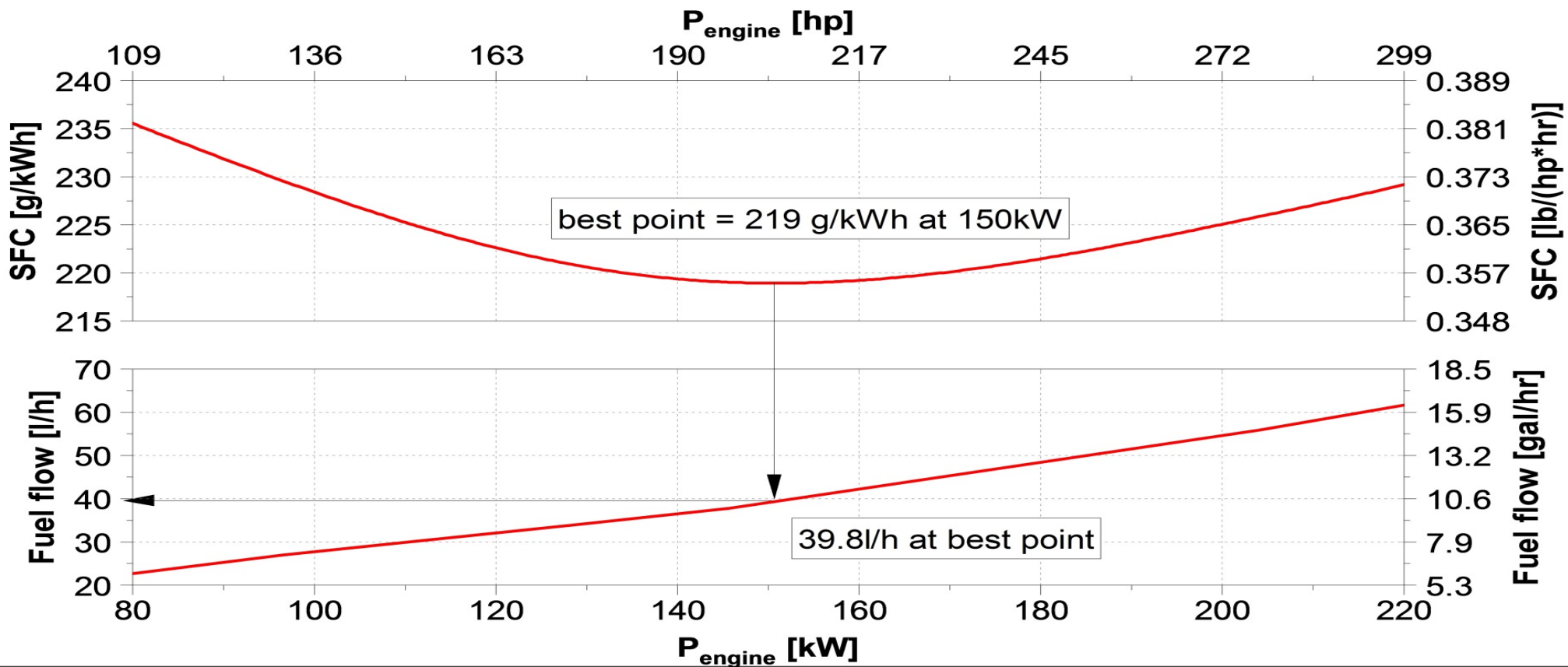


Item	Details
Type of engine	6 cylinders, V-arrangement, DOHC, 4 valves per cylinder
Engine code	CD-300
Swept Volume	2987 cm ³
Swept Volume per Piston	497,8 cm ³
Engine principle	4 stroke Diesel Direct Injection with 2 turbochargers
Power	Take off: 221 kW (DIN 15°C) at 2300 RPM for 5 min. Max Cont.: 200 kW (DIN 15°C) at 2300 RPM Best Economy: 150 kW (DIN 15°C) at 1900 RPM (73%)
Torque @ T.O.	918 Nm at 2300 /min
Bore	83.0 mm
Stroke	92.0 mm
Compression ratio	15,5:1
Valves per cylinder	2 intake, 2 exhaust
Max. fuel pressure	1600 bar (23206 psi)
Max. exhaust temperature	850 °C
Max. manifold Pressure	2900 mbar
Valve clearance compensation	Hydraulic
Type of cam drive	Chain
Specific Fuel consumption (best economy)	219 g/kWh (0.355 lb/hph)
Specific Airflow	Approx. 1200 kg/h

