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2024 国际电动航空 (昆山) 论坛专刊

e-flight-forum 2024 show edition



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电动航空 - 是繁荣的结束还是只是盘中调整

E-flight: End of the boom or merely a pause?

在过去几周里，我们一直在关注新闻 - 对于所有相信航空业电气化必将发生并且一定会发生的爱好者来说，这都是跌宕起伏的。一些是好的 - 比如作为中国首个载人 eVTOL (亿航) 和大型货运 eVTOL (峰飞) 取得适航证，以及 2 月份在珠江三角洲进行的首次长距离跨海 eVTOL 飞行。

然后是低谷，例如 Universal Hydrogen 终止经营。接着又是一个高潮 -- Joby 的 800 公里氢燃料电池 eVTOL 创纪录飞行 (参见 e-flight-Journal - 2-2024)，然后又是一个低谷，例如罗尔斯罗伊斯电气停业和 Lilium 的破产。

但同时也开始了世界上第一架 eVTOL 的销售、飞行和培训业务 (参见本期文章)。与此同时，今年夏天丰田加大了对 Joby 的投资，而全球最大的动力电池制造商宁德时代则对峰飞进行了大笔投资。

很多分析师、投资者、政府官员和飞行员都在问——电动飞行会成为现实吗——还是会像肥皂泡一样突然破灭。

这一切都回到了一条古老的航空规则——发展过程总是比预计的要长，而且总是需要比原计划更多的资金。我们 e-flight-journal 和 Flying China 的编辑们确信电动飞行会实现，问题是如何实现以及实现的速度有多快。最早投入使用的可能不是垂直起降的空中出租车——它们终将会实现，但最有可能的是，我们将看到首批具有短距起降能力的电动传统飞机。它们需要更少的能量来实现相同的运输性能，而且基础设施已经存在。在载人飞行之前，将会有更小和更大的货运无人机。在能源方面，首次商业运营通常不仅使用电池，还会使用混合动力——一开始是内燃机和涡轮发电机，后来可能是燃料电池。但这将是一场马拉松，而不是短跑，并不是每个人都能实现目标，但有些人会。这在每一次行业变革中都是如此，尤其是当它像航空电气化一样具有颠覆性时。

威利·塔克 *Willi Tacke*
中文版主编 *Xin Gou*



Please find the english editorial on the other side of the magazine in the e-flight-journal section at the end of the magazine.

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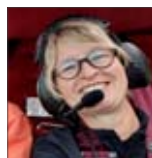
威力·泰克 (Willi Tacke)

《自由飞翔与通航》和《自由之翼》出版人之一, 资深运
动航空类爱好者, 还出版有德文杂志 Flügel 和 WDFW 目
录刊。拥有轻型运动飞机私照及教员证。



苟昕 (Gou Xin)

固定翼私照飞行员, 具有特技飞行资质和后三点
式机型签注。喜爱休闲娱乐飞行, 长期关注器材
自制飞机、各类轻型飞机和特技飞机, 对航空运
动和私人飞行领域的发展有深刻认识。



贝提娜 (Bettina Cosima Larrarte)

资深航空记者, Flügel 杂志创刊人之一, 超过 27
年的航空杂志撰稿经验。1987 年至今取得私人飞
行私照、悬挂滑翔机执照、滑翔伞执照。



马里奥·博瑞克 (Marino Boric)

毕业于航空工程专业, 持有 PPL 和 CPL/IFR 执照,
曾是军机飞行员。非常热爱家庭自制超轻型飞机。
是 Flügel 和 Vol Moteur 杂志的资深记者, 喜欢驾
驶飞机到处旅游。



罗比·贝尔 (Robby Bayerl)

1992 年开始飞滑翔伞, 接下来 10 年从事超轻型
飞机飞行和教学。2002 年考取滑翔机执照, 之后
先后考取美国 LSA 执照、PPL 执照。德国 Flying
Pages 公司特约记者, 三轴类超轻型飞机试飞员。



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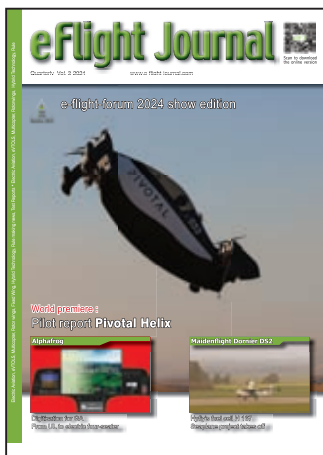
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MDA1 – the fully electric, versatile aircraft



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6 航展 Expos / Fairs

2024 年法国布洛瓦航展—不止于超轻机

Blois 2024 Impression and News!

布卢瓦 超轻机盛会

文字: Jean-Michel Bossuet/wp. Fotos: Bossuet

一万名观众。一万! 在巴黎西南 160 公里处的布卢瓦举办的 " 超轻型飞机航展 " 仍然是法国最重要的超轻机盛会, 它是发现超轻机、结识超轻型爱好者、了解超轻机和设计师的最佳平台。

盖帕德服务公司

法国的 A é roservices Gu é pard 制造商在布卢瓦不容错过地展示了其轻型飞机最重要的研发成果。最新的研发成果是安装了弧形门, 这是提高机舱舒适度的一种简单易行的方法。机舱宽度从稍窄的 1.07 米增加到 1.22 米。起落架也用钢弹簧进行了加固。各种透明舱门给人一种漂浮在空中的感觉。目前正在计划推出水陆两栖型。

最令人惊叹的是著名的 Gu é pard 单座版, 它配备了减半的 Rotax 912 S 发动机, 保留了四个气缸中的两个。单座版与双座版一样优雅, 同样给人以轻盈的感觉, 而且功率为 50 马力, 具有良好的功率重量比。



传统的系列现在包括两个版本: 俱乐部版和越野版, 后者针对粗糙跑道进行了强化, 可选择 60 升或 80 升的油箱。空重重量为 300 或 310 千克。俱乐部版售价为 87500 欧元, 越野版售价为 96000 欧元。

AeroZach 和 FK9

Zacharie 'Zach' Viaud 是位于布卢瓦的 UL 飞行学校 AeroZach 的创始人。他以一架金丝雀黄色的 Tetras 开始他的培训事业, 最近开始销售 FK9。对于扎克来说, 这架飞机是旅行和训练适用性之间的最佳折中, 价格约为 135 000 欧元, 巡航速度为 210 公里/小时, 空重 328 公斤。这架飞机的做工质量特别高, 座椅后可放置 35 公斤的行李。行驶里程为 950 公里, 非常适合旅行。

915 iS 发动机尚未安装, 但除了油耗略低外, 不会带来任何优势。在培训方面, 扎克每年培训五名学生, "步伐不太稳健", 他对此表示遗憾。但也不得不说, 他将大量精力投入到了 Stampe SV4 微型飞行器的制造上。他花了两年时间制造这架飞机, 投入了近 3000 个小时的大量劳动。原因何在? 由于使用的材料和需要做的细微工作不同, 该套件需要大量的定制工作。此外, 还需要组装四个机翼, 所需的精力是其他套件的两倍



Zacharie Viaud 很高兴成为新型飞机 FK9 的经销商之一。

阿尔托，俱乐部的重要 UL

双座并排 UL 下单翼飞机 Alto 又回到了布卢瓦，但没有任何重大变化。不过，去年 Alto 进行了一些改动。例如，仪表板被放大以容纳 EFIS。今年最重要的新变化是价格保持不变：不含增值税的价格为 11 万欧元，带无线电和应答器。公司总经理法布里斯-图桑 (Fabrice Toussaint) 不得不略微降低利润率，以便能够以可接受的价格面向其最重要的目标群体——俱乐部。这一招似乎奏效了，因为那些已经向他下了订单的客户正在再次投资购买同一款飞机：它可以轻松取代经过认证的 Echo DR400 飞机，因为 Alto UL 的飞行速度几乎一样快，而且还可以用作滑翔机的牵引机。

毒蛇 SD4 和兰巴达

Aquilair 已成为 Viper SD4 (UL 版和飞机版) 在法国的全国销售合作伙伴。然而，人们往往会忘记，该公司销售 Lambada 也已有 7 年之久。这是一款 UL 机动滑翔机，可配备 80 马力和 100 马力的 Rotax 发动机，巡航速度可达 170 公里/小时。令人惊叹的是，翼展可以延长两米，从 13 米增至 15 米，使 Lambada 的滑翔比达到惊人的 28。尽管如此，这并不是一款性能卓越的机型，而更像是一把瑞士军刀。



Alto 是一款经典的 UL 机型，有点像旅行者，最适合飞行学校和俱乐部使用。

滑翔机也适用于训练或牵引滑翔机。螺旋桨还可调整桨距。

由于 Lambada 并非其主营业务，因此产量仍然不大，制造商每年仅生产 15 架，价格从基本款的 10 万欧元到配置齐全的 12.5 万欧元不等，但需要指出的是，价格涨幅一直非常温和。



Aquilair 作为 Viper SD4 和 Lambada 的经销商参加了布卢瓦展会，取代了布卢瓦展会的老常客 Roland Chevalier。

鲨鱼保持不变

由 Charles Marignan 经销的 "鲨鱼" 不会改变。在空气动力学方面非常成熟。其内部装饰令人眼前一亮，让人不由自主地想坐上去，想象自己正在狩猎，正在追逐另一只 "鲨鱼"。做工完美无瑕。如果不是因为这款顶级机型的 price 问题，一切都会很好。四年时间里，"鲨鱼" 的价格从 26 万欧元涨到了现在的 31.9 万欧元。通货膨胀有朝一日甚至会影响富裕买家的能力。近 6 万欧元的大幅涨价与技术发展仅有些许联系。到了一定时候，买家会意识到，他们在独享乐趣上的投资不再有回报，因为市场发展的动力可能会减弱。正如查尔斯所说，"更快地到达目的地是没有用的，尽可能长时间地停留在空中才是真正的乐趣所在"。

越野和忍者装备包

我们已经习惯了在经销商的展台上看到可直接飞行的微型飞机。但是，套件仍然是销售政策的重要组成部分。因此，kūn-来自圣埃克苏佩里 ULM 基地的 Luc Boucherat 指出，尽管 Nando Groppo 的 Trail 套件需要花费大量时间，但其销售额中有一半是用于购买该套件，尤其是与 Boucherat 同样销售的 Skyleader 的 Ninja 套件相比。Trail 套件需要大约 800 小时的制造时间，而 Ninja 只需要 200 小时。吕克-布歇拉特制造了一架 Trail，因此他知道自己跟客户说什么。他花了大约八个月的时间。不过，意大利制造商 Groppo 和其他制造商一样，决定为客户组织培训和组装课程。与通常情况一样，该套件有多个版本。基本版本 (23,000 欧元) 包含除发动机、螺旋桨和航空电子设备之外的所有组装部件。几乎可以飞行 (ARTF) 的套件版本包括成品组件，如机翼、机身、线路、燃



油系统等。Groppo 公司的 G70 具有与 Trail 相同的机翼，但提供可随时飞行的版本，包括一台 100 马力的发动机，售价为 15 万欧元。对于 Luc Boucherat 来说，这种价格和装备水平的飞行器竞争相对较小。许多过去由玻璃纤维制成的部件现在都由碳纤维制成：发动机罩、小翼和机舱内的一些部件。G70 的飞行速度为 200 公里/小时。如今，这款飞行器配备了 E-PROPS 螺旋桨。众所周知，Skyleader 提供两种不同型号的 400：俱乐部型和巡航型。后者的油箱容量为 120 升，突出了其作为旅行飞机的用途。这架飞机的有趣之处还包括与 Trail 一样的折叠式机翼和“负”襟翼，“负”襟翼可使巡航速度略有提高。最后，行李舱可容纳 40 公斤的重量。

法国多瓦飞机公司的云雀 DV1

法国多瓦飞机公司在布卢瓦展出了第一架在法国制造的超轻型飞机。总经理埃娃-冈察洛夫和伊利亚-冈察洛夫要找到合格的工匠在法国制造云雀 DV1 并不容易。如今，多瓦飞机法国公司 (NorAero) 已成为捷克制造商的一个成熟的组装厂，生产的 DV1 飞机从捷克的帕斯科夫装箱组装。目前，法国多瓦飞机公司决定推迟出售该飞机的套件。两位总经理希望飞机制造的质量保持一致。这是一个形象和安全问题。Skylark DV1 的技术方面：Rotax 912 iS 发动机、1.18 米的机舱宽度、1200 公里的航程和真正的飞机外观。

埃尔韦-里贝特的环球项目

在布卢瓦展出的还有埃尔韦-里贝特的 UL。他想驾驶自己的 Dova Skylark 环游世界。为什么？埃尔韦说得很谦虚，也许还带着一丝调侃的意味：他想跳出固有的思维模式，在巴黎-多维尔的经典路线之外再飞远一点，去品尝一打牡蛎（典型的法国口味）。在德国，他们谈论的是咖啡飞行）。诚然，埃尔韦选择了不同的航行方式：55 个赛段、111 个飞行日、60,000 公里。事实上，正如很多情况一样，这个想法是在一个漫长的成熟过程中产生的，

鲨鱼经销商查尔斯-马里尼昂 (Charles Marignan) 仍然对成本上升感到惊讶，因此也对新的 UL 的价格感到惊讶。乌克兰和加沙的战争提供了一个很好的理由、以证明商品价格上涨是合理的。

最初的问题是“为什么不是我？”埃尔韦开始阅读报告，并与环球旅行者交谈，尤其是与“环球旅行者”(Earthrounders) 协会的旅行者交谈。在收到无数的提示、计划、建议和鼓励后，他决定从北面环游地球。乌克兰的战争改变了他的计划。他将走南方：摩洛哥、塞内加尔、巴西、阿根廷、澳大利亚、斯里兰卡，然后返回，途经西非，这意味着总共需要五个月的飞行时间。这次旅行需要在公海上进行长途飞行，距离很远。尽管云雀不是很渴，埃尔韦还是安装了两个转场油箱，大的位于乘客座位上，可容纳 200 升，由多瓦工厂开发，安装后不会影响飞机的重心。最多，一侧会比另一侧略重，例如，如果乘客超重。第二个可容纳 40 升，位于乘客座位后面。这样的安排可容纳 330 升燃料。这些燃料也是必要的，因为复活节岛和鲁滨逊克鲁索岛之间近 3500 公里的最长航程将在 3500 英尺高空飞行 17 至 18 个小时，将油箱中的燃料消耗殆尽。现在，埃尔韦只需保持 18 小时的清醒状态即可。因此，埃尔韦在几周前完成了一次长达 14 小时的试飞，绕法国一圈，没有着陆。这次试飞非常成功。

支持 Dova 的决定很简单：他想要一架坚固的金属超轻型飞机，因为易于维修。14.3 万欧元的价格是另一个重要理由。Hervé 是一名飞机和超轻机驾



Groppo G70 是一款可折叠机翼的双座飞机，可在几分钟内收纳在一辆卡车上。



Skyleader 400 (俱乐部版) 是理想的训练装备；巡航版则专为旅行而设计



多瓦飞机公司的 Skylark 由法国多瓦飞机公司 (NorAero) 为法国制造。部件从捷克装箱运抵法国，然后在法国组装。

驾驶员，曾是一名空手道艺术家，拥有语言学学位，同时也是一名环球旅行家。这架飞机将于不久后下线。

VL3 配备涡桨飞机指日可待

在两年前的 AERO 上，UL 飞机整流罩下的涡轮机让所有人都大吃一惊。对于 JMB 飞机公司的 Jean-Marie Guisset 来说，这在安全性、舒适性、性能和可靠性方面都是一个收获。“它像 Rotax 一样运行，噪音更小”。美国人似乎对涡轮驱动的 VL3 特别感兴趣，他们希望将其认证为实验飞机。第一批 VL3 涡轮增压飞机（简称 VL3T）将于明年 12 月交付。目前已订购了 12 架 VL3T：法国客户订购了 9 架，比利时客户订购了 1 架，奥地利客户订购了 2 架。基本型的入门价格为 35 万欧元。值得注意的是，VL3T 在快速巡航时的飞行速度为 180 kt (330 km/h)。在低空，VL3T 比配备 Rotax 916 iS 发动机的 VL3 更快，据让-马里称，后者的速度可达 200 kt (370 km/h)。不过，在高海拔地区，配备 Rotax 发动机的 VL3 的效率更高。它的耗油量约为每小时 20 升。