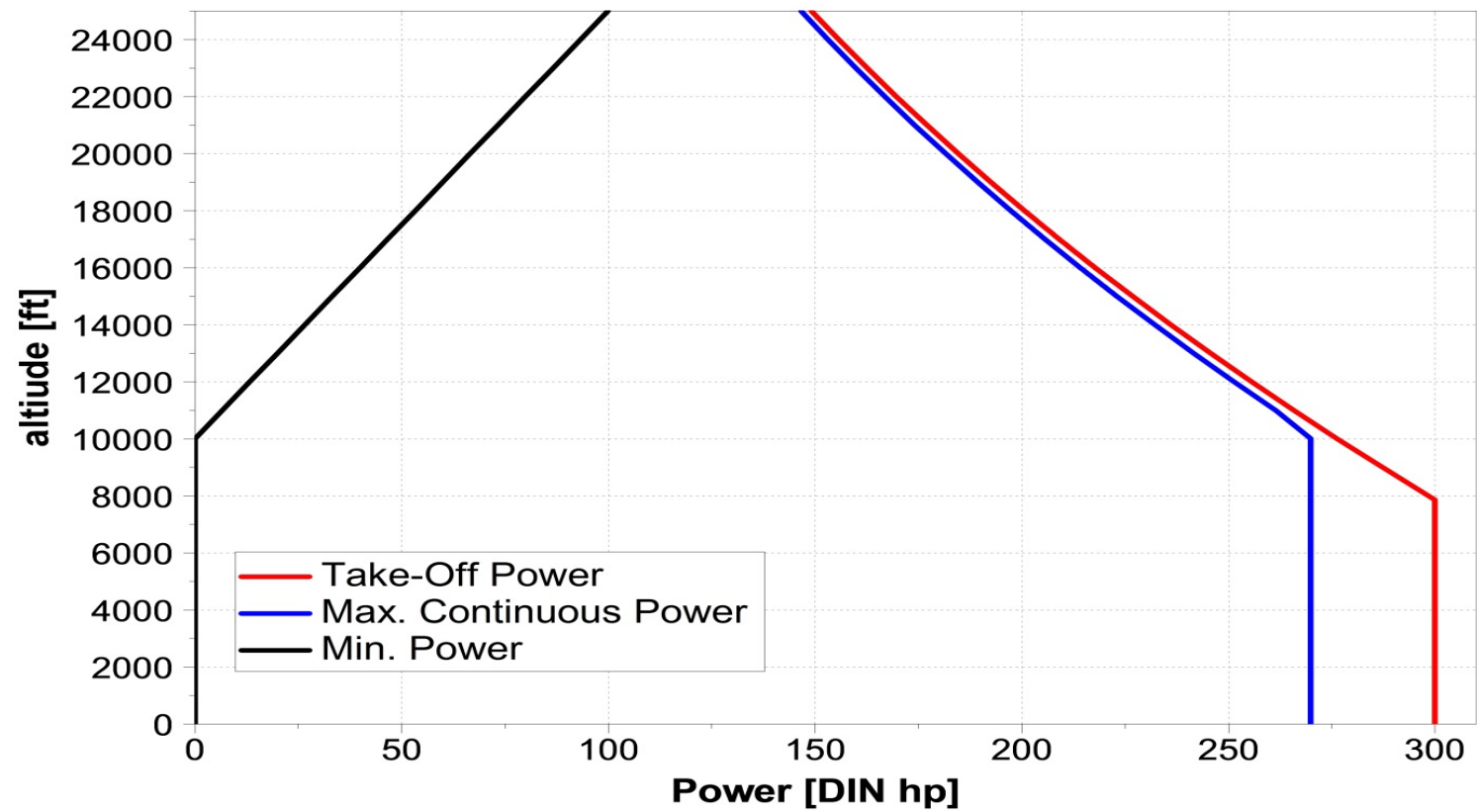


CD 300 Specific Fuel Consumption

CD300
specific fuel consumption at different power settings at sealevel
(basic calibration for fix wing AC, other calibrations possible on request)



CD300 Altitude Performance



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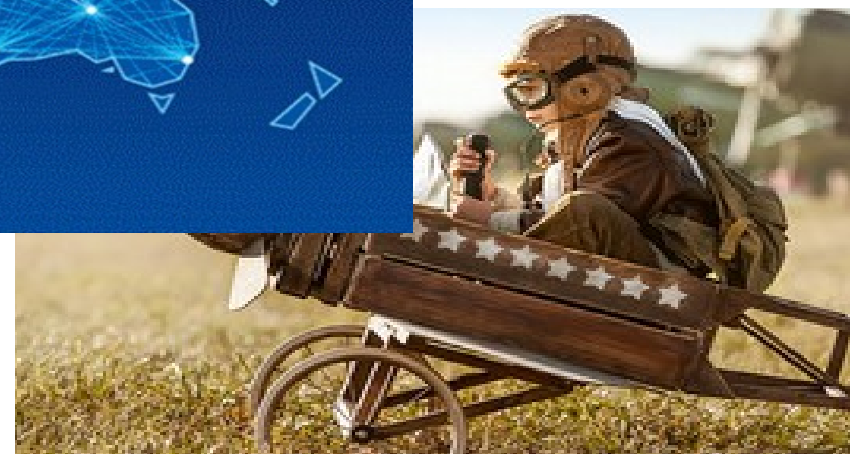
展望