据让-马里-吉塞 (Jean-Marie Guisset) 介绍，如今比利时 JMB 飞机公司每年生产 65 架飞机。公司生产的飞机全部销售出去，其中 60% 销往欧洲，20% 销往美国，其余销往世界其他地方。他认为，由于飞机适用于多种应用和设备，因此发展是永久性的。JMB 制造商的其他机型包括目前正在改型的传奇机型凤凰 (Phoenix)。JMB 解释说，各种技术问题仍有待解决，因为之前的制造商在测试方面做得不够。他们正在一点点脱离 UL 概念。JMB 飞机公司已开始制造订购的八架 Lancair Evolutions 中的两架。模具和工具已返回工厂，营



埃尔韦 - 里贝特计划驾驶云雀环游世界。机上装有 330 升燃料，这将为他提供近 20 个小时的飞行时间。他希望分 55 个阶段完成 60,000 公里的飞行。

销工作也已重新启动。Lancair 的精神与 VL3 相同，但这次引擎盖下的功率为 750 马力，巡航速度为 290 kt (535 km/h)。Lancair 的价格范围将低于 200 万欧元，与同类型的新型 TBM 相比相差甚远。

配备 Rotax 916 iS 的 Blackwing

一个公开的秘密：Blackwing 现在可以使用 Rotax 916 iS 发动机。UL 刚刚获得德国 DULV 600 公斤级认证。在布卢瓦展会上展出的两台机器中，一台配备了 Rotax 最强劲的发动机，当然需要新的认证。另一款是 912 iS。如今，飞机的制造已经完成，因此制造商现在需要提高生产率。今年早些时候在挪威开设的新工厂将很快实现这一目标。黑翼公司的既定目标是每年生产 12 架飞机。

超轻、超远

航展非常棒，对许多参观者来说，这是一次难得的机会，可以近距离观看飞机，了解飞机的尺寸、驾驶舱、发动机的尺寸，或者感受复合材料令人难以置信的精湛工艺。最后，您还可以看到这些杰作飞行。在起飞时，它们的加速度、在跑道上的表现以及被周围气流带离跑道的瞬间都令人惊心动魄。不过，神奇的时刻通常都会结束。因为它们一飞上天空，就会消失在远方，变成了空中的一个小点。没错，距离是必要的预防措施。它们代表着飞行员、其他参赛者和观众的安全。我们知道这一点。我们还知道，航展的飞行指导并不是一名合格的审查员。

他努力做到最好。但是，这种最佳状态并不能带来布卢瓦等地的准飞行员才有的惊险刺激。精确着陆

锦标赛的飞行员们表演得安全而精彩。他们看得见。近在眼前。但是, "黑翼" (Blackwing) 和涡轮 VL3 的飞的飞行员在哪里呢? 不幸的是, 他们已经远离了公众。真是遗憾。

带涡轮的 BRM Aero XL8

继今年 4 月在腓特烈港航展 (AERO) 上展出之后, BRM Aero XL8 又在布卢瓦展出了: 配备涡轮机的 BRM Aero XL8。该动力装置目前仍在测试中, 但已显示出令人感兴趣的性能数据: 爬升率为 1,600 英尺/分钟时, 时速为 240 公里, 耗油量为 30 升/小时。据公司总监达米安-福韦特 (Damien Fauvet) 称, 在飞行高度为 1万5千英尺时, 时速还能增加 20 公里, 这使得长途旅行成为可能。XL8 的座舱宽度为 1.30 米, 因此非常舒适。初步结果似乎完全符合机身和涡轮机制造商的期望。然而, 这种性能是有代价的: 额外的 10 万欧元。这使得该飞机的价格达到了 30 万欧元。涡轮发动机改装的发起者提出的主要论点是, 不仅可以使使用可持续航空燃料 (SAF) 和其他燃料, 而且还可以减少维护工作, 在与活塞发动机相同的响应速度下实现无振动的舒适性。在去碳化和使用 SAF 燃料方面, 轻型飞机的二氧化碳排放量在总排放量中所占比例并不高。因此, 我们距离在轻型航空中使用二氧化碳友好型涡轮机的迫切需要还有很长的路要走。"二氧化碳排放专业工程师达米安-福韦 (Damien Fauvet) 总结道: "不过, 即使不是绝对必要, 也必须朝着这个方向前进。然而, 公司需要收集足够的涡轮机利用率数据, 以便将重点放在比较轻型航空更有利可图的领域, 因为轻型航空可能只有少数几个涡轮机买家。当然, 这不足以使其成为一项有利可图的业务。最有前景的市场可能是军机和无人机。"

在 BRM 的展台上, 对技术情有独钟的参观者可以看到 Benoit Dametto 开发的新型燃油喷射系统。两年来, 他一直与 Aerolight 公司的 Jean-Baptiste Bely 合作开发喷射系统, 该系统最大的质量特点是冗余, 以避免故障。它也是 "fuelflex"。这意味着, 由于配备了一个用于配置正确剂量的传感器, 即使使用不同类型的燃料, 它也能始终保持完全高效。该系统为每个气缸提供一个或两个喷油器, 并配有三个泵回路: 机械泵、电动泵和高压泵。它还可以燃烧生物乙醇, 从而减少 70% 的二氧化碳排放量, 因为这种燃料的辛烷值为 107。安装这种喷射系统的费用为: 单冗余约 17 000 欧元, 双冗余约 22 000 欧元。价格看似很高。然而, 由于与无铅 Super Plus 98 的价格差异, 只需飞行 300 小时就能获得投资回报。



坎帕维亚, 新与旧的结合

为何不将老式 UL 现代化, 并将其作为高端 UL 的替代品? 让-查尔斯-杜奇 Ni 开始重振 Spring Box。他的 Campavia 是一款双座并排式 UL, 发动机安装在驾驶舱前上方的中央支架上。虽然设计复古, 但据 Duccini 称, UL 的需求量很大, 他将其形容为天空中的越野车。它具有令人愉悦的敏捷操控性。80 马力的发动机是宗申 (Zongshen) 公司生产的, 是中国仿制的 Rotax 发动机。座位下有一个 60 升的油箱。这样, 在巡航速度为 140 公里/小时的情况下, 可行驶 4 个小时。因此, Campavia 与现代 UL 的性能数据相去甚远。但这正是让查尔斯坚信其市场潜力, 并将其推向美国市场。在 market 需求的推动下, 杜奇尼推出了另一款传统的 UL--上单翼飞机 M85。

橙色涂装的贝尔蒙特号

又一个老熟人: Fabrice Perral 的 Belmont DW 200。这款飞机采用漂亮的橙色涂装, 不再有任何需要修正的缺陷。制造商贝尔蒙特航空 (Belmont Aero) 是一家拉脱维亚公司, 它从一位业内知名设计师那里购买了设计图。它的驾驶舱是市场上最

法国新法规, 适用于 UL

由于采用了创新型发动机, MTOW 可从 525 千克增加到 600 千克。这为制造商 Turbotech 为 JMB 飞机公司的 VL3 配备涡轮机开辟了道路





JMB 接管了凤凰飞机。不过,由于该品牌的前所有者没有完成必要测试的测试,因此仍需对其进行一些改进。

大的驾驶舱之一, 100 马力的 Rotax 或宗申发动机使其成为巡航性能良好的 UL, 在 225 公里/小时的巡航速度下可自主飞行 8 小时。贝尔蒙特可以安装各种类型的螺旋桨。经过 MTOW 测试的 600 千克 UL 空重为 295 千克。

UL Stampe SV4。比原版更好吗?

今年, Ultralight Concept 公司再次推出了三架 Stampe SV4, 并在 Aerozach 展台上展出。怀旧的 UL 取得了圆满成功, 这要归功于项目发起人拉乌尔-塞弗林 (Raoul Séverin), 他后来卖掉了自己的公司。它是按照 1:1 的比例制造的, 同时也考虑到了现代性, 采用了技术优化的解决方案。SV4 与原版一样易于飞行, 但更加灵活。

Amaury de Lacoste 是 Ultralight Concept 最新加入的商务总监。他的任务是通过开发分销网络, 加强该品牌在欧洲、美国和加拿大的影响力。该公司已成功与著名飞行员 Lisa Zosel 合作, 后者现已成为 Ultralight Concept 团队的一员。

和德国经销商。德国市场已经占据了 Stampe SV4 销

售额的很大一部分。它的现售价格约为 15 万欧元, 是 2017 年出售的不带发动机和航空电子设备的套件的十倍。

飞行设计 CT 恢复生产

德国制造商 Flight Design 与哈萨克斯坦的重要企业 Virah 成立了一家合资企业, 并在当地建造了一家工厂。这使得 CT 生产得以恢复。第一架 CT 将于今年交付, 到 2025 年 8 月还将交付 28 架, 之后将有新的订单。乌克兰飞行设计团队负责 CT 的制造。他们在哈萨克斯坦工作, 模具转移到新工厂。哈萨克斯坦的面积是德国的 7.5 倍, 但只有 2000 万居民, 首都阿斯塔纳距离柏林以东约 4000 公里, 将生产的飞机用火车运到西欧需要三十天的时间。CT 的售价为 143,900 欧元。

飞行设计公司: 第 10 架 F2 已经出厂。下一架 CS-23 机型 计划于明年初交付。尽管该型号 新机已经通过了几个月的认证, 但由于对机身, 特别是座椅调节系统进行了重大改动, 因此必须经过新的认证程序。

在 Christophe Briand 的展台上, 配备可收放起落架的 Risen 与 CT 同时展出。这不是在法国销售的型号, 而是配备 Rotax 916 iS 的版本。去年 7 月, 阿尔贝托-波尔图驾驶这架飞机经由冰岛和加拿大飞往奥什科什: 以平均 220 海里/小时的速度和 16000 英尺的高度飞行了 10 个小时。由于这一版本的 "里森" 不会投放市场, 法国人将不得不使用 912 iS, 它的动力当然较弱, 但在省油模式下可续航 2400 公里。而在 75% 功率时, 续航里程仅为 1,300 公里。目前, Risen 主要在美国销售, 年产量为 50 台, 在奥什科什航展上获得的订单大幅增加。912 iS 版的售价为 23.5 万欧元起。

XL8 配备涡轮机已有一段时间, 但有些问题必须首先解决。



活力与龙蒿

新款 Dynamic 的现有型号有一些并不明显的改动：更平的座舱盖、新的更长的发动机罩，这表明 Aerospool 正在努力引进更大功率的发动机，同时接受更轻的螺旋桨（如 E-螺旋桨）。不过，最新展出的 Dynamic 是原装设备，配备了刚刚推出的虎式四叶螺旋桨。由于对空气动力学进行了优化，飞机的飞行速度提高了 15 公里/小时。这意味着在 5300 rpm 转速下，最大 Vmax 可达到 285 km/h。不过，价格也因此受到影响：现在已经超过了 20 万欧元 还有一条信息：Tarragon 现在由 Finesse Max 经销。一旦立陶宛制造商决定安装涡轮机，欧洲 600 公斤级 UL 也将在法国上市。这将是法国市场目前唯一的入门级机型，因为法国市场的 MTOW 规定仍然有效，为 525 公斤，只允许使用 912 iS 机型。

另一方面，在布卢瓦展出的 Tarragon 是一架试验机，最大载重量为 750 公斤，配备 916 iS 发动机，供持有私人飞行执照的飞行员使用。其操控性非常出色。一位经验丰富的战斗机飞行员表示，这架飞机的操控精度堪比阿尔法喷气式飞机。做工质量上乘。价格与购买者的雄心不谋而合：912 iS 版售价 40 万欧元，涡轮版售价 50 万欧元。

同样新颖的是：Finesse Max 代理 Dynon Avionics，特别是飞机上的新型 12 英寸 EFIS。遗憾的是，由于屏幕较大，无法在所有 UL 上安装新型 12 英寸 EFIS。

海燕 X

Petrel X 水上飞机重返布卢瓦。两年前，制造该设备的 Splash-inAviation 公司负责人 Arnaud Colleaux 带着一辆拖车参加了展会。当时，他展示的 Petrel 尚未完成，没有舱门和方向舵。现在，它已经可以飞行了。它的最大载重量为 570 千克，空重为 318 千克。生产已经开始：第 4 架飞机正在建造中。发动机是经典的 Rotax 912，功率为 100 马力，机翼由碳纤维制成，镶板由 Oratex 制成。至于内部设计：有点土气。我们离 VL3 的 Connolly 皮革还很远。售价：15 万欧元（不含增值税）。



Jean-Charles Duccini 非常喜欢 Ur-UL Spring Box，它的发动机安装在驾驶舱前方。虽然这不是最现代的配置，但杜奇尼发现他的 UL 感觉易于飞行。



埃沃斯基尔，高端轮辋

碳纤维轮辋制造商 Evoskil 今年带着一款新产品来到布卢瓦：安装有 6 活塞制动卡钳的 8 英寸轮辋。这是一个 该品牌的目标客户是从事丛林飞行并希望飞机上安装丛林轮或大尺寸低压轮的飞行员。这一品牌的推出显然受到了欢迎：“客户很高兴能有一种比 Beringer 轮辋更轻（40%）、价格更优惠的替代品。他们中的一些人已经购买了机轮，以宣传我们的举措。在周日举行的 STOL 锦标赛决赛上，公众看到了 Evoskil 的形象大使之一 Éric Gérard，他的灰色 Yuma 让所有人都大吃一惊。他展示了只需滑行一两米就能起飞的能力，尽管副翼尺寸过大。这带来了市场影响力，但最重要的是对产品的积极反馈。●



现在，“里森”（上图）已在法国上市，其最大载重量为 525 千克，机身重量为 1.5 千克。Rotax 912 发动机，巡航速度为 150 公里/小时。千米/小时)。左图：飞行设计 CT。

从事赛车运动的 Benoît Dametto 两年来一直致力于开发冗余喷射系统，该系统可应对 Rotax 发动机的所有假定问题。除安全性外，其喷射系统还提供“fuelflex”版本，因此也可使用乙醇燃料。



贝尔蒙 DW200 也在布卢瓦展出：Rotax 发动机、宽大的驾驶舱、机翼上的储物格。它拥有长途旅行所需的一切。

Stampe SV4 无疑是著名的 Stampe 的最佳复制品之一，飞行性能良好，反应精确，适合历史性飞行活动。



Tarragon 现在由 Finesse Max 负责销售。事实上，法国人将无法获得 UL。除非他们将其作为套件飞机制造(通过 CNSK 认证)。在布卢瓦展示的版本采用的是 Rotax 916 发动机。如果使用涡轮发动机，它可以获得 600 kgUL 的认证。注意：CNSK-UL 需要 PPL 驾驶。



新的 Dynamic 采用了更扁平的机舱罩和新的螺旋桨。这使其时速提高了 15 公里



Dynon 推出了一款 12 英寸的 EFIS。该制造商提供的最大 1100 欧元换购一套旧的 Dynon 航空电子系统，这对价值 3500 欧元的 EFIS 来说是个很有吸引力的报价。

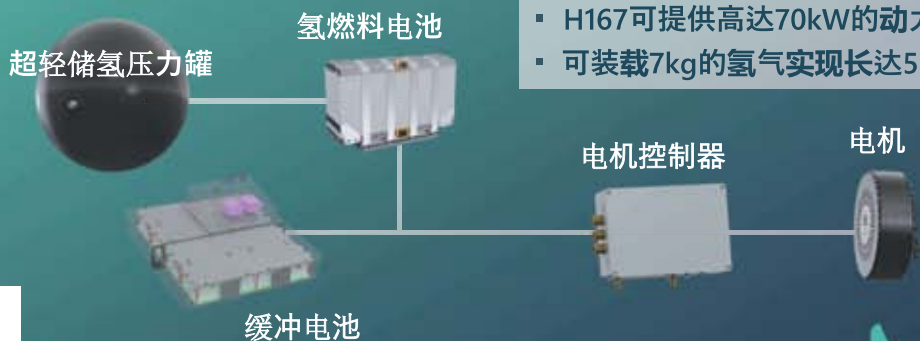
售价 15 万欧元的 Petrel X 在布卢瓦展出时是带门的，而两年前的原型机是不带门的。



Eric Gérard 的 Yuma 参加了 STOL 比赛的决赛。他是复合材料机轮制造商的形象大使之一。

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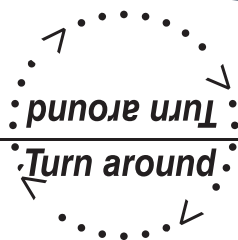
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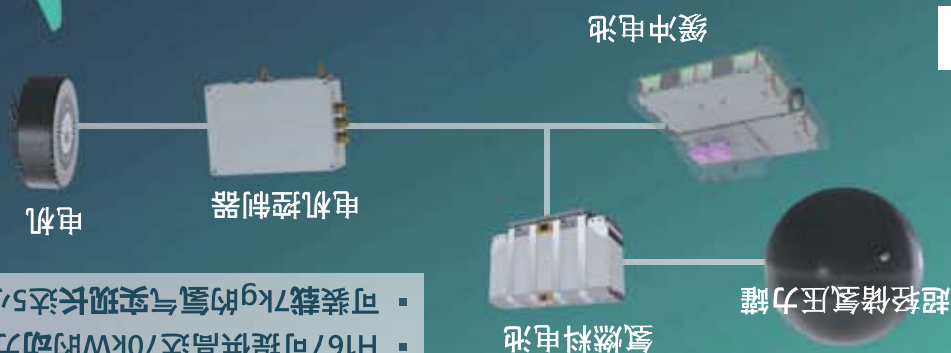
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Pilot report Pivotal Helix

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From UL to electric four-seater

Maidenflight Dornier DS2



Hyfly's fuel cell H 167
Seaplane project takes off

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E-flight: End of the boom or merely a pause?