3. 为什么大陆选择航煤混合动力



3.1 全球获得性、安全、环境友好

Jet fuel is available globally / safe / environmentally friendly

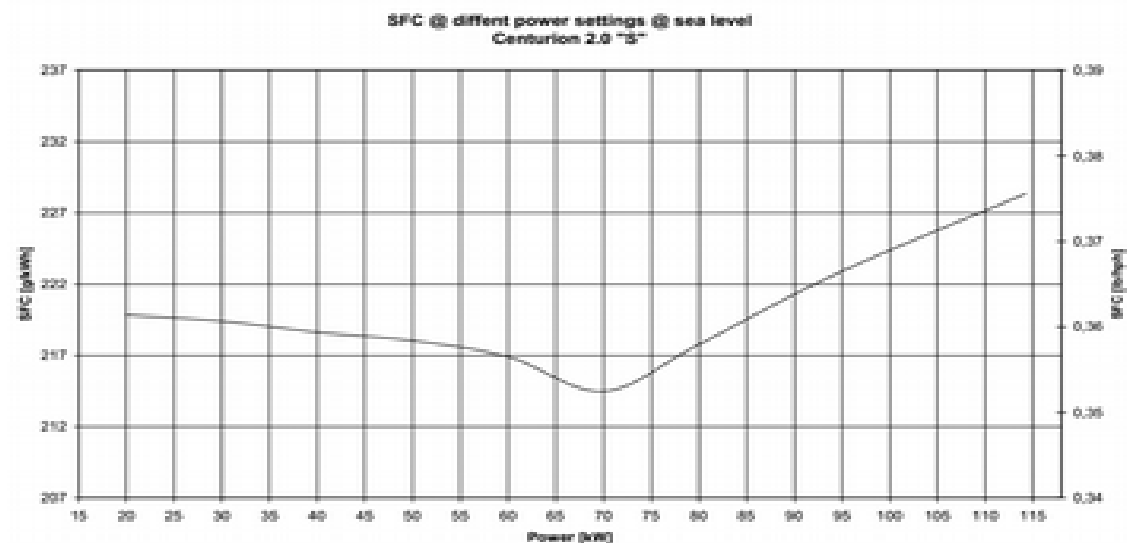
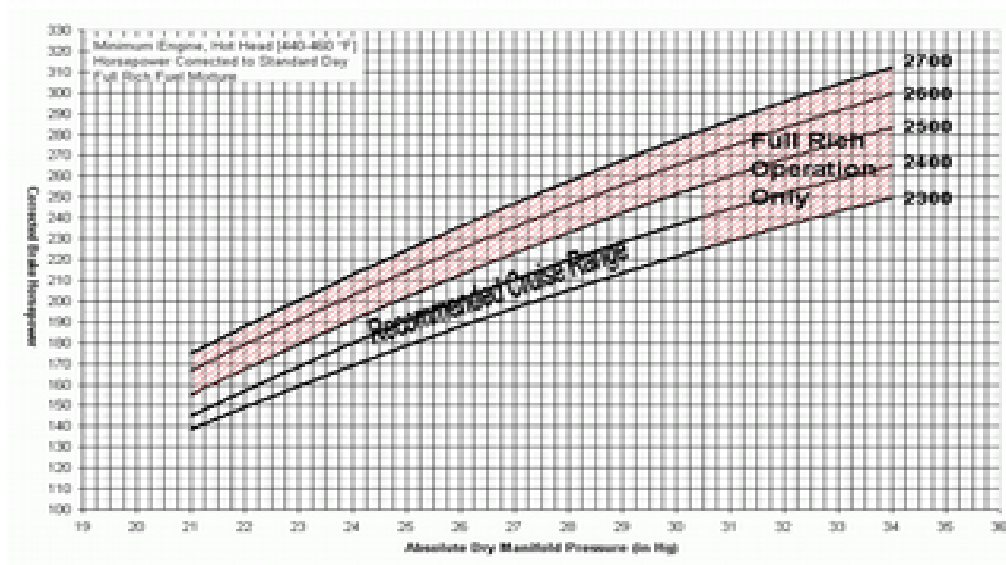