Following the news in recent weeks has been a roller-coaster for enthusiasts who are confident that electrification in aviation is both necessary and inevitable. Some ups - as the first eVTOL certifications in China for manned aircraft (eHang) and large cargo drones (Autoflight) and in February, the first long-distance vertiport to vertiport flight over the Pear River delta (AutoFlight)

Subsequently, there were setbacks, such as the closure of Universal Hydrogen, the cessation of operations by Rolls Royce Electrical, and the insolvency of Lilium, alongside achievements like Joby's 800 km record flight (refer to e-flight-Journal - 2-2024). Also noted the commercial availability, flight, and training operations of the world's first eVTOL, the Pivotal Helix (see article in this magazine)

At the same time, this summer, Toyota invested more in Joby, and the largest battery manufacturer worldwide, CATL, invested heavily in Autoflight.

Analysts, investors, politicians, and pilots question whether electric aviation will become a reality or dissipate like a fragile soap bubble.

It all comes back to an old aviation rule: development always takes longer than planned and requires much more money than initially estimated.

The editors of E-flight-journal and Flying China are confident that the era of fully electric flight is imminent. The key considerations are the method and speed of this transition. It is unlikely that vertical take-off air taxis will be the first to enter service. While they will eventually arrive, it is more probable that the initial electrified aircraft will be conventional models with STOL capabilities. These aircraft demand less energy for comparable performance, and the necessary infrastructure is already in place.

Before the widespread availability of transportation services, we will likely see the emergence of small and large cargo drones. Initially, commercial operations will predominantly utilize hybrid propulsion systems rather than relying solely on batteries. These systems may start with combustion engines and turbo generators and evolve to incorporate fuel cells. This process will be a marathon rather than a sprint, with only some achieving success, as has been the case in every industrial revolution, particularly those as disruptive as the electrification of aviation.

Willi Tacke

中文版主编 **Xin Gou**



Please find the chinese editorial on the other side of the magazine in the **Flying China** section - at the end of this publication.



Archer 获得日本客户 200 架订单并将在 2025 大阪世博会上展示飞行

Archer received 100 orders from Japanese Client and to conduct demo flight during 2025 World Expo in Osaka

Soracle, a joint venture established by Japan Airlines and Sumitomo Corporation, has signed an agreement with Archer for orders of up to 100 of its Midnight aircraft, totalling approximately \$500 million.

The company plans to launch its AAM operations in Japan using Archer's Midnight aircraft and will develop a variety of flight routes in attractive areas for residents, as well as domestic and international visitors. Route locations could include places like Tokyo, Osaka, Nagoya, Hokkaido, Setouchi and Okinawa.

Soracle and Archer will work closely with the Japanese Civil Aviation Bureau (JCAB) to obtain the necessary permissions and certifications, with Archer already having discussions with JCAB and intending to formally apply for concurrent type certificate validation in the near future. Additionally, Archer and Soracle plan to conduct a public flight demonstration at the 2025 World Expo in Osaka, to build public support, demonstrate the future of aviation and accelerate stakeholder's engagement in Japan.

The Expo is anticipated to be one of the most significant global events of the year, expecting around 28 million visitors from Japan, the USA and other countries over its six-months duration.

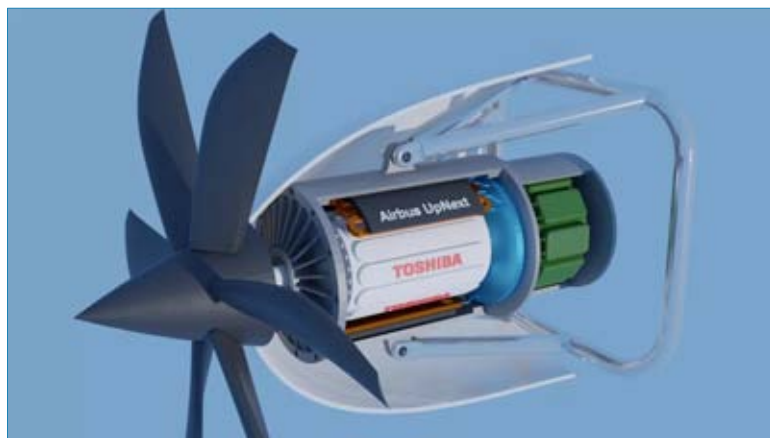
Soracle 是由日本航空公司和住友商社成立的合资企业，该公司已与美国 Archer 公司签署协议，订购最多 100 架 Archer 公司正在申请 FAA 适航审定的 Midnight 五座 eVTOL，总价值约 5 亿美元。Soracle 计划使用 Midnight 日本开展 AAM 业务，并将在吸引居民以及国内外游客的地区开发各种航线，地点可能包括东京、大阪、名古屋、北海道、濑户内和冲绳等地。

Soracle 和 Archer 将与日本民航局 (JCAB) 密切合作，以获得必要的许可和认证，Archer 已经与 JCAB 进行了讨论，计划在不久的将来正式在日本申请型号合格证。此外，Archer 和 Soracle 计划在 2025 年大阪世博会上进行公开飞行演示。预计世博会将成为当年最重要的全球盛事之一，预计在六个月的展会期间将吸引约 2800 万游客。

空客与东芝合作开展氢动力超导技术研发

Airbus and Toshiba to Collaborate on Superconductivity Research for Hydrogen Powered Aircraft

Airbus UpNext, a subsidiary of Airbus, and Toshiba Energy Systems & Solutions Corporation, the company group's energy arm, are to collaborate on superconducting technologies for future hydrogen-powered aircraft. During the past 10 years, Airbus has made efforts to de-risk such technologies. Recently, Airbus UpNext launched Cryoprop, a demonstrator to test a two megawatt-class superconducting electric propulsion system. Meanwhile, Toshiba has been carrying out R&D on these applications for nearly half a century and has released its own two megawatt-class superconductivity motor prototype for mobility applications in June 2022.



空客子公司 Airbus UpNext 和东芝能源系统与解决方案公司（该公司集团的能源部门）将合作开发未来氢动力飞机的超导技术。在过去 10 年中，空客一直在进行此类技术的研发。最近，Airbus UpNext 推出了 Cryoprop，这是一款用于测试两兆瓦级超导电力推进系统的演示器。与此同时，东芝近半个世纪以来也一直在进行此类技术研发，并于 2022 年 6 月发布了两兆瓦级超导电机原型用于移动应用。

FAA 发布针对 eVTOL 运行的特殊规则

FAA released special federal aviation regulation concerning eVTOL operation

In October FAA released the special federal aviation regulation for the “Integration of Powered Lift: Pilot Certification and Operations” which spells out permanent amendments to 14 CFR rules that will remain in force for an initial 10-year period. They apply to aircraft defined as “heavier-than-air and capable of vertical takeoff, vertical landing, and low-speed flight, which depends principally on engine-driven lift devices or engine thrust for lift during these flight regimes and on non-rotating airfoils for lift during horizontal flight.” The measures are intended to enable operations under existing Part 91 rules for private operations and Part 135 rules applying to commercial flights. They also cover Part 136 commercial air tour operations and Part 97 rules on special instrument procedures. Most notable among these are the energy reserves that electric aircraft will be required to operate with and how eVTOL pilots will be trained and certified.

10 月 FAA 发布了业界期待已久的针对 eVTOL 的特殊航规（SFAR）“集成类动力升力：飞行员认证和运行及与旋翼类航空器和飞机相关的杂项修正案”。该 SFAR 专门针对 eVTOL 的飞行员培训和认证的相关飞行标准现有航规做了针对性的修订，规定了飞行教员和飞行员驾驶“动力升空”类别航空器所必须具备的资格和培训。该规章将直升机操作要求应用于 eVTOL，并采用基于性能的方法执行运行规则，允许 eVTOL 飞行员使用单飞行操纵系统进行动力升力类航空器的飞行训练。

Joby 获得丰田 5 亿美元增资并增发 2 亿美元普通股

Joby Received USD500 million from Toyota and offered USD200 Million Public Stock

Toyota Motor Corporation will invest an additional \$500 million to support the certification and commercial production of Joby Aviation's eVTOL. The investment will be made in two equal tranches with the first tranche targeted to close later this year and the second in 2025. This investment brings Toyota Motor Corporation's total investment in Joby to \$894 million.

Toyota's relationship with Joby began through an initial investment made by Toyota Ventures. Toyota Motor Corporation subsequently completed investments totaling \$394 million. Since 2019, in addition to monetary investments, Toyota has been investing time and human resources to share its knowledge of the Toyota Production System via process planning, manufacturing method development, and tooling design.

In addition Joby Aviation has announced a public offering of common stock priced at USD 5.05 per share with expected proceeds surpassing USD 200 million. In addition, Joby intends to grant the underwriters a 30-day option to purchase up to an additional USD30 million of its shares of common stock.



Airbus has officially begun remotely piloted flight testing of its full-scale prototype for the CityAirbus NextGen electric vertical take-off and landing (eVTOL). This flight test follows a significant development phase in December 2023, when the CityAirbus powered up for the first time as part of a series of ground tests. These tests focused on evaluating the aircraft's electric motors, rotors, flight controls, and avionics as part of preparations for its first flight. The CityAirbus NextGen is a four-seat eVTOL aircraft designed for short-distance urban air mobility, capable of flying up to 80 kilometres (50 miles) at speeds of 120 km/h.



10月，丰田汽车公司宣布对 Joby 增资 5 亿美元，以支持 Joby Aviation 的 eVTOL 的适航审定和量产。该投资将分两笔相等的款项进行，第一笔款项计划于今年晚些时候完成，第二笔款项计划于 2025 年完成。本次增资后丰田汽车公司对 Joby 的总投资达到 8.94 亿美元。

丰田与 Joby 的关系始于丰田风险投资公司的初始投资。丰田汽车公司随后完成了总计 3.94 亿美元的投资。自 2019 年以来，除了资金投资外，丰田还投入时间和人力资源，通过流程规划、制造方法开发和工具设计协助 Joby 的研制工作。此外，Joby Aviation 宣布公开发行普通股，发行价为每股 5.05 美元，预计募集资金将超过 2 亿美元。Joby 还打算授予承销商 30 天期权，以额外购买最多 3000 万美元的普通股。

空客 CityAirbus NextGen eVTOL 开始试飞

Airbus began test flight of CityAirbus NextGen eVTOL

空中客车公司已正式开始对其 CityAirbus NextGen 电动垂直起降航空器 (eVTOL) 的全尺寸原型机进行遥控驾驶飞行测试。此次飞行测试是在 2023 年 12 月的重要开发阶段之后进行的，当时 CityAirbus 首次作为一系列地面测试的一部分启动。这些测试侧重于评估该机的电机、旋翼、飞控和航电设备，作为首飞准备工作的一部分。CityAirbus NextGen 是一款四座 eVTOL，专为短距离城市空中交通而设计，能够以 120 公里 / 小时的速度飞行 80 公里。

BETA 完成 3.18 亿美元 C 轮融资

BETA Technologies Raises Over USD300 Million in Series C Funding

BETA Technologies has raised USD318 million via a Series C Equity Capital Round. QIA, a Qatar-based global investment organization led the raise, while several of BETA's largest investors including Fidelity Management & Research Company and TPG Rise Climate, increased their stake. Longtime client, United Therapeutics, also joined this Round as an investor. The financing was priced at an increased valuation relative to prior equity capital raises, yet was still oversubscribed. To date, BETA has raised more than USD1 billion. This new funding will support the continued production, certification and commercialisation of BETA's Aircraft the ALIA CTOL and ALIA VTOL alongside the company's multimodal charging systems and growing infrastructure network. It will also directly assist the continued ramp-up of production and delivery of BETA's aircraft and chargers to customers. BETA's production facility has the capacity to produce up to 300 aircraft per year.



美国 BETA Technologies 公司宣布 C 轮融资筹集了 3.18 亿美元。总部位于卡塔尔的全球投资组织 QIA 领投了此次融资。BETA 的几家最大投资者（包括 Fidelity Management & Research Company 和 TPG Rise Climate）也增加了持股。长期客户 United Therapeutics 也作为投资者加入了本轮融资。与之前的股权融资相比，此次融资的估值有所提高，但仍超额认购。迄今为止，BETA 已筹集了超过 10 亿美元。这笔新资金将支持 BETA 研发的 ALIA CTOL 固定翼电动飞机和 ALIA eVTOL 的生产、适航审定和商业化，以及公司的多式联运充电系统和不断增长的基础设施网络，以及继续提高产量并向客户交付飞机和充电器。BETA 的生产设施每年最多可生产 300 架电动飞机。

百合花公司申请破产并同时寻求被兼并收购

Lilium seeking being acquired while applying for bankruptcy

Lilium has announced its principal German subsidiaries will apply for self-administration proceedings with the competent court in the country. Self-administration, if and when granted by the court, aims to preserve and continue the business that is the subject of the proceedings. This result follows a lengthy and complex government approval process for a loan from KfW, which failed in the Budget Committee of the German parliament. The company was also unable to reach an agreement in principle with the Bavarian government to guarantee a Euro 50 million loan. Lilium has appointed KPMG to conduct an open, transparent and fair Mergers & Acquisitions (M&A) process and confirmed first investor briefings will start soon. Work at its subsidiaries continues towards the next significant program milestone, first manned flight. The first two Lilium Jets are currently on the final assembly line, with the first aircraft having recently completed the initial low-voltage power-on milestone and due to advance shortly into the ground testing phase.



德国 Lilium 公司宣布向德国法院申请自我管理破产程序。如果法院批准自我管理，则旨在保留和继续诉讼所涉及的业务。这一结果是在德国复兴信贷银行的一笔贷款经过漫长而复杂的政府审批程序之后得出的，该贷款在德国议会预算委员会审议失败。百合花公司还未能与巴伐利亚州政府就 5 千万欧元的贷款担保达成协议。Lilium 已任命毕马威 (KPMG) 进行并购 (M&A) 流程。与此同时，该公司继续朝着下一个重要的项目里程碑——首次载人飞行努力。前两架 Lilium eVTOL 目前正在总装线上，第一架最近完成了低压通电测试，并将很快进入地面测试阶段。

ZeroAvia 与 Power Cell 合作研制下一代中高温燃料电池技术

ZeroAvia and PowerCell Partner on NextGen Fuel Cell

Development to Explore Higher Temperature Technologies

ZeroAvia has signed a MOU with PowerCell Group to partner on next generation fuel cell technologies. R&D will focus on intermediate and high temperature cells which will open up more energy intensive aviation applications including for large fixed-wing aircraft and rotorcraft. Increasing the operating temperature of fuel cell systems can allow for a reduction in cooling and humidification required, simplifying the architecture and improving the amount of power for a given unit of weight. The two companies have been working together for the last few years, with PowerCell fuel cell stacks forming part of the prototype ZeroAvia powertrains. ZeroAvia is designing a bespoke multi-stack balance-of-plant architecture using PowerCell's low temperature proton exchange membrane (LT-PEM) stacks applicable to aviation applications. As such, the Swedish fuel cell manufacturer is a key supplier for ZeroAvia's first 600kW powertrain (ZA600) designed for up to 20 seat aircraft. This high temperature PEM fuel cell HT-PEM (part of the roadmap to delivery of ZA2000 powertrain for 40–80 seat aircraft and a key part of the company's component offering to other clean flight innovators) is already demonstrating industry record power density in excess of 2.5 kW/kg at the cell level, with a clear pathway to reaching 3+ kW/kg at the system level in the coming months.