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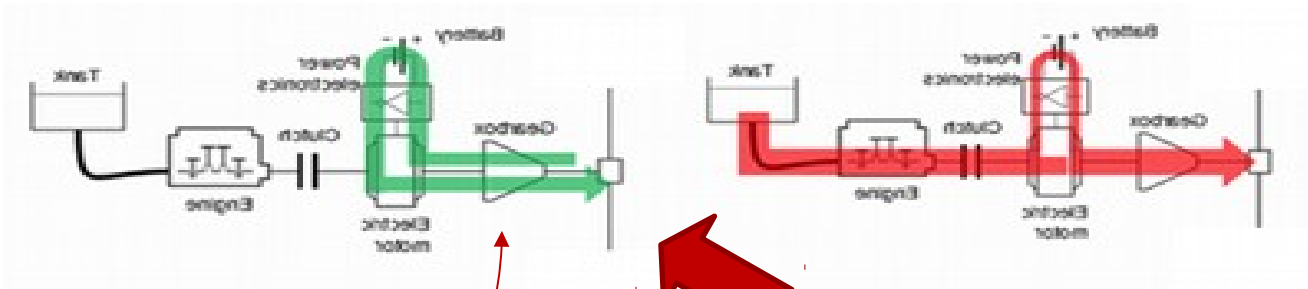


3.2 燃油消耗

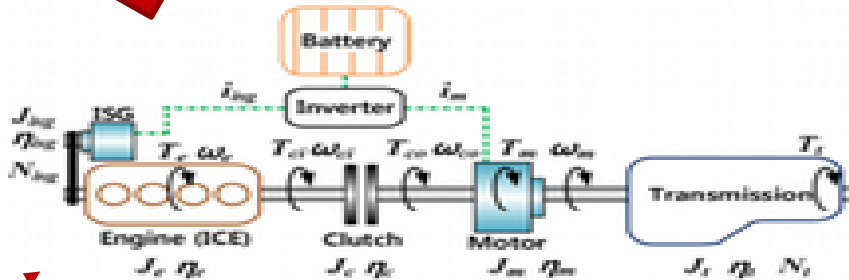
压燃式航空煤油发动机综合工况的热效率比传统航空汽油发动机高 30% 以上，而且全工况条件下的单位燃油消耗率变化只有 6%，但航空汽油发动机由于在高功率条件下需要限制富油运行，尤其是增压发动机，导致单位油耗率变化量高达 40%；混合动力航空推进系统中内燃机通常在高功率范围运行，导致传统点燃式汽油发动机的油耗相比压燃式发动机高 50%-60%，完全无法适应混合动力装置的要求。