ZeroAvia 已与 PowerCell Group 签署谅解备忘录，合作开发下一代燃料电池技术。研发将专注于中高温电池，这将为包括大型固定翼飞机和旋翼机在内的能源密集型航空应用开辟道路。提高燃料电池系统的工作温度可以减少所需的冷却和加湿，简化架构并提高给定重量单位的功率。这两家公司在过去几年中一直在合作，PowerCell 燃料电池堆是 ZeroAvia 动力系统原型的一部分。ZeroAvia 正在设计一种定制的多堆平衡装置架构，使用 PowerCell 适用于航空应用的低温质子交换膜 (LT-PEM) 堆。因此，这家瑞典燃料电池制造商是 ZeroAvia 首款 600kW 动力系统 (ZA600) 的主要供应商，该动力系统设计用于最多 20 座的电动飞机。这种高温 PEM 燃料电池 HT-PEM (ZA2000 动力系统向 40–80 座飞机交付路线图的一部分，也是该公司向其他清洁飞行创新者提供零部件的重要组成部分) 已经展示了业界创纪录的超过 2.5 kW/kg 的电池级功率密度，并且在未来几个月内在系统级达到 3+ kW/kg。

罗尔斯罗伊斯电气公司终止经营

Rolls-Royce Electrical to cease operation

Rolls-Royce has announced to shut down its electric propulsion unit, Rolls-Royce Electrical, after unsuccessful attempts to sell the business. Rolls-Royce initially announced in November 2023 its plans to exit the electric propulsion sector while seeking a buyer for its electric aviation technologies. The Rolls-Royce Electrical division had been focused on developing propulsion and power distribution systems specifically designed for the growing eVTOL and regional electric aircraft markets. It has three main products: the 150 kW electric propulsion unit (EPU) eVTOL engine, the 320 kW EPU regional aircraft engine, and an onboard power distribution system to support these applications while developing MW level electric propulsion system.

罗尔斯罗伊斯宣布关闭其电推进子公司罗尔斯罗伊斯电气公司。此前罗罗曾试图出售电推业务但未成功。罗罗 2023 年 11 月宣布计划退出电推进领域，当时计划为电动航空技术寻找买家。罗尔斯罗伊斯电气公司一直专注于开发专为 eVTOL 和电动支线飞机设计的推进和配电系统，有三个主要产品：针对 eVTOL 的 150 kW 电推系统、针对支线飞机的 320 kW 以及机载配电系统，同时还在研发兆瓦级电推进系统。罗尔斯罗伊斯电气参与过多个已经试飞的电动飞机项目。



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Does it even fly?

A new eVTOL has been launched, notable for its wing design, enabling more efficient flight and adherence to the American Part 103 ultralight category regulations. Is it both feasible and safe? According to eFlight Journal / Flying China editor Willi Tacke, the first aviation journalist worldwide to test the Helix from Pivotal in Palo Alto, California, the answer is yes to both.



它能飞吗?

一款新型 eVTOL 已经推出，其机翼设计引人注目，能够实现更高效的飞行，并符合美国 103 部超轻型飞机类别的规定。它既可行又安全吗？eFlight Journal/Flying China 编辑 Willi Tacke 表示，他是全球首位在加州帕洛阿尔托 Pivotal 公司试飞 Helix 的航空记者，他的答案是肯定的。





Helix flying at Byron Airport - green aircraft flying green energy.
与拜伦机场的“螺旋”号一起旅行——风力发电机作为绿色能源的绿色飞机。

Following nearly ten days of ground and simulator training in Palo Alto, we have finally proceeded to the Pivotal test airfield in Byron. Test flights have been repeatedly postponed due to temperatures exceeding 40° Celsius in recent days, and today's forecast also predicts temperatures above 37° Celsius. This necessitates an early start!

At 6:01 local time, the sun rises over the horizon as my flight instructors, John and Sabrina, conduct the pre-flight inspection on the Helix, the newly named version of the former “Blackfly.” I am preparing for my first vertical take-off in this aircraft. I settle into the cockpit, which features a minimalist carbon fiber seat to maintain weight efficiency. We proceed with the cockpit checklist, selecting the right control stick from the two available. The

engines are started, and the rudder check is completed. Abort scenarios are clearly marked: “gray or yellow error: proceed with start,” and “red or purple error: abort!” Wind conditions are entered as “No wind,” and the start mode is set to “Hover mode.” With everything in place, my inaugural flight begins as I push the rocker switch on the control stick forward. The eight motors accelerate, the airframe tilts, and I ascend vertically into the deep blue morning sky.

At 100 feet, I halt the climb by setting the rocker switch to neutral. The engines decelerate, allowing the aircraft to maintain its altitude and position autonomously using a triple radar and GPS system. My initial task: I rotate the control stick until the aircraft turns 45 degrees to the left. Stop! Then, return it to the

The training team monitors the first flight from the ground.

培训团队从地面监控我的首次飞行





Motion simulation: The VR simulator conveys the feeling of flying very realistically. Professional flight instructors also assist the “pilot”.

飞行模拟：VR 模拟器非常逼真地传达了飞行的感觉。专业的飞行教官也在这方面为“飞行员”提供支持。

在帕洛阿尔托接受了近十天的地面和模拟器培训后，我们终于去了拜伦的 Pivotal 测试机场。由于过去几天的气温远高于 40 摄氏度，试飞已多次取消，预计今天的气温也将超过 37 摄氏度。

所以你得早点起

当地时间 6:01。太阳从地平线后面悄悄探出，我的飞行教官 John 和 Sabrina 一起对我将驾驶的 Helix eVTOL 进行飞行前检查。这是前“Blackfly”的新名称，我应该在接下来的几分钟内进行我的第一次 eVTOL 飞行。我爬进座舱。座椅是很简洁的碳纤维外壳 - 由于重量限制。驾驶舱有两个操纵杆。我开始检查发动机和方向舵。中止情况用颜色标出：“灰色或黄色错误：继续启动！”；“红色或紫色错误：中止！”输入风力参数：“无风”！启动模式：“悬停模式”！我的第一次飞行可以开始了。

我向前推动控制杆上的摇杆开关。八个电机启动。机身翻转，我垂直飞向深蓝色的晨空。

在离地面 100 英尺的地方，我停止了爬升。电机转速慢下来了。我转动控制杆，直到向左转动 45 度。停！然后又回来。向右也是如此。然后我把摇杆开关稍微向后拉。飞机慢慢开始下降。在 15 英尺处，机载计算机报告“Autoland available”（可自动着陆）我按下了控制杆上的降落“触发器”，飞机慢慢地进一步下降，轻轻地把我放在了着陆台上，机身微微前倾，然后着陆了。我作为飞行员的首次 eVTOL 飞行安全完成。

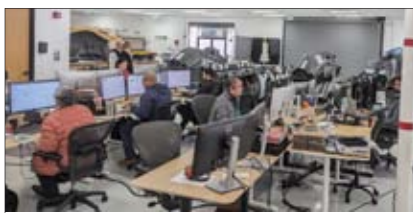
良好的模拟

令人惊讶的是，在第一次飞行期间，我对单座飞机感到如此熟悉。这是因为我之前已经在“Helix Motion Simulator”模拟器



Fast charging: The 8 kWh battery can be charged simultaneously via two charging ports (left). A ballistic rescue system is also installed (bottom left). All software was developed in-house (bottom). Spartan seating: For reasons of weight, a carbon seat shell has to suffice in an ultra-light aircraft (right).

速充电：8 千瓦时电池可通过两个充电接口同时充电（左）。还安装了整机降落伞（左下）。简陋的座椅：出于重量方面的考虑，超轻型座椅必须采用碳纤维外壳（右图）。所有软件都是自己开发的（如下图）。



original position and repeat the process to the right. Next, I slightly pull back the rocker switch, gradually causing the aircraft to descend. At 15 feet, the descent halts automatically, and the onboard computer announces “Autoland available” via the headset and flight display. I then press the “trigger” along with the rocker on the control stick, and the Helix continues to descend gently, landing smoothly on the pad. I observe the airframe slightly shift forward as the nose tilts downward—I have landed. My first eVTOL flight as pilot in command is completed. It’s incredible how familiar I already feel with the single-seater on this first flight. However, I had previously spent three full days, eight hours a day, with two instructors in the “Helix motion simulator” (HMS). The engineers did a great job here. During the first flight, I had the feeling that I’d done this before, and I could do it too. Yes, I have over a thousand flight hours as a pilot in command with very different aircraft - but nothing like this.

The remarkable similarity between actual flight and simulation extends beyond hovering. When I transitioned to cruise mode, nearly everything mirrored the simulator experience. The only surprise was the sudden quietness as the computer reduced engine power. My initial reaction was concern, thinking, “Is something wrong?” However, a quick check of the instruments—constant speed at 54 knots, altitude steady at 250, and all engine parameters in the green—reassured me that everything was functioning properly and the new flying experience was underway.

Notably, the battery power drain drops significantly compared to “hover mode.” The noise reduction was so remarkable that I promptly removed my active noise-cancelling headphones while in cruise mode. Exceptionally quiet!

As a pilot experienced with fixed-wing aircraft, hang gliders, and trikes, you will find “Cruise mode” immediately familiar. The forward, upward, and lateral visibility is excellent, and the agility during turns is responsive and enjoyable. I felt so at ease that within minutes, I wished the maximum turn angle could exceed 30 degrees. Directional changes in this mode are initiated by tilting the stick sideways, resembling the aileron control of an aviation joystick, rather than turning it as in “hover mode.” The sophisticated triple-flight computer translates stick inputs into a coordinated movement of the four ailerons and adjusts the RPM of the eight motors with fixed-pitch propellers. Additionally, the computer maintains a constant speed and stable aircraft attitude without pilot input.

Returning to the flight, thermals had developed during my previous flight, bringing with them a surface wind of 10 knots, gusting up to 15 knots. Given that the airfield circuit for eVTOLs in Byron is predefined, and to avoid a 180-degree turn following a tailwind approach over the landing pad, facing into the wind as per the aircraft’s operational rules, I opted to make the final approach at a 90-degree angle to the wind as an alternative. Before turning final, I decelerate the aircraft by pulling the control stick backward and engaging the “hover mode” at 130 feet. The Helix briefly pitches upwards and continues with an increased angle of attack, maintaining forward visibility as the motors spool up significantly. Upon reaching the landing pad at 40 feet, I halt the descent and neutralize the joystick.



Tilt aircraft: During takeoff, the aircraft rotates around the pilot into a vertical flight position. Helix 是尾座式 eVTOL：起飞时，飞机围绕飞行员旋转过渡到垂直飞行姿态。



Well cared for: John Gilbert and Kristina Menton (left) and Sabrina Alesna and Robert Dreer (right) took care of Willi Tacke (center).
精心照料：John Gilbert 和 Kristina Menton (左) 以及 Sabrina Alesna 和 Robert Dreer (右) 照顾 Willi Tacke (中)。



中与两位教练一起度过了四天训练，每天训练长达 8 小时。模拟器的效果很好。因此，在第一次飞行时，我有一种感觉：我已经熟悉了该机，我可以安全驾驶它了。而这种实际飞行和模拟之间的惊人的相似性不仅存在于悬停中。即使我后来切换到“巡航模式”，几乎所有东西都像以前一样在模拟器中一样。我唯一的震惊是在过渡到固定翼模式后，

电机仿佛一下子关掉了，变得非常安静。我的第一个想法是：“它坏了”。我看了一眼显示屏 - 速度 54 节，高度 250 英尺，所有发动机参数都在绿色区域 - 于是我平静了下来。有趣的是，能耗立即明显低于“悬停模式”。噪音差异如此之大，以至于我立即在“巡航模式”摘下了主动噪音耳机。真的很安静！

在“巡航模式”下，作为传统飞机驾驶员，您会立即感到熟悉的感觉。向前、向上、向下和侧面的视野都非常好，转弯也非常灵活、舒适。我感觉非常舒适，几分钟后，我就希望最大转弯角度不要限制在 仅仅30 度了。在这种飞行模式下，方向的改变是通过向侧面倾斜操纵杆来实现的，这更像是操纵杆，而不是像在“悬停模式”下那样通过转动操纵杆来实现。

不过，还是回到飞行上来吧。在上一次飞行中，我遇到了热气流，因此地面风速为 10 至 15 节。因为拜伦机场的 eVTOL 起降航线是指定的，我不想顺风接近该位置后进行 180 度转弯，以便按照规定在我的机头迎风的情况下着陆，所以我最后一次接近侧风 90 度飞行。在进入着陆航线之前不久，我降低了飞行速度，并在 130 英尺处切换到“悬停模式”。Helix 短暂地点头，然后以增加迎角继续飞行，同时仍然保证了前方的视野。当我到达着陆台上方40英尺时，我结束下降并将操纵杆置于中立位置。现在飞机跟着我向后倾斜，所以我只能看到头顶的蓝天。但是当从肩部侧向看时，灰色的着陆台映入眼帘。鼓起的风袋现在表示强风，但飞机会自行原地悬停并保持高度。通过转动摇杆，我把机头朝向风中。因为我还没有直接越过着陆台，所以我通过向前和向侧面倾斜来纠正我的位置。只有当我看到着陆台的一角在肩膀上方时，我才会慢慢向后拉动摇杆上的摇杆开关，然后下降到 15 英尺高度。当“Autoland available”（可以自动着陆）消息出现在屏幕上时，我按下“扳机”，回到了地面。我最长的一次飞行持续了将近 20 分钟，之后必须快速充电，大约需要 25 分钟。但是我们想在天气变得太热之前进行尽可能多的飞行，所以第二架飞机已经准备好让我立即重新起飞。于是我顺利完成我的完整的飞行计划，包括紧急程序。

USB-C 的问题

为了使该机尽可能轻便和简单，原型机上安装了一些标准组件。例如，显示工具是一个简单的安卓平板电脑。而这正是在我的一些飞行过程中出现麻烦的原因。有一次，屏幕突然只显示“USB 断开连接”。但是由于我们也在模拟器中模拟过这个场景以及许多其他可能的错误，所以我没有恐慌，向教练报告了情况，他指示说可以继续飞行，高度、温度和风向等数值通过无线电传输显示正常。其实即使没有显示器，该机也可以毫无问题地飞行，因为最大速度是受限的，不存在失速可能性，只要不操作操纵杆上的摇杆开关，就可以保持高度。

由于我还有一段时间要飞行，所以我尝试了一个老技巧，我拔出 USB 插头，重新插上 - 显示正常了。“我们认识到了问题所在，”首席运营官 Kristina Menton 说。“如果USB 的触点因振动而接触不良，平板电脑将不再接收任何数据。即使触点随后恢复，您也必须拔出一次插头，然后再次插入。这与机载计算机或传感器无关，平板电脑仅用作显示器。因此，在量产型中，将使用定制的显示器，该显示器通过固定电缆连接到飞控计算机。然后在后部还安装了一个摄像头，然后您可以看到俯视图 - 如后退和着陆时。另一个改进是更具视觉吸引力的驾驶舱，包括一个薄的座垫。此外，地面上的飞行教练可以通过遥控接管飞机并降落。“从技术上讲，这不是问题，”培训经理 Robert Dreer 说。“无论如何，我们大部分的试飞都是在没有试飞员的情况下进行的。这些飞机就是为此而设计的，地面上的飞行教练无论如



Production is slowly increasing.

The airframe is now tilted backward, allowing me to see only the blue sky above when looking forward. However, glancing sideways over my shoulder makes the grey landing pad visible.

The windsock shows strong winds, yet the aircraft maintains its position and altitude autonomously. I adjust the controls to align the nose with the wind, and since I'm not directly above the pad, I correct my position by tilting forward and sideways. When I see one corner of the pad over each shoulder, I gradually pull the rocker switch on the stick backward, descending to 15 feet. Once the "Autoland available" message appears, I activate it, and the aircraft lands safely. My longest flight lasted nearly 20 minutes. After that, the plane must be connected for fast charging, which takes about 25 minutes. However, a second plane is ready for me to use to maximize the number of flights before it gets too hot—a true luxury. This allows me to complete my entire flight program, including emergency procedures and check flights, in just half a day.

Problem with USB-C

Standard components were incorporated into the prototype to ensure the machine remained lightweight and straightforward. The display instrument used is an Android tablet, which led to issues during some flights. On one occasion, the screen unexpectedly showed "USB disconnected." However, having simulated this scenario and other potential errors, I remained calm and informed the flight instructor of the "malfunction." He advised me to continue the flight, as essential data such as altitude, temperature, and wind direction would be communicated via radio. The aircraft can be operated without difficulty, even without a display, as its maximum speed is restricted, it does not stall, and it maintains altitude automatically unless the rocker switch on the control stick is used.

As I still have some time before entering the final approach in the traffic pattern, I attempt a familiar solution from experience with other Android devices. I disconnect the USB-C cable and reconnect it, and the display functions again. "We have identified the issue," states COO Kristina Menton. "If the USB connection is disrupted due to vibration, the tablet ceases to receive flight or engine data from the flight computer. Even if the connection is restored, you must unplug and replug the connector. This is unrelated to the onboard computer or sensors." She further explains: "The tablet serves solely as a display. In the production version, a custom display for the Helix will be used, connected to the aircraft's computers via a fixed cable to eliminate vibration problems. Additionally, cameras will be installed at the rear, allowing a view during take-off and landing on the display, similar to reverse parking in a car."

An additional update will include a more aesthetically pleasing cockpit with a slim seat cushion. The ground-based flight

instructor can also control and land the aircraft remotely. "Technically, that's feasible," states training manager Robert Dreer. "We conduct most initial test flights without a test pilot as it is. The aircraft is built for this, and the flight instructor on the ground receives all the telemetry data on their screen. Naturally, all flight instructors must also possess a drone pilot's license and their flight instructor's license."

Does it fly?

This was the most common question I received from friends and acquaintances when I shared my Pivotal flying experiences and videos with them. When I first encountered the machine in Oshkosh in 2018, I had the same doubts. Like many others, I was astonished. After watching the flight videos, particularly the take-off, I was convinced: flying such a machine seemed impossible! As a pilot, landing on my back while looking over my shoulder was unthinkable!

Having observed the company consistently fly the aircraft at Oshkosh and other events in recent years, I decided to examine this unique eVTOL design more closely. My interest in electric flying began when I first piloted an electric UL in 2009, and it has captivated me ever since despite challenges with battery energy and range limitations.

When Volocopter founder Alex Zosel assured me at AERO 2012 that "you will soon be flying our eVTOL," it became one of my aviation aspirations. However, the journey has taken longer than anticipated. While I have flown several all-electric three-axis aircraft and trikes, the eVTOL experience had yet to materialize itself. Volocopter and many other companies aim to operate their devices commercially, necessitating EASA or FAA certification, which involves significant time and financial investment. Numerous startups are assembling motors and propellers to create manned multicopters, but they remain in the development stage, often with constrained financial resources. Some of these startups even intend to market machines that are not fully developed. Due to safety concerns, I would not currently risk flying most of these machines. Nevertheless, the Helix stands out as an exception.

Some basic considerations

I firmly believe that small and lightweight eVTOLs should be classified under the UL category and entrusted to responsible operators. This category offers the most efficient environment for researching new technologies. The success of numerous conventional electric ULs and Volocopter exemplifies this. However, this can only be achieved if manufacturers pledge to eventually make their products available to pilots within the UL class.



The Pivotal Helix can be packed into a small trailer in under 30 minutes.

Pivotal Helix 只需不到 30 分钟就能装入小型拖车

何都通过遥测将所有数据显示在他的地面屏幕上。当然，所有飞行教练必须持有无人机飞手执照。

它真的能飞起来吗？

它真的可以飞吗？当我告诉朋友和熟人我在 Pivotal Helix 的飞行经历时，他们经常问我这个问题。我不得不承认：当我第一次看到这架飞机时，我也问自己这个问题。那是 2018 年在奥什科什航展。和许多人一样，我惊讶地揉了揉眼睛。在我看了飞行的视频，尤其是起飞的视频后，我很清楚：飞这样的东西？绝对不行！作为一名飞行员，我应该坐着着陆，回头看向后方？不可能！

然而，在该公司近年来每年都在奥什科什和其他地方进行演示飞行表现了令人印象深刻的专业飞行性能之后，我仔细研究了这种 eVTOL 设计。自从我 2009 年第一次驾驶电动飞机飞行以来，我一直被电动飞机所吸引——尽管还存在电池和航程不足等问题。

Volocopter 创始人 Alex Zosel 在 2012 年 AERO 展上向我承诺：“您很快就可以用我们的 eVTOL 实现飞行！” 我的飞行梦想之一。花了更长的时间。到目前为止，我已经能够驾驶一些全电动的超轻机和动力三角翼，但 eVTOL 并没有真正奏效。Volocopter 和许多其他公司都希望将他们的产品用于商业用途，这意味着他们需要 EASA 或 FAA 的适航审定，这是非常漫长的过程。一些 eVTOL 初创公司甚至想销售尚未真正完全研制好的产品。出于安全考虑，我目前不敢驾驶大多数 eVTOL，然而，对于 Helix，情况就不同了。

一些基本考虑因素

我确信，像 Helix 这样的超轻型 eVTOL 属于负责任的产品。没有其他类别的航空器可以如此高效地推动研究新技术。众多电动超轻机以及 Volocopter 的成功都证明了这一点。但是，这只有在制造商承诺稍后向超轻机飞行员提供其产品时才有可能。

UL 级 eVTOL 的基本要求之一是它必须利用当前可用电池的有限能量密度。因此，它必须很轻，并且理想情况下还得产生气动升力，因为机翼产生的升力要有效得多。一般来说，有三个概念：“多旋翼”、“倾转旋翼”（或“倾转翼和旋翼”）和“复合翼”。前者需要消耗大量能量才能在空气中停留，而后的缺点是机械复杂性高。另一方面，复合翼在重量方面存在缺点。所

有这些都并不真正适合 UL 类别。

作为替代方案，Pivotal 创始人 Marcus Leng 发明了“Tilt Aircraft”，飞机围绕飞行员旋转，八个螺旋桨与两个机翼连接。起飞时，飞机向后上转动，使螺旋桨垂直向上，产生向上的拉力。如果你向前推动控制杆，机翼也开始产生升力，如果你切换到“巡航模式”，发动机/螺旋桨的能耗会急剧降低，比“悬停模式”低 70%。

这种“尾座飞机”的解决方案，即飞机围绕飞行员旋转，对于习惯于坐着的飞行员来说，最初是非常“奇怪”的。但是，由于我发现工程方法（“当开发实现其目的时，开发即告完成，你不能遗漏任何内容”）和 Helix 解决方案如此简单，所以我无法将其从脑海中抹去。我想出了一个主意：如果你想用分布式推进（即许多电机）和“线控飞行”的 eVTOL 飞行——即通过计算机和电缆将控制信号传输到控制面上的伺服系统——那么这只有通过计算机、复杂的软件和大量冗余才能实现，以防万一出现故障。不过，执行我的控制指令的计算机并不关心飞行员是坐着还是躺着。Helix 的空气动力学经过优化，转换过程——从垂直飞行到水平飞行的关键过渡——也非常顺利。

在这种情况下，在权衡安全方面时，我想：Pivotal 的主要投资者是 Google 的创始人之一的拉瑞佩奇，当然也是世界上最了解计算机和软件使用的人之一。通过他的人脉和公司位于硅谷中心帕洛阿尔托的地理位置，他与世界上最好的硬件和软件工程师建立了联系。此外，佩奇还对该公司进行了长期投资。Pivotal 不必像一些通过风险投资融资的竞争对手那样必须尽快将产品推向市场。自 2011 年以来，Pivotal 制造了 80 多个原型产品并制定了长期的销售策略，包括精心设计的飞行训练和模拟器程序，以及大量的冗余设计，最终说服了我——是的，我会驾驶这架 eVTOL 的。另一个论点是，

该机拥有整机弹道降落伞系统。

我从未后悔过自己的决定。驾驶该机飞行的感觉和第一次在没有教练陪伴的情况下驾驶单座飞机的经历，让我想起了我第一次驾驶滑翔机和超轻型飞机的经历。

第 103 部超轻型

Pivotal 的 Helix eVTOL（通过必要的更改和策略）符合 FAA 的 103 部超轻机规定，这是基于 1982 年的一项非常特殊的规

A fundamental requirement for an eVTOL in the UL class is addressing the limited energy density of current batteries. It must be lightweight and ideally generate efficient aerodynamic lift, as lift from wings is significantly more effective than rotors or propellers alone. Generally, there are three concepts: “multicopter,” “tilt rotor” (or “tilt wing and rotor”), and “lift and cruise.” The first consumes substantial energy to remain airborne, the second involves significant mechanical complexity, and the third, while beneficial, carries extra weight due to motors and propellers used only during specific flight phases. In my view, none of these concepts genuinely align with the UL class.

As an alternative, Marcus Leng, the founder of Pivotal (formerly known as Opener), developed the “Tilt Aircraft,” where the aircraft rotates around the pilot. The eight propellers are securely mounted on the two wings. The aircraft flips onto its back for take-off, allowing the propellers to point vertically upward and generate lift independently. By pushing the control stick forward, the wings also start to provide lift, and when switching to cruise mode, the engine/propeller speed is significantly decreased. This reduces battery consumption by up to 70% compared to hover mode.

The “Tilt Aircraft” concept, where the aircraft seems to rotate around the pilot, initially appears quite unconventional for pilots accustomed to flying in a seated position. However, I was captivated by the engineering principle (“A development is complete when it fulfills its purpose and nothing more can be omitted”) and the Helix solution’s remarkable simplicity. I realized that flying an eVTOL with distributed propulsion requires numerous motors and a “fly-by-wire” system. This system transmits the pilot’s control inputs via computer and electrical cables to the servos on the control surfaces and motors, with the computer interpreting stick movements and translating them into aircraft maneuvers. This is achievable only through computers, advanced software, and significant redundancy to ensure safety in case of failures...

However, the computer executing my control commands operates independently of whether the pilot is seated or reclined. It is impossible for anyone to manually pilot an aircraft with eight or more engines and various control surfaces.

The aerodynamics of the Helix have been refined to ensure a seamless transition from vertical to horizontal flight.

Considering the security aspects, I reflected that Pivotal’s primary investor is Larry Page, the founder of Google—one of the most knowledgeable individuals globally regarding computer and software usage, with the financial resources necessary to ensure the aircraft’s development is as secure as possible before market release. His connections and the company’s strategic location in Palo Alto, at the heart of Silicon Valley, provide access to the world’s top hardware and software engineers.

Additionally, Page’s long-term investment in the company means Pivotal is not pressured to rush its product to market, unlike competitors reliant on venture capital. Since 2011, over 80 prototypes have been created alongside a comprehensive sales strategy. A sophisticated training and simulation program and significant redundancy ultimately convinced me to try it.

Another point raised was the complete aircraft ballistic rescue system, similar to the ultralights and hang gliders I have been piloting since the early 1980s.

I have never regretted this choice. The sensation of flying, particularly my initial solo flight in a single-seater aircraft without an instructor beside me, strongly reminded me of my early experiences with hang gliders and ultralight aircraft.

Part 103 Ultralight

The ability to fly the Pivotal eVTOL in the USA is made possible by a specific regulation from 1982 known as Ultralight FAR Part 103, established by the FAA (Federal Aviation Administration), the United States’ aviation authority. This regulation is the foundation for nearly all ultralight aircraft in the Western world. It specifies that an ultralight plane can have a maximum fuel capacity of five gallons (approximately 19 liters), must not exceed a speed of 55 knots (approximately 100 km/h) at full throttle in level flight, and must have a stall speed of less than 24 knots (approximately 44 km/h). The aircraft must not weigh more than 254 lbs (approximately 115 kg)..

Part 103: The floats trick

The Pivotal Helix can be labeled legally as an “ultralight” despite exceeding 254 pounds due to a specific weight exemption rule. This rule states that the 254-pound limit is “excluding floats and safety devices.” In other words, the weight of floats and safety devices is not included in the maximum empty weight. The exemptions allow an additional 30 pounds (13.6 kg) per float (or buoyant hull), 10 pounds (4.5 kg) for each auxiliary float, and 24 pounds (10.8 kg) for the rescue system. This results in an allowable empty weight of 348 pounds (157 kg), comprising 30 pounds for the Helix’s hull, 40 pounds for the four auxiliary floats, and 24 pounds for the rescue system. The manufacturer had to demonstrate water take-offs and landings to qualify for these FAA weight exemptions. “We accomplished this,” states Pivotal CEO Ken Karklin, “although water take-offs are a safety feature and not a standard take-off method we endorse.” ✓

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定。该条款称为 FAR 第 103 部，它是几乎所有超轻型飞机的基础。103部超轻型飞机的最大燃料容量为 5 加仑（约 19 升），在水平飞行中全油门飞行时不能超过 55 节（约 100 公里/小时），并且失速速度必须低于 24 节（约 44 公里/小时）。关键点：重量不得超过 254 磅（约 115 公斤）。

浮筒的诀窍

但为什么 Pivotal Helix 可以自称“合法的103部超轻型”呢？诀窍在于一项额外的重量规定：254 磅“不包括浮筒和安全装置”。通俗地说：浮筒和安全装置不计入空重。您可以为每个浮筒（或浮力船体）增加 30 磅（13.6 千克），为每个辅助浮筒增加 10 磅（4.5 千克），为救援系统再增加 24 磅（10.8 千克）。这样，“Helix”船体的重量为 30 磅，四个辅助浮筒的重量为 40 磅，救援系统的重量为 24 磅，因此允许的空重为 348 磅（157 千克）。为了向美国联邦航空局申请重量豁免，制造商必须演示水上起飞和着陆。“Pivotal 公司首席执行官肯-卡克林（Ken Karklin）说：“当然，我们做到了这一点，从水中起飞是可能的，但不是我们推荐的常规起飞方式。”

如何购买 Pivotal Helix?

正如我之前所说，该机目前只能在美国合法飞行。价格从 19 万美元到 25 万美元不等，具体取决于配置。Helix 的量产已经开始，第一架已经售出。我驾驶的这架迄今为止已作为试生产交付，是 Blackfly 原型机和 Helix 的混合物。与传统的层压复材 Blackfly 相比，Helix 的碳纤维部件、机身和机翼采用“预浸料压缩成型”工艺制成，这应该会进一步减轻部件的重量。

MOSAIC 双座飞机和德国 UL?

那么，Pivotal 的开发是否会以单座 Part 103 超轻型飞机结束呢？“不，当然不是，”Pivotal 首席执行官 Karklin 回答道。“但这是我们的第一款产品 现在正在大规模生产和交付。我们目前不打算申请FAA 或 EAA 的适航审定。然而，随着美国 LSA 级（轻型运动飞机）的新 MOSAIC 规则将于明年生效，双座 eVTOL 也可以作为私人LSA。“当然，我们正在计划推出 MOSAIC 双座型号，”Karklin 说，“这对全球其他市场来说当然也很有趣。此外，当然还有一些其他可能的用途，例如作为无人机和救援目的。美国空军已经认识到这一点，去年购买了几架 Blackfly，包括用于评估目的的模拟器。”



eFlightJournal editor-in-chief Willi Tacke with Pivotal CEO Ken Karklin at the company's headquarters in Palo Alto, California.

本刊主编 Willi Tacke 与 Pivotal 首席执行官 Ken Karklin 在帕洛阿尔托公司总部合影

结论

在我完成飞行训练后，我不得不说：这是一个全新的世界。经过十天的飞行训练后，我感到很安全，玩得很开心。像 Helix 这样的 eVTOL 也完美地融入了简单运动航空器的超轻理念。不是为了运输，而只是为了享受飞行的超轻机。就像超轻机的早期一样。德国的 UL 等级也可以提供类似的东西吗？为什么不呢？自 2011 年以来，Pivotal 团队已将该设备开发成一台功能齐全的产品，制作了 80 多个原型机，数千记录的飞行小时和所有重要系统（包括救援系统）的三重冗余设计，应该可以确保即使单个组件出现故障，您也可以安全地到达地面。帕洛阿尔托的团队已经明白，在航空领域，最大的危险往往来自飞行员。因此，他们不依赖法律规定的东西。根据第 103 部的规定，驾驶该机不需要飞行执照。因此，该公司原本可以在简短的介绍后向愿意付款的客户交付尽可能多的产品，但将面临严重事故的风险。Pivotal 与专业飞行教练一起制定了一个精心设计的培训计划，Robert Dreer 的培训团队不断学习新事物并提高他们的技能。来改善现有的状况。没有经过确认的飞行培训，任何人都不能进入 Helix 驾驶舱。这种 eVTOL 是否也适合德国 UL 级别呢？应该在与多家制造商的测试计划中澄清 - 就像过去几十年的其他新飞机一样。与电动三角翼、旋翼机、滑翔伞和超轻型直升机一样，您不应简单地只看制造商的规格，而应测试您自己的噪声、容错等方面的经验。让德国宇航中心(DLR)的研究机构参与进来是合适的，DLR 本身在 eVTOL 领域已经有深入研究。就像EASA 在80 年代初说管布超轻机的制造商应该将其飞机注册为 E 级飞机一样有意义。简单、美妙的超轻飞行永远不会像这样出现

Triple redundancy for safety: Not only are all sensors available in triplicate, but so is the Helix's flight computer.