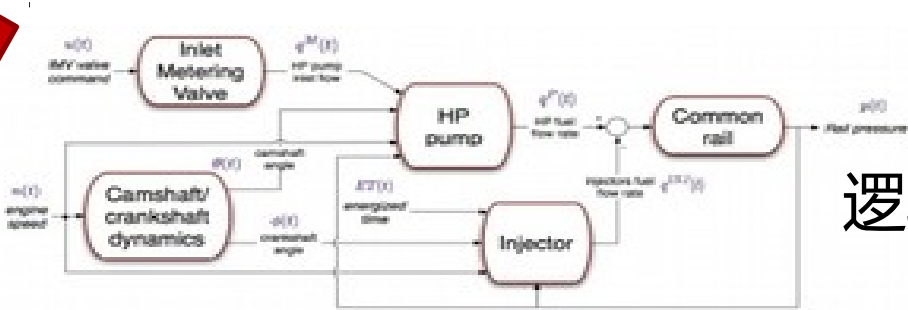
3.3 FADEC 不是可选项而是必须 控制复杂性的必然要求



模式转换



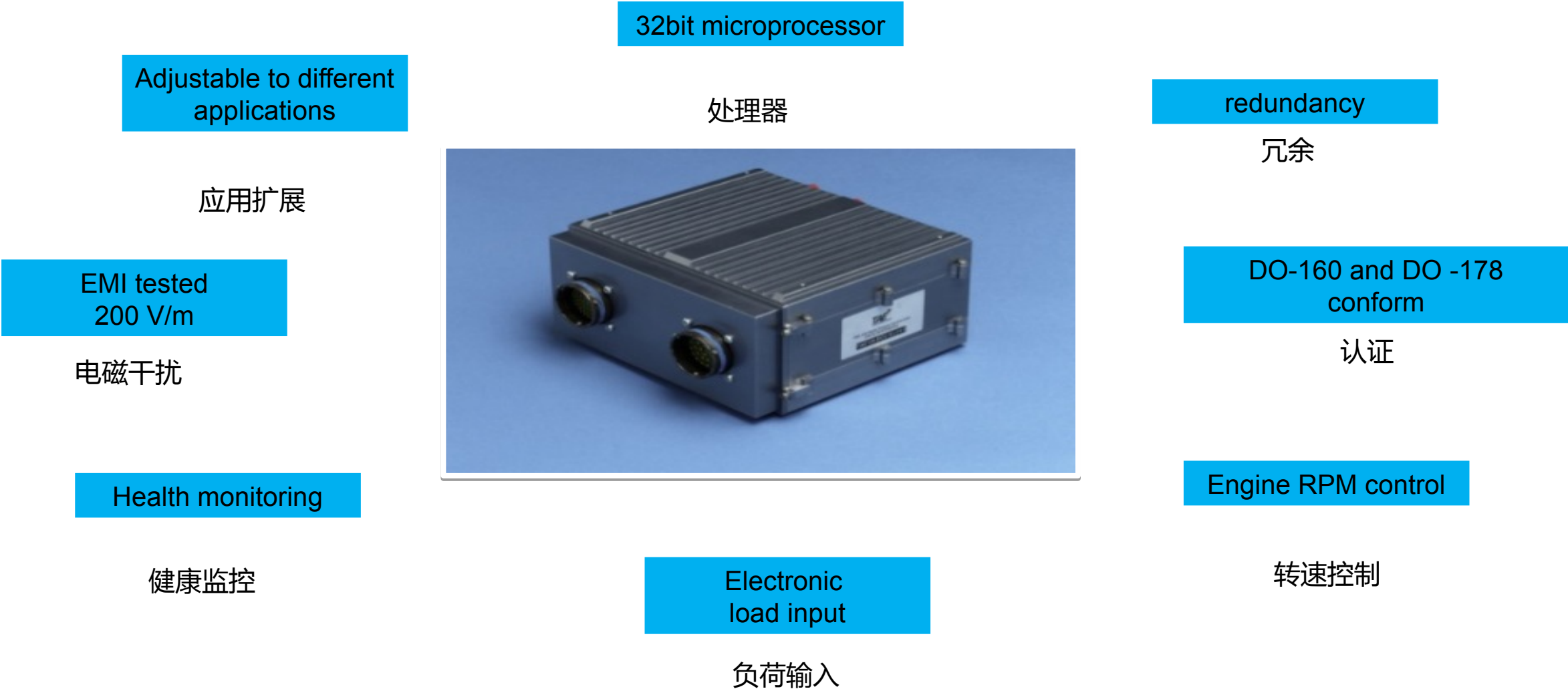
参数



逻辑

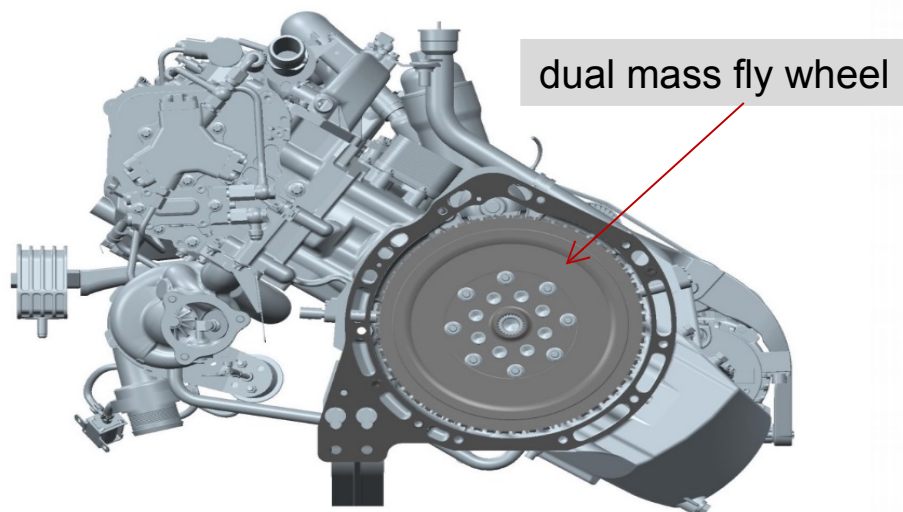


3.3.1 FADEC — CD100 /CD300 发动机

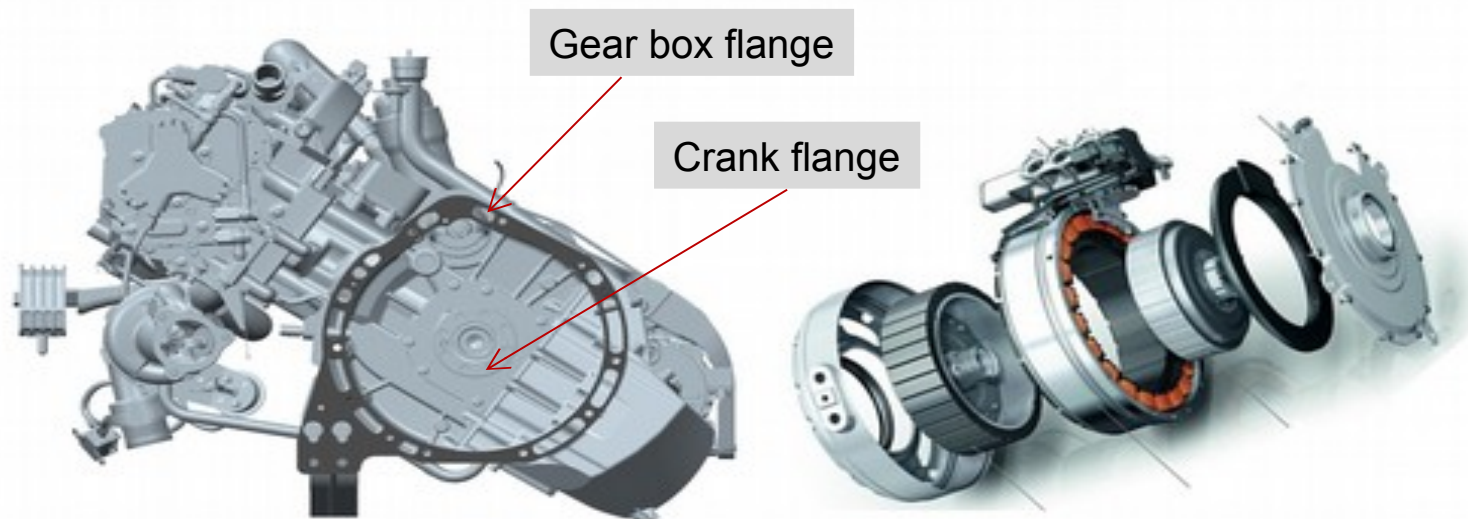