三重冗余确保安全：不仅所有传感器，Helix 的飞控计算机也有三重冗余

Aalen, Bern, Augsburg



今夏欧洲的电动航空活动集萃 Summer e-Vents in Europe

In September over the skies of Bern Belpmoos/Switzerland: electric aircraft like these three Pipistrel Velis.
九月，瑞士伯尔尼贝尔莫斯机场的天空：飞行着像这三架 Pipistrel Velis 电动飞机。

With the first AERO fly-in “Future meets History” at the end of August in Aalen-Elchingen, the 8th Electrify In Switzerland from September 6th to 8th in Bern-Belp and the Airtec in Augsburg, there were three electric flight events in German-speaking countries. In addition to flight demonstrations, there were also some interesting news. In Bern, the Swiss Rolf Stuber showed the complete prototype of his Smartflyer SF1 for the first time. The four-seater SF1, made entirely of carbon fiber, stands out for its distinctive traction propeller on the tail unit. In Aalen, the Dornier DS 2C amphibian, electrified by Kasaero and powered by the Hyfly H167 fuel cell system, was on display and is due to takeoff soon.



Although many electric aircraft are still in development, the Pipistrel Velis is already being sold and is flying in many flight schools. At the Fly In, it could even be admired in formation flight over Bern. 许多电动飞机仍在开发中，但 Pipistrel Velis 已经开始销售，并且已经在许多航校中使用。在这次电动航展上人们甚至可以欣赏到多架该机在伯尔尼上空编队飞行。



One of the most beautiful electric aircraft is the Silence with electric propulsion, which is used by Dufour Aerospace as a test vehicle.

最漂亮的电动飞机之一是电动的 Silence，它被 Dufour Aerospace 用作测试飞机。

今夏在欧洲主要有三场电动航空相关的活动，8月底在阿伦-埃尔欣根举行的首场“未来与历史相遇”AERO航展主办的配套飞行集会、9月6日至8日在瑞士伯尔尼举行的第八届瑞士电动飞行展以及德国奥格斯堡的 Airtec 论坛。除了飞行表演之外，还有一些有趣的新闻。在伯尔尼，瑞士人 Rolf Stuber 首次展示了他的 Smartflyer SF1 电动飞机的全尺寸原型机。四座 SF1 完全由碳纤维制成，因其垂尾上安装的电机螺旋桨而引人注目。由 Kasaero 公司进行电动改型的道尼尔 DS 2C 飞机在阿伦展出，并将很快投入运营，该机由 Hyfly 公司研制的 H167 燃料电池系统提供动力。

艾伦和伯尔尼都提供了良好的飞行天气，因此电动飞机可以翱翔在蓝天上。阿伦的有趣之处在于现代电动飞机与卡尔·格里明格 (Karl Grimminger) 的老式飞机的结合，他将收藏的老式飞机存放在阿伦-埃尔辛根机场专门建造的机库中。阿伦航空团队负责餐饮和组织工作，支持活动包括有关飞行安全和电动飞行主题的有趣讲座。对于下一届，我们希望更多的电动飞机能够到达阿伦。奥格斯堡 Airtec 展会上参展的制造商也很少，但来自 VFS 的 Mike Hirschberg 与来自空中客车、Vaeridion、Volocopter 和 Lilium 等顶级公司的专家一起打造了精彩的讲座节目。多年来，该活动吸引了罗罗等领先电动飞机开发商的演讲和小组讨论。罗罗、MagniX、Joby、Wisk、Pivotal 等来自美国、欧洲和亚洲的众多公司吸引了多达 500 名与会者的关注。然而，今年，就像奥什科什的 AirVenture 一样，它受到了同期举办的范堡罗航展的影响，这让一些参观者感到惊讶，因此本届 Airtec 的参展商较少。此次展会的一大亮点是电机制造商 MagniX，该公司不仅展示了其发动机，还展示了在展览中心和水上飞机基地运行的 Harbour Air eBeaver 电动改装的水獭飞机。

Aalen and Bern both offered excellent flying weather, so that the electric planes could take to the blue skies. What was interesting about Aalen was the combination of modern electric planes and the vintage planes of Karl Grimminger, who housed his gems in a specially built hangar at the Aalen-Elchingen airfield. The Aalen air sports association took care of the catering and organization, and the supporting program included interesting lectures on the subject of flight safety and electric flight.

For the next event, we hope that even more electric planes will find their way to Aalen. At Airtec Augsburg, only very few manufacturers exhibited, but Mike Hirschberg from the VFS had once again put together an excellent program of lectures with experts from

top companies such as Airbus, Vaeridion, Volocopter and 46 Lillium. Over the years, the event has attracted the attention of up to 500 attendees with presentations and panels from leading developers in the electric aircraft space such as Rolls Royce, MagniX, Joby, Wisk, Pivotal and many others from the US, Europe and the Far East. This year, however, like AirVenture in Oshkosh, it suffered a little from the Farnborough Airshow taking place at the same time, which surprised some visitors. This was evident in the small number of exhibits, as only a few eVTOL developers and other electric aircraft manufacturers showed their products. A highlight here, however, was engine manufacturer MagniX, which not only showed its engine but also the Harbour Air eBeaver in action on the exhibition grounds and at the seaplane base.



The original Smartflyer SF1 was on display for the first time at a trade fair in Bern-Belpmoos. The four-seater with the distinctive motor on the horizontal stabilizer is made entirely of carbon fiber. With a takeoff power of 160 kW, it is expected to achieve a maximum range of 800 kilometers. Three versions are planned: fully electric, hybrid with range extender and with a fuel cell, with the energy source always housed in the long nose.

Smartflyer SF1 原型机首次在瑞士伯尔尼贝尔莫斯的电动航展上亮相。这架四座飞机的垂尾上装有电机，完全由碳纤维制成，起飞功率为160千瓦，最大续航可达800公里。计划推出三种型号：全电动、带有增程器和燃料电池的混合动力，混动能源装在长长的机头内。



Dufour Aviation not only showed the electric version of the Silence (previous page), but also its Tilt Wing eVTOL design as a model. Dufour Aviation 不仅展示了 Silence 的电动版本（上一页），还展示了其倾转机翼 eVTOL 缩比模型（左图）。



IBMS converted this Zenair CH 750 into an electric aircraft. The power supply is provided by a combustion engine. The electric motor has an output of 75 kW.



The Elektra Trainer, which was shown in Aalen, has the new Helix Talon propeller with propeller tips bent in the direction of spinning.

在阿伦展出的 Elektra Trainer 配备了新型 Helix Talon 螺旋桨，螺旋桨尖端沿旋转方向弯曲。



The Cellsius team at ETH Zurich presented the electrified version of the South African Sling kit aircraft in detail in the original (above) and in several presentations (right). ✓

苏黎世联邦理工学院的 Cellsius 团队在原型机上（上图）和几次讲座（右图）中详细介绍了对南非的 Sling 套材飞机的电动改装。



Not an electric plane, but absolutely worth seeing: the Fieseler Storch from the Flying Museum collection.
虽然不是电动飞机，但绝对值得一看：飞行博物馆收藏的 Fieseler Storch



Electric aircraft and vintage aircraft met for the first time at Aalen Airport. Hyfly showed the electric version of the Dornier DS 2C, which will soon be able to take to the skies with an electric motor and then also with a fuel cell.

电动飞机和老式飞机首次在阿伦机场相遇。Hyfly 展示了 Dornier DS 2C 飞机的电动版本，该机很快将配备电动机和燃料电池（上图）飞上天空。



The Pipistrel Taurus is already a classic among electric ultralights and can be seen here with a front propeller that folds forward.

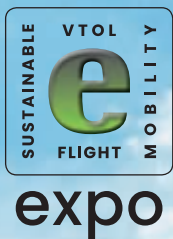
Pipistrel Taurus 已经是电动超轻机中的经典，在这里可以看到它向前折叠的螺旋桨。





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2024国际电动航空（昆山）论坛议程

e-Flight-Forum Program



11月18日				
8:30-9:05	开幕式 opening ceremony	中方主持人：高远洋 北京航空航天大学通用航空产业研究中心主任		
时间 time	环节 item	发言人 speaker	职务 job title	
8:35-8:40	致辞 welcome speech	林左鸣 Lin Zuoming	中国航空学会理事长 The Chairman of CSAA (China Society of Aeronautics and	
8:40-8:45		李健 Li Jian	中国民用航空局原副局长 Former Deputy Administrator of CAAC	
8:45-8:50		陶智 Tao Zhi	中国科学院院士 Member of The Chinese Academy of Sciences	
8:50-8:55		徐超群 Xu Chaoqun	中国航空学会飞行器适航分会主任 Director of the Airworthiness Committee of CSAA	
8:55-9:00		Willi Tacke	德国飞页公司总裁 CEO, Flying Pages	
9:00-9:05			待定 tbd	地方政府领导 Kunshan government official
11/18/2024	18-Nov-24			
上午 Morning				
议题一: Subject 1:	低空经济管理政策及行业前瞻 policymaking and industry prospective			
下午 afternoon				
议题二: Subject 2:	电动航空行业主机厂发展 OEM update			
议题三: Subject 3:	产业生态及上下游供应链 ecosystem and supply chain			
11/19/2024	19-Nov-24			
上午 Morning				
议题四: Subject 4:	空域管理政策及配套设施 airspace management and infrastructure			
分论坛一, sub-forums one:	电动航空适航审定探讨 certification workshop			
下午 afternoon				
议题五: Subject 5:	eVTOL体验、运行商业模式及融资租赁 eVTOL first-hand experience, operation and lease financing			
分论坛二, sub-forums two:	电动航空产业链的需求及路演 demand for the supply chain and project road show			
详细安排 Program				
11/18/2024				
时间 time	单位名称 company	职务 job title	姓名 speaker	演讲题目 topic
议题一：低空经济管理政策及行业前瞻 policymaking and industry prospective				

上午 Morning				
9:10-9:25	中国民用航空局航空器适航审定司 The airworthiness department of CAAC	司长 Director General	徐锋 Xu Feng	
9:27-9:43	欧洲航空安全局 (EASA)	驻华首席代表	Javier Vicedo	EASA的可持续航空政策思考 review of the sustainable aviation policymaking of EASA
09:45-10:00	中国民航华东地区管理局 Eastern China regional office of CAAC	二级巡视员 Level II Bureau Rank Official	钱惠德 Qian Huide	eVTOL飞行性能适航要求的思考 Review of the airworthiness requirements of eVTOL flight performance
10:02-10:17	法国AOPA协会 AOPA France	President of AOPA France and Member of the IAOPD Board	Emmanuel Davidson	与欧洲空中导航安全组织 (EUROCONTROL) 合作制定欧洲通用航空无人机和eVTOL新兴空中交通结构的报告 Report of the Work with Eurocontrol on new traffic structure in Europe for GA Drones and eVTOLs
10:30-10:45	广州航空器审定分中心 certification center of CAAC in Guangzhou	主任 director	王敏 Wang Min	中国民航电动航空器适航审定概览 Overview of China's Civil Electric Aircraft Airworthiness Certification
10:47-11:02	工信装备工程研究院 Ministry of Information and Industry	研究总监 director	金伟 Jin Wei	低空产业体系构建与政策思考 Construction of low-altitude economy system and policy review
11:04-11:19	中国民用航空机场协会兼低空经济基础设施分会 Airport Alliance of China	副秘书长 deputy secretary general	黄伟宏	对我国低空经济基础设施建设的思考 review of the construction of low-altitude economy infrastructure in China
11:21-11:36	中国航空运输协会通航业务部、无人机工作委员会 The UAV Committee of China Air Transport Association	主任 executive director	孙卫国 Sun Weiguo	低空空域管理改革进展与趋势 Progress and Trends of Low-Altitude Airspace Management Reform
11:36-11:56	问答交流 panel discussion			



下午 afternoon

议题二：电动航空行业主机厂发展 OEM update

第一组 group one				
13:00-13:15	美国Joby公司	创始人兼CEO founder and CEO	JoeBen Bevirt	Joby的eVTOL之路与氢燃料电池创纪录飞行 the road of Joby's eVTOL and the fuel cell record flight
13:17-13:22	上海峰飞航空科技有限公司 Autoflight	创始人兼CEO founder and CEO	田瑜 Tian Yu	盛世龙载人eVTOL与凯瑞鸥物流型号的并行研发 The integrated development of the manned and unmaned eVTOLs Prosperity (Passenger)and "Carry All" Cargo
13:24-13:39	法国VoltAero飞机公司	founder and CEO/亚洲销售主管 head of Asia sales	h Botti/Jean-Luc Valde	采用创新鸭翼和氢燃料混动动力的Casio 330短途飞机 Development of the Hybrid Commuter Casio 330 with its inovative Carnard Design and Hydrogene ready Hybrid Propulsion system
13:41-13:56	德国Volocopter公司	中国区总裁 head of China	Emerson Xu	Volocopter, 让城市空中交通成为现实的开拓者 Volocopter, Pioneer in bringing Urban Air Mobility to Life
13:58-14:20	问答交流 panel discussion			
第二组 group two				
14:22-14:37	中国商用飞机有限责任公司北京民用飞机技术研究中心 COMAC Beijing Research Center	预研总师 chief researcher	杨志刚 Yang Zhigang	智能氢电机技术探索 Exploration of Intelligent Hydrogen-Electric Aircraft Technology
14:39-15:14	德国MD飞机公司 MD Aircraft	技术总监 chief engineer	Eric Vianello	九座全电动双发短途飞机研发 Development of a 9-seat Full electric twin commuter
15:16-15:31	四川沃飞长空科技发展有限公司 Aerofugia	总裁 CEO	郭亮 Guo Liang	当低空出行的蓝图逐步实现 ——基于运营需求的eVTOL产品发展思路 When the blueprint of low-altitude travel is gradually realized ——eVTOL product development ideas based on operational needs
15:33-15:48	德国NEX飞机公司	founder and CEO	Mohamed ATTIA	全球首款氢燃料电池中程载客复合翼eVTOL Development of the world first fuelcell driven Lift and Cruise mid range Passenger eVTOL
15:50-16:05	广州汇天航空航天科技有限公司 HTAero Xpeng	副总裁 VP	王义 Wang Yi	让飞行更自由—— 小鹏汇天在低空经济中奋力前行 To make flying more free—how Xpeng HTAero strives to move forward in the low-altitude economy
16:07-16:30	问答交流 panel discussion			
16:30-16:50	茶歇 tea break			
议题三：产业生态及上下游供应链 ecosystem and supply chain				
16:50-17:05	昂际航电 AVIAGE	产品市场经理 Product Manager	茆唯伟 Mao Weiwei	智驭天际 - 面向新兴低空航空器的航电及飞控解决方案 Intelligent Driving in the Sky - Avionics and Flight Control Solutions for Emerging Low-Altitude Aircraft
17:07-17:22	奥地利Willinger公司	总裁 CEO	Marcus Willinger	针对eVTOL及电动飞机的除冰技术 introduction of the de-icing technology for eVTOL and electric aircraft
17:24-17:39	安徽盟维新能源科技有限公司Monta vista	董事长 President	张跃钢 Zhang Yuegang	高能航空动力电池技术现状与展望 Current status and prospects of high-energy aviation power battery technology
17:41-17:56	德国Alphafrog公司	总裁 CEO	Marco Hitsch	针对FAA新设MOSAIC LSA级别的四座电动飞机的智能航电 Development of intelligent electronics for a new 4 Seat electric aircraft for the new FAA MOSAIC LSA class
17:58-18:20	问答交流 panel discussion			