3.4 结构特点

CD100 及 CD300 有相同的结构设计特点 .



CD100 双质量飞轮及连接结构



CD100 除飞轮外结构 .

Background Picture : Audi ®

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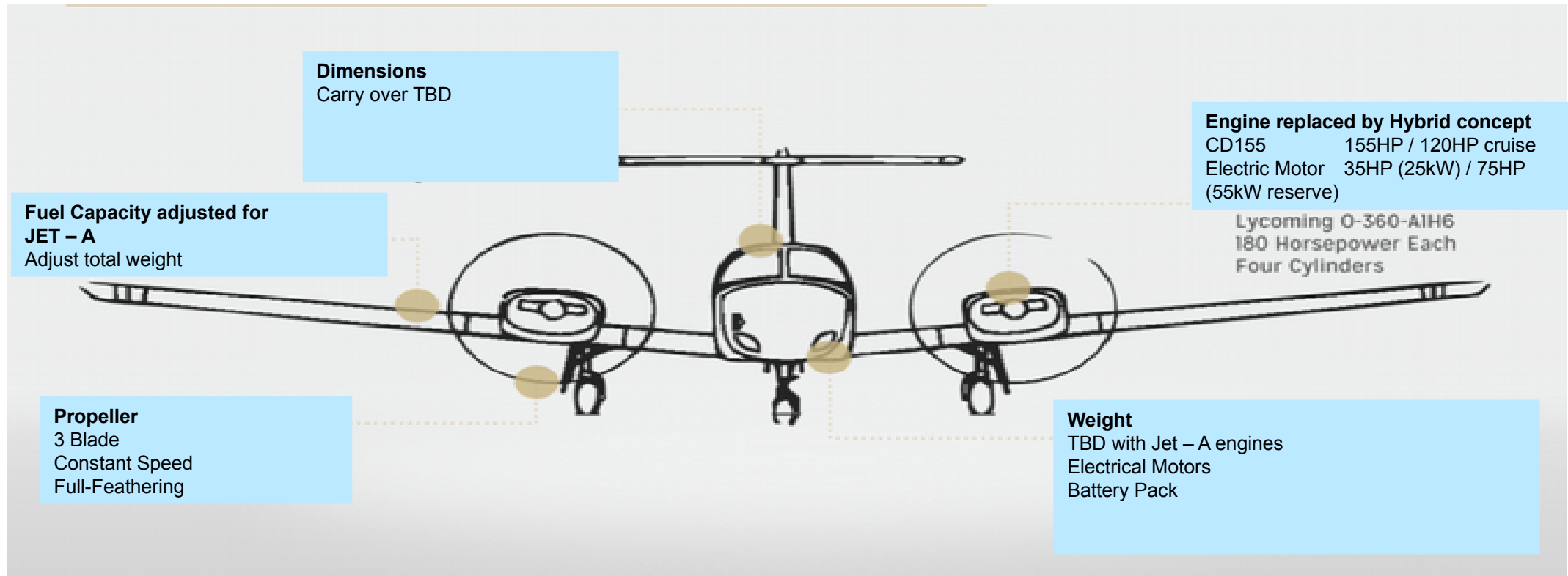
航煤混合动力的概念应用

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4.1 概念应用：双发飞机

事例：Twin A/C application

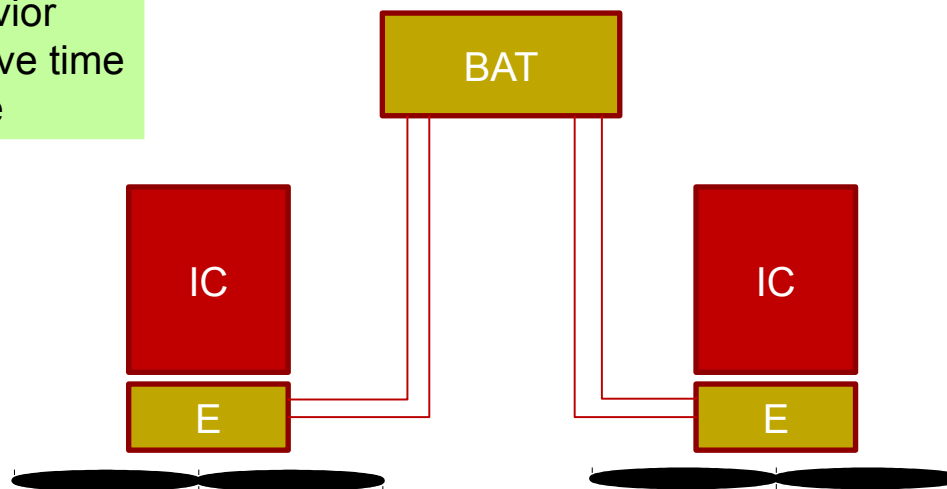


Background Picture: Piper Aircraft ®

4.1 概念应用：双发飞机

- 起飞 IC + E
 - 巡航 IC only
 - 单发失效 Single Engine + 2x E
 - 近进 2x E only with override
- 安全 Additional safety features
→ 低噪声 Improved noise behavior
→ 长寿命 Improved IC engine live time
→ 单发性能 Better Performance