11/19/2024				
上午 Morning				
议题四：空域管理政策及配套设施 Airspace management and infrastructure				
8:30-8:45	粤港澳大湾区数字经济研究院 (IDEA)	院长 President	李世鹏 Li Shipeng	低空经济安全体系初探 Exploration of Safety & Security Framework for Low-Altitude Economy
8:47-9:02	清华大学 Tsinghua University	教授 Prof.	曲小波 Qu Xiaobo	先进的城市低空交通：载具、管控及商业模式 Advanced Urban Aerial Mobility: Vehicle, Traffic Management and Business Model
9:04-9:21	DLR 德国宇航中心 (线上发言)	无人机项目主管 Head of the DLR facility for drone and manned eVTOL testing and devel	Daniel Sülberg	无人机智能空管设计与实践 design and practice of intelligent UTM
9:23-9:38	德国Skyroads公司	总裁 CEO	Corvin Huber	面向未来的融合智能空管体系建设 building the nextgen intelligent ATM in converged airspace
9:40-9:55	中国民航第二研究所无人机中心 UAV Center of the Second Research Institute of Civil Aviation of China	主任 director	张建平 Zhang Jianping	低空交通智能管控服务的实践探索 Practice of low-altitude traffic intelligent control services
9:57-10:12	Bauhaus Luftfahrt公司	创新总监	Jochen Kaiser	电动飞机和eVTOL与现有航空体系的整合研究 Evaluating possibilities the integration
10:14-10:34	问答交流 panel discussion			
议题五：电驱系统 electric propulsion system				
10:36-10:51	卧龙电气驱动集团股份有限公司 Wolong Electric	副总裁 VP	刘栋良 Liu Dongliang	下一代航空器电力动力系统机遇与挑战 Opportunities and Challenges of Next Generation Aircraft's Electric Power System
10:53-11:02	捷克MGM Compro公司	董事总经理 Managing director	Martin Dvosky	电驱集成系统设计与实践：以PT6涡桨发动机替代电机为例 design and practice of electric propulsion integration: an example of PT6 replacement
11:04-11:19	德国HyFly公司	总裁 CEO	Karl Käser	Hyfly氢燃料电池动力总成验证机 Hyfly Hydrogen Fuel Cell Powertrain Demonstrator
11:21-11:36	问答交流 panel discussion			
下午 afternoon				
议题六：eVTOL体验、运行商业模式及融资租赁 eVTOL first-hand experience, operation and lease finance				
13:00-13:15	美国Pivotal飞机公司	总裁 CEO	Ken Karklin	103部超轻型尾座式eVTOL及其模拟器培训方式的市场化之路 Realisation of a single seat "Tilt aircraft" eVTOL including a very realistic Simulator and training syllabus
13:17-13:22	上海柘飞航空科技有限公司 Zephyr Aviation	董事长 president	陈开鸣 Chen Kaiming	
13:24-13:39	慕尼黑工业大学 TUM	模拟器项目主管 head of simulator	Maximilian Wechner	采用“硬件在环”方式的eVTOL模拟器设计 Developing of simulator for different eVTOL systems with a Focus of using the real aircrafts "Hardware in the loop"
13:41-13:56	天津空港东疆综保 Tianjing free trade zone	副局长 deputy director	李凯 Li Kai	“测试+文旅+巡检+载体+金融”，天津东疆综合保税区发展低空经济的地方经验 "Testing+ Tourism+Inspection + Carrier + Finance", the local experience of Tianjin Dongjiang Comprehensive Bonded Zone in
13:58-14:13	德国Volocopter公司	中国区总裁 head of China	Emerson Xu	Volocopter, 让城市空中交通成为现实的开拓者 Volocopter, Pioneer in bringing Urban Air Mobility to Life
14:15-14:35	问答交流 panel discussion			

Please note:

All information subject to change without notice.

11/19/2024				
上午 Morning				
分论坛一：电动航空适航审定探讨 parallel sub-forum: certification workshop				
时间 time	单位名称 company	职务 job title	姓名 speaker	演讲题目 topic
9:00-10:30 圆桌讨论	沃飞	适航总监	周双勇	
	中国民航科学技术研究院适航所 CAAC research insitutte	所长 director	刘薇薇 Liu Weiwei	
	成都审定中心	主任	郑雪峰	
	北京航空航天大学 Beihang University	教授 Prof.	张曙光 Zhang Shuguang	主持人
	EASA代表		待定	
10:50-11:05	中国汽车工程研究院股份有限公司安全技术中心 CAERI (an automobile safety research insitutue)	副主任 deputy director	王国杰 Wang Guojie	飞行汽车安全标准体系建设的思考
11:07-11:22	尚飞航空科技有限公司	总工程师 chief engineer	孙凤琴 Sun Fengqin	eVTOL企业体系构建、型号安全设计和验证 eVTOL enterprise system construction, model safety design and verification
11:24-11:39	中国民航大学 CAUC university	教授 Prof.	高洁 Gao Jie	电动航空器电推进系统安全性与适航 Safety and airworthiness of electric propulsion system for electric aircraft
11:41-11:56	中国民航大学 CAUC university	教授 Prof.	石膏鹏 Shi Xiaopeng	eVTOL适坠性的新挑战 New Challenges in Crashworthiness of eVTOL
下午 afternoon				
分论坛二：电动航空产业链的需求及路演 parallel sub-forum: demand for the supply chain and project road show				
13:00-13:15	航投私募基金管理有限公司 China Civil Aivation Investment Fund (CAIF)	董事长 President	高建明 Gao Jianming	如何看待和投资新能源航空 How to view and invest in new energy aviation
13:17-13:32	中科创星 CASStar fund	投资副总VP	兰可 Lan KE	电动航空产业链的投资视角 Investment perspective of the electric aviation industry
13:34-13:49	江苏亨睿航空工业 HRC	技术总监 Technical director	邱宏波	eVTOL机体结构设计与制造关键技术探讨 Key Technologies for the Structural Design and Manufacturing of eVTOL
13:51-14:04	宜昌斯塔娜航空科技 Sterna Propellor	创始人 founder	郑伟 Zhen Wei	
14:06-14:21	法国VoltAero飞机公司	亚洲销售主管 head of Asia sales	Jean-Luc Valerio	
14:23-14:33	捷克MGM Compro公司	董事总经理 managing director	Martin Dvosky	
14:35-14:45	天翎科航空科技（上海）有限公司	联合创始人 Cofounder&CMO	卢懿 Louise Lu	用创新之翼重塑城市天际线 Redefining urban skyline, Creating infinite links
14:47-14:57	德国MD飞机公司 MD Aircraft	技术总监	Eric Vianello	
15:00-15:10	德国Skyroads公司	总裁 CEO	Corvin Hueber	
15:25-15:35	德国NEX飞机公司	总裁 CEO	Mohamed ATTIA	
15:12-15:22	德国HyFly公司	总裁 CEO	Karl Käser	
15:24-15:34	奥地利Willinger公司	总裁 CEO	Marcus Willinger	

e-Flight Journal

The first publication
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eVTOL, autonomous flight

LSA, UL, passenger aircraft, battery, equipment;
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ALPHAFROG Takes Flight Revolutionizing General Aviation with AI and Electrification



In an era when technological advancements are propelling industries to new heights, ALPHAFROG emerges as a frontrunner in the electrification and modernization of general aviation (GA).

German software visionary and aviation enthusiast Marko Hirsch, known for his two decades of innovative work with companies exentra GmbH and EXP Software GmbH, is at the helm of this ambitious project. Hirsch, who has dedicated years to developing AI-driven digital twin software for the German industrial sector, is now merging his passion for flying with his expertise in software to create the next generation of aircraft.

With the introduction of the ALPHAFROG eG1, Hirsch is taking a revolutionary approach to designing electric aircraft specifically for the ultralight category. The aircraft is not merely an upgraded model; it's a reimagined concept that integrates state-of-the-art software systems for unprecedented safety and ease of operation. "We believe software and electronics can

elevate safety in aviation, just as they have in the automotive industry over the past two decades," Hirsch explains. "There's no reason why light-sport and ultralight aircraft shouldn't have advanced systems like anti-collision, atmospheric monitoring, autoland, and stall prevention. These systems have the potential to reduce accidents by up to two-thirds."

The eG1's design takes inspiration from Aviasud's legendary Sirocco, a single-seat aircraft that made history 40 years ago when French adventurer Patrice Franceschi circumnavigated the globe in it. Now, ALPHAFROG has revived and transformed this classic with a full carbon structure, enhanced aerodynamics, and advanced wing profiles, delivering greater efficiency and control. But the true innovation lies within: the eG1 is powered by a 20 kW electric motor with a

ALPHAFROG 起飞 利用人工智能和电气 化革新通用航空

在技术进步推动行业迈向新高度的时代，ALPHAFROG 成为通用航空 (GA) 电气化和现代化的领跑者。

德国的富有远见的软件专家和航空爱好者 Marko Hirsch 以在 exentra GmbH 和 EXP Software GmbH 公司从事创新工作二十年而闻名，他创立了这个雄心勃勃的项目。Hirsch 多年来一直致力于为德国工业部门开发人工智能驱动的数字孪生软件，现在他正将自己对飞行的热情与软件专业知识相结合，打造下一代飞机。

随着 ALPHAFROG eG1 的推出，Hirsch 正在采取革命性的方法设计专门用于超轻型电动飞机。这架飞机不仅仅是一款升级型号；它是一个重新构想的概念，集成了最先进的软件系统，实现了前所未有的安全性和易操作性。“我们相信软件和电子设备可以提高航空业的安全性，就像过去二十年来它们在汽车行业所做的那样，” Hirsch 解释道。“轻型运动飞机和超轻



型飞机没有理由不配备防撞、大气监测、自动着陆和失速预防等先进系统。这些系统可以将事故减少三分之二。”

eG1 的设计灵感来自 Aviasud 传奇的 Sirocco，这是一款单座飞机，40 年前法国冒险家 Patrice Franceschi 驾驶它完成了首次超轻机环球飞行，创造了历史。现在，ALPHAFROG 以全碳结构、增强的空气动力学和先进的机翼设计复兴并改造了这款经典飞机，从而实现了更高的效率和控制力。但真正的创新在于：eG1 由 20 kW 电动机驱动，最大短时功率为 30 kW，配备折叠式螺旋桨和反推，并由先进的 ALPHAFROG 中央计算机管理，具有云连接和先进的传感和分析 AI 能力。此外，配套的平板电脑和智能手机应用程序可实现无缝的用户交互和控制。

With the G1 you receive basically three pieces of software that work together: a tablet application, a smartphone application and the board computer.

在 G1 上您可以获得三个可以协同工作的软件：平板电脑应用程序、智能手机应用程序和主控计算机。

30 kW boost, a folding propeller, reversible thrust, and is managed by a sophisticated ALPHAFROG central computer with cloud connectivity and advanced sensing and analytical AI. In addition, a companion tablet and smartphone app allow for seamless user interaction and control.

For the first time in the 135 kg ultralight category, the eG1 comes equipped with a fully integrated autopilot, managing all three axes and throttle. The system includes features such as envelope protection, stall prevention, and auto-glide functionality, with the potential for a future autoland feature. The technology's core functions are safeguarded by separated control components for enhanced reliability, while updates are delivered over-the-air (OTA), ensuring the system evolves in line with technological advances.

ALPHAFROG's vision extends beyond the eG1, with concepts already underway for the full-electric, four-seater eG4 designed for the new MOSAIC LSA class in the United States. This aircraft, with its high-aspect-ratio, non-strutted wings and lightweight carbon composite body, is engineered for efficient, long-range performance, even in all-electric mode. The cockpit promises a panoramic view and user experience akin to that of a modern automobile, making flights more accessible, comfortable, and safe.

Hirsch is enthusiastic about the new MOSAIC rules, which allow ALPHAFROG to innovate within a less restrictive regulatory framework. "The Mosaic rule opens up an unprecedented opportunity to design a true four-seat travel aircraft at lower risk," he says. "Certifying this aircraft under Part 23 would be cost and time-intensive, so we're starting with the MOSAIC LSA version in the U.S., the world's largest GA market."

To address range requirements, ALPHAFROG will offer the eG1 also as G1 with a low noise and efficient combustion engine. The eG4 hybrid, for example, can be optionally equipped with a small combustion engine in the nose as a range extender, and in the future, potentially a fuel cell.

With the launch of the ALPHAFROG eG1 and the upcoming eG4, Hirsch's vision of an AI-enhanced, electric future for general aviation is taking flight—promising to bring unprecedented safety, sustainability, and enjoyment to pilots worldwide. ✓

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Specification ALPHAFROG G1 & eG1

ALPHAFROG G1



PIC + Pax

1



Empty Mass

131 kg



MTOW

300 kg



Cruise Speed

120 km/h



Max. Speed

140 km/h



Range

600 km



Power

25 kW
30 HP



Price

from 42 000
EUR Base Kit

ALPHAFROG eG1



PIC + Pax

1



Empty Mass

118 kg



MTOW

300 kg



Cruise Speed

120 km/h



Max. Speed

140 km/h



Range

up to 150 km



Power

20 kW
Boost 30 kW



Price

from 51 000
EUR Base Kit

在 135 公斤超轻型飞机类别中，eG1 首次配备了完全集成的自动驾驶仪，可管理所有三个轴向和油门。该系统包括包线保护、失速预防和自动滑行等功能，并有可能在未来实现自动着陆功能。该技术的核心功能由独立的控制组件保护，以提高可靠性，同时通过无线更新 (OTA)，确保系统与技术进步同步发展。

ALPHA FROG 的愿景不仅限于 eG1，其全电动四座 eG4 概念已经在进行中，该设计概念专门针对美国新的 MOSAIC LSA 类别，采用高展弦比、悬臂机翼和轻质碳纤维复合材料机身，即使在全电动模式下也能实现高效的航程性能。驾驶舱可提供与现代汽车类似的全景视野和用户体验，使飞行更加便捷、舒适和安全。

Hirsch 对 FAA 新的 MOSAIC 规则充满热情，该规则允许 ALPHA FROG 在限制较少的监管框架内进行创新。“Mosaic 规则为设计真正的四座旅行飞机提供了前所未有的机会，风险更低，”他说。“根据第 23 部认证这架飞机将耗费大量成本和时间，因此我们将在美国这个全球最大的通航市场从 MOSAIC LSA 型号开始。”

为了满足航程要求，ALPHA FROG 除了提供 eG1，同时提供低噪音高效内燃机的 G1。例如，eG4 混合动力飞机可以选择在机头配备一台小型内燃机作为增程器，未来还可能配备燃料电池。

随着 ALPHA FROG eG1 和即将推出的 eG4，Hirsch 对通用航空人工智能增强型电动未来的愿景正在实现——有望为全球飞行员带来前所未有的安全性、低碳可持续性和飞行的乐趣。



Four-Stroke EOS Quattro Engine

四冲程 EOS Quatro 增程发动机

Geiger HPD 20/30

The Geiger engine is well known and has been used for several years. Electric is quiet, isn't it? But most of the noise is generated by the propeller. Due to the low RPM, the propeller in the ALPHA FROG G1 is very quiet. Additionally, there is no gearbox, which further reduces noise. When you use the folding propeller with the HPD 20/30, it is just fantastic to glide smoothly and calmly through the air. Since the HPD 20/30 is about the size of the engine mount, it reduces drag even further and therefore also reduces noise.



Geiger HPD 20/30 电机

Geiger 的电机非常出名，已经在多种飞机上应用多年。电机很安静，不是吗？大部分噪音是由螺旋桨产生的。由于转速低，ALPHA FROG G1 的螺旋桨非常安静。此外，没有变速箱，这进一步降低了噪音。当将折叠螺旋桨与 HPD 20/30 配合使用时，在空中平稳而安静地飞行真是太棒了。由于 HPD 20/30 的大小与发动机支架差不多，小尺寸可以进一步减少阻力，从而降低噪音。



The eG1 is inspired by the legendary Sirocco ultralight designed by Aviasud.

eG1 的设计灵感来自 Aviasud 设计的传奇的 Sirocco 超轻机



Both models can be easily disassembled and then transported or stored using a trailer.

两个型号都可以方便地拆装后使用拖车运输或存放。

MDA1 - the fully electric, versatile aircraft



photmontage

The MDA1 - the fully electric, versatile aircraft and the enabler of carbon-free commercial aviation in the Regional Air Mobility (RAM) segment.