- 电机可过载 37% override
- 电池 + 电机重量 vs. 油耗
- 纯电动飞行时间
- 内燃机附件减少
- 翼载荷 @ wings

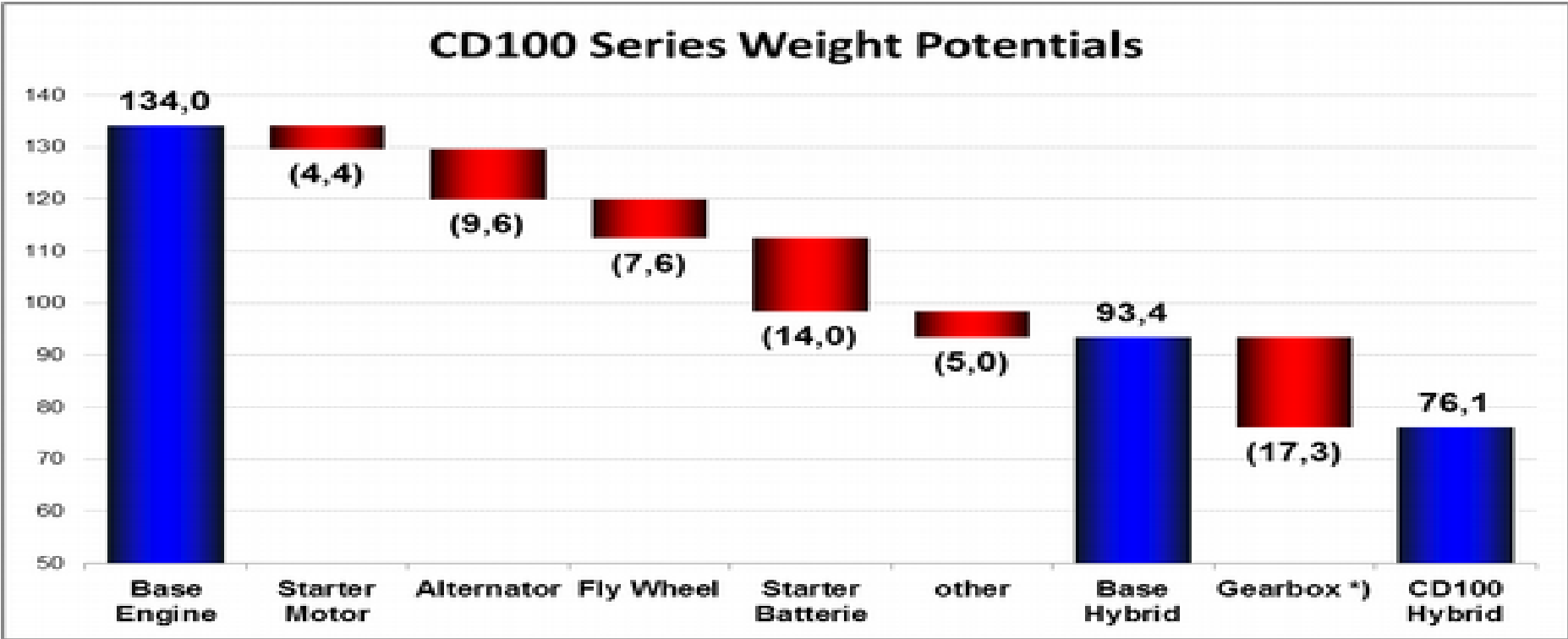


起飞功率：2x IC + 2x E 2x 190 HP 135PS @ IC + ~~55~~ HP (40kW)
巡航功率： 2x IC 2x 135 HP 135PS @ ~~IC~~
单发失效：1x IC + 2x E 1x 155 HP + 2 x 55HP (40kW)
备用功率：2x E 2x 75 HP (55 kW) for 15 Min.

IC: Internal Combustion Engine; E: Electrical Machine; BAT: Battery Pack



4.2 CD100 为例附件减重潜力

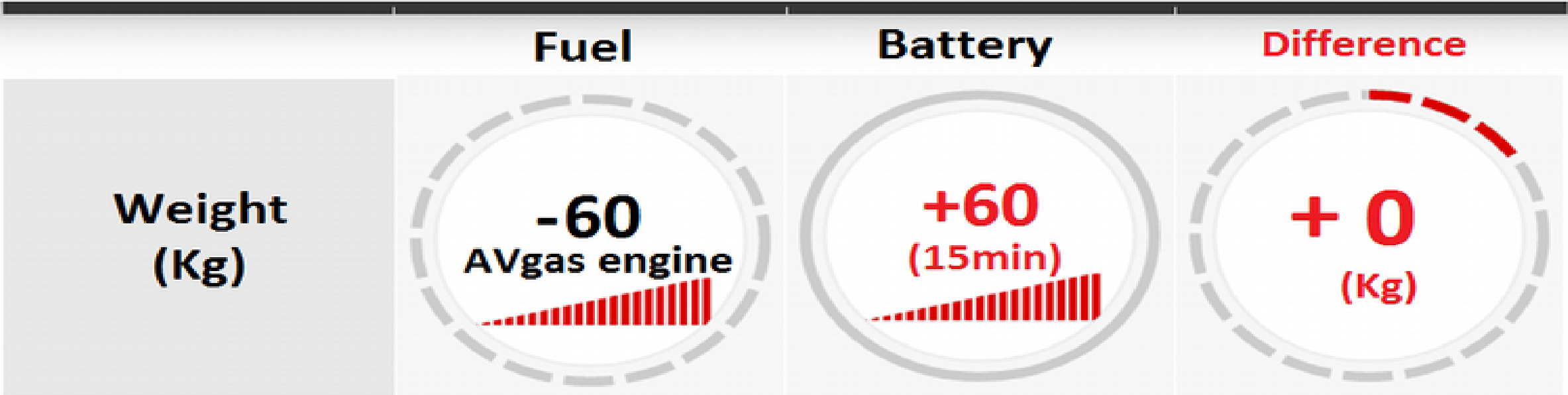


空间：57.9Kg for Motor and accessories.



*) Gearbox weight incl. housing for e-machine

4.3 燃油量的节省



单发 700 公里航程
Compare to a conventional 190hp single avgas engine aircraft in 700Km's flight.



4.4 安全性 (单发飞机)

15 分钟的预留航程虽然有时不能抵达终点，但足够安全的回到地面。

15min is not enough to reach where you want to go but it is enough to get where you need to be.

(这解决了通航飞行最大的痛点)



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展望

大陆发动机将开发混合动力装置专用的航煤发动机——将重量和整机成本控制在可接受的水平；

- 集成式电机箱
- 集成式冷却系统
- 启发一体
- 电动附件
- 集成电力系统
- 智能阻尼装置
- 智能驱动模式选择

让我们一起为世界提供 更安全、更环保、更经济、更舒适的飞行体验！



Thank you for your attention