Mobility is a location factor! Comprehensive availability and its vitality are crucial for functional value creation processes and at the same time promote a high degree of willingness on the part of the economy to invest. The MDA1 creates a mobility offer that enables timely, flexible and individual use. To get from A to B, short waiting, travel and journey times are required. This applies equally to passenger and cargo applications. There are small airports and airfields all over the world that can be operated by the MDA1. Costly and time-consuming investments in infrastructure that would be essential for such mobility or on the road are not necessary. MD Aircraft GmbH (MDA) is currently developing a 10-seat, purely electrically powered eSTOL commuter, the MDA1, in collaboration with MD Flugzeugbau GmbH & CO.KG (MDF). Passenger, cargo and surveillance are equally the target applications. Both companies, like MD Composite Technology GmbH (MDC), belong to the MD Group. MDF is not a start-up, but a company that has been successfully operating in the aviation sector for 30 years. And it is an EASA-certified design (21J), production (21G) and maintenance organization (CAO, Part 145) whose competence in development and approval no longer has to be proven. The market values

the quality and reliability of MD. Approvals and construction of various aviation devices as well as the MD-TJ42 turbine engine developed, produced and approved by MDF are worth mentioning in this context. More than 150 fully electric aircraft of the JS3-RES type approved by MDF and units sold on the market are evidence of the intensive experience and broad competence in the field of electrification of aviation. The core competence of lightweight construction and the production of tools and molds for prototype construction and also for series production is also comprehensively and deeply anchored and present in the MD group of companies!

The development of the MDA1 is the result of the resulting vision and mission to quickly and promptly make an approvable solution for decarbonized commercial aviation in the RAM segment available to the market. The MDA1 is being developed strictly against the existing approval regulations of EASA CS 23. The time-to-market approach is being consistently followed. The demonstrator will fly at the end of 2026, and series production of the then approved MDA1 will start in 2030. We are ahead of the timeline, no milestone has been missed yet.

MDA1 是一款全电动多功能飞机，是区域空中交通 (RAM) 领域实现无碳商业航空的推动者。

出行是一个重要的地理因素！便捷的可达性以及地域的活力对于经济价值创造至关重要，同时还能促进经济上的投资意愿。MDA1 提供了一种及时、灵活和个性化的出行选择。要更好地实现从A到B的出行，需要减少等待和旅行时间。不仅客运，这一需求同样也适用于货运航线。世界各地都有适合 MDA1 运营的小型机场和航空场地，这样就无需进行额外的，昂贵且耗时的机场或道路的基础设施投资。

MD Aircraft GmbH (MDA) 目前正与 MD Flugzeugbau GmbH & CO.KG (MDF) 合作开发一款 10 座纯电动 eSTOL（电动短距起降）通勤飞机 MDA1。客运、货运和航空监视都是其目标应用。这两家公司与 MD Composite Technology GmbH (MDC) 一样，均隶属于 MD 集团。

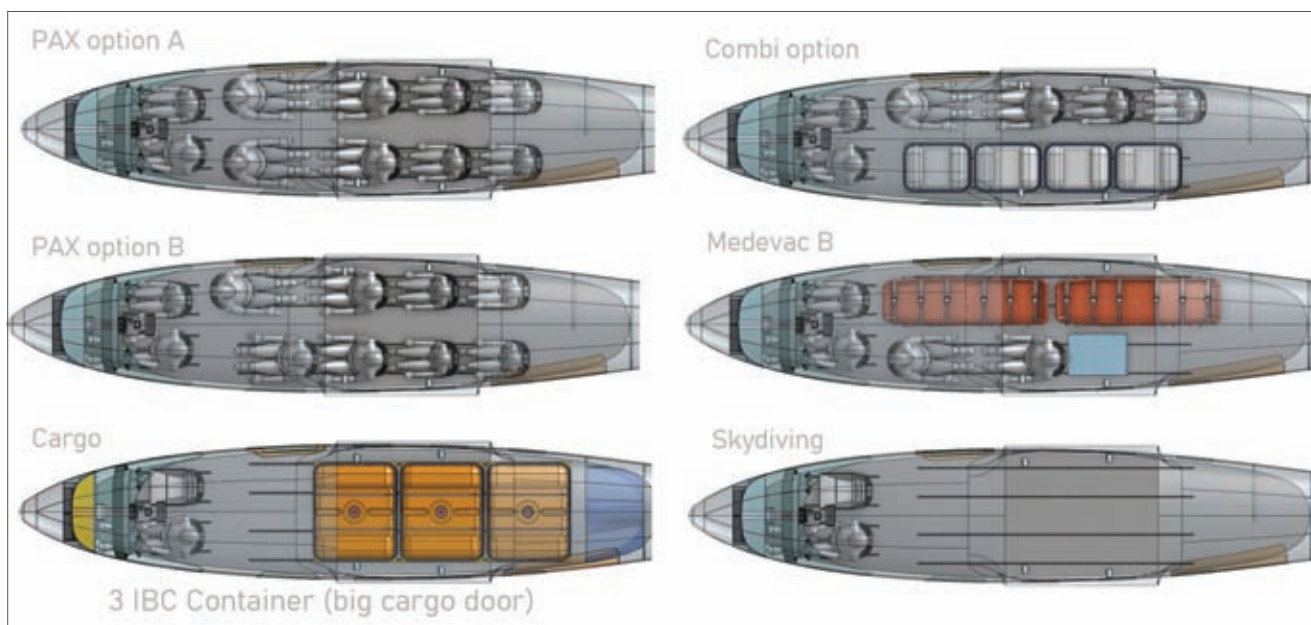
MDF 并非一家初创公司，而是一家在航空领域成功运营了 30 年的公司。它是 欧洲航空安全局（EASA）认证的设计（21J）、生产（21G）和维护组织（CAO，第 145 部分），其开发和认证的能力毋庸置疑。市场对



MD的质量和可靠性高度认可。值得一提的是，MDF 不仅设计、生产和取得了多种飞行器和航空设备的认证，还开发生产了MD-TJ42 涡轮发动机。

MDF 已获得认证并投放市场的JS3-RES 型全电动飞机销售超过了 150 架，这证明了其在航空电气化领域的丰富经验和广泛的专业能力。轻量化设计，以及生产用于原型建造和批量制造的工具和模具是MDF的核心能力，这也全面而深入地扎根于 MD 公司集团！

MDA1 的开发源于我们的愿景和使命，即迅速、及时地向市场推出区域空中交通领域可认证的无碳商用航空





The first MDA1 aircraft, for which pre-orders have already been received from 4 different airlines, will be equipped for VFR flight. The MDA1 concept and the current design of the MDA1 make it possible to cover 70% of the routes flown globally today in the RAM short segment. 3 IBC containers in terms of volume or approx. 1 tonne of payload can be transported. Necessary prerequisites to meet the requirements of a multi-purpose commuter! The commuter can be quickly and easily converted for its specific use. The concept impresses with its diverse and quickly generated possible cabin layouts.

The MDA1 provides the market with a powerful, flexible and reliable aircraft. Carbon-free commercial aviation can then be rethought. The mobility offer is thus available on a large scale and moves closer to the people who are looking for and want fast and flexible travel from direct A to direct B. The journey to the point of departure is shorter and free of traffic jams. The overall travel time is shorter and, above all, more climate-friendly and significantly cheaper to operate than comparable aircraft models powered by fossil energy.

The MDA concept is impressive, it shows not only foresight, but also broad-ranging. You can see that visionaries with aviation experience are working in all areas on the carbon-free future of commercial aviation who understand aircraft construction but also the market. ✓



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解决方案。MDA1 的开发严格遵循 EASA CS 23 的现有认证法规，并始终遵循投入市场的时间方案。其原型机将于 2026 年底试飞，并计划于 2030 年开始获得认证的 MDA1 批量生产。我们目前领先于时间表，尚未错过任何项目里程碑。

首架 MDA1 飞机将配备 VFR（目视飞行规则）飞行装备，并已收到来自 4 家不同航空公司的预订。MDA1 的设计和概念使其能够覆盖当今全球 70% 的 RAM 短途航线。它能装载相当于 3 个 IBC（中型散货集装箱）的货运体积，或约 1 吨的有效载荷。这使其满足多用途通勤机的要求！而通勤机也可以快速轻松地转换为其他特定用途。它的设计概念，以及其多样化且快速生成的机舱布局令人印象深刻。

MDA1 为市场提供了强大、灵活且可靠的飞机，为无碳商业航空提供了新的思路。这种出行服务可以大规模地提供给那些正在寻找更快速灵活出行方式的人们。他们的旅行时间将更短，并且不会出现交通拥堵。与使用化石能源的同类飞机相比，不仅其整体旅行时间更短，最重要的是，它更环保，运营成本也会更低。

MDA1 的设计概念令人印象深刻，它不仅展现了远见卓识，还体现了广泛的视角。您可以看到，航空界的远见卓识者们正带着他们对飞机制造和航空市场的了解，在各个领域致力于商业航空的无碳未来。



LDI

Ice Protection Systems



*orange and blue marked areas = LDI Ice Protection Systems



橘红色和蓝色区域 = LDI 防冰系统

LDI Ice Protection Systems can be applied to various parts of the aircraft. The simplest and most durable solution for ice protection on leading edges of wings, empennage, nacelles, air intakes, propellers, radomes and any other area where ice protection is required.

Ice build-up in flight is a known serious hazard for aircraft, but even more so for multicopters and other VTOL aircraft as precise rotor balance is absolutely critical for safety, especially during take-off and landing.

Even a small accumulation of ice changes the aerodynamics and performance of a rotor, and in the case of a multi-rotor VTOL aircraft it causes unbalance and can lead to a sudden uncontrolled crash. Tests in an icing wind tunnel at NASA with a multicopter in freezing temperatures and foggy conditions resulted in an uncontrolled crash after less than 15 seconds.

Dangers of icing:

Aircraft icing can occur at any time of the year, given the appropriate humidity, and can occur at temperatures well above freezing.

Change in aerodynamics: Ice build-up on the propellers or rotors changes the aerodynamic properties, resulting in a loss of stability and efficiency. The result is a loss of thrust and the multicopter may no longer be properly controllable.

Imbalances in the rotors: Ice build-up on the propellers creates imbalances that cause vibrations. These vibrations can affect the stability and control of the multicopter and lead to damage to the motors or other components.

Ice shedding from spinning rotor blades

Ice shedding from rotor blades can be a ballistic concern in several applications, as it can damage the fuselage and other aircraft components and pose a danger to people in the vicinity of the aircraft. It can also block rotors, for example in ducted fan propulsion systems.

Three types of Ice Protection Systems suit every type of application

ETIPS - Electro Thermal Ice Protection System - orange marked areas (photo on top)

EMIPS - Electro Mechanical Ice Protection System - also orange marked areas (photo on top)

FIPS - Fluid Ice Protection System - blue marked areas (photo on top)

三种防冰系统可适用于每一种应用

ETSIPS- 电加热防冰系统 - 橘红色区域 (上图)

EMIPS- 电气机械防冰系统 - 橘红色区域 (上图)

FIPS- 液体防冰系统 - 蓝色区域 (上图)

LDI 防结冰系统

LDI 防结冰系统可应用于飞机的各个部位。这是机翼前缘、尾翼、发动机舱、进气口、螺旋桨、机鼻雷达罩和其他需要防冰的区域的最简单、最耐用的解决方案。

飞行过程中结冰是飞机的已知严重危害，但对于多旋翼eVTOL和其他垂直起降飞机来说更是如此，因为精确的旋翼平衡对于安全至关重要，尤其是在起飞和降落期间。即使是少量的冰堆积也会改变旋翼的空气动力学和性能，对于多旋翼垂直起降飞机来说，它会导致不平衡并导致突然失控坠毁。NASA 在结冰风洞中对多旋翼eVTOL进行了测试，测试环境为极寒天气和大雾天气，不到 15 秒后就发生了失控坠毁。

结冰的危险

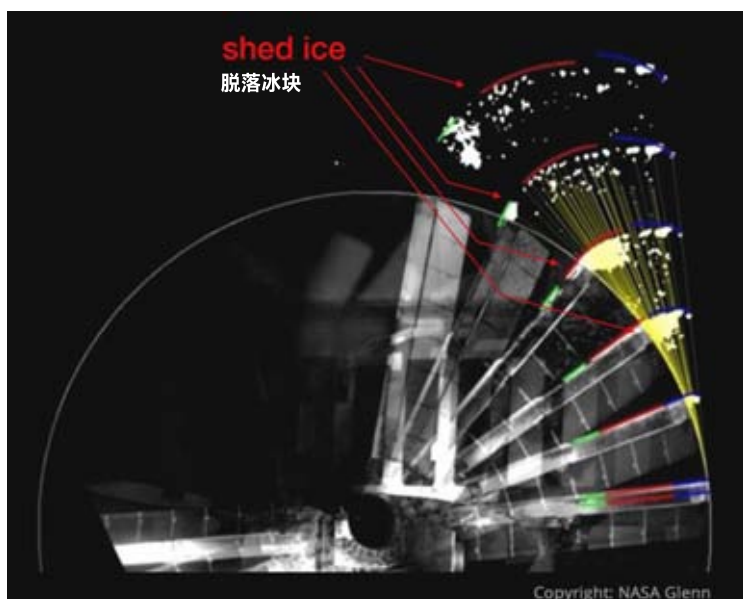
Danger of icing

只要湿度适宜，飞机一年中的任何时候都可能结冰，而且在远高于冰点的温度下也可能发生结冰。

空气动力学变化：螺旋桨或旋翼上的冰堆积会改变空气动力学特性，导致稳定性和效率下降。结果是推力损失，多旋翼飞行器可能不再能正常控制。

旋翼不平衡：螺旋桨上的冰堆积会造成不平衡，从而引起振动。这些振动会影响多旋翼飞行器的稳定性和控制，并导致电机或其他部件损坏。

旋转的旋翼桨叶上的冰脱落：旋翼桨叶上的冰脱落多种情况下可能引起冰块高速撞击问题，会损坏机身和其他部件，并对飞机附近的人员造成危险。它还会阻塞旋翼，例如在涵道风扇推进系统中。



FC

Comparison of ice formation on unprotected reference propeller blade (300 seconds of icing) with by fluid-based IPS protected propeller blade (560 seconds of icing)

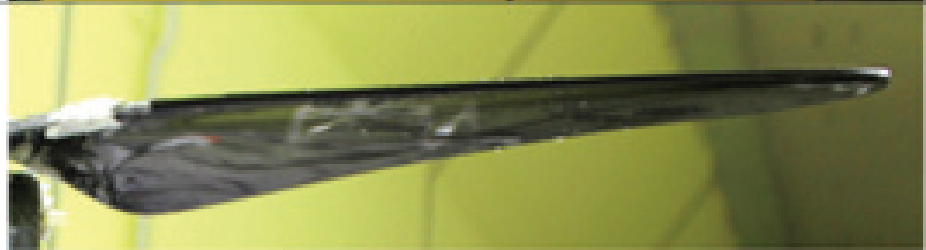
Conditions: -5° C, 20 m/s, MVD 20 microns, LWC 2.34 g/m³, App C IM envelope, tilted -10°

未受保护的参考螺旋桨叶片结冰情况对比 (结冰 300 秒) 和受液体 IPS 保护的螺旋桨叶片结冰情况对比 (结冰 560 秒)

条件: -5° C, 20 m/s, MVD 20 微米, LWC 2.34 g/m³, App C IM 包络线, 倾斜角 -10°



Unprotected reference propeller 1 (Run 5)
Protected propeller 1 (Run 17b)



未受保护的参考螺旋桨 1 (运行 5)
受保护的螺旋桨 1 (运行 17b)

Sensor interference:

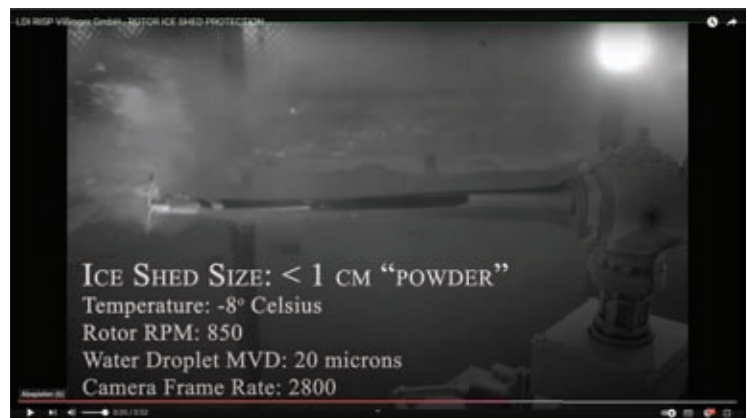
Many multicopters are equipped with sensitive sensors (e.g. GPS, IMU, barometer) which can be affected by moisture and ice build-up. A malfunctioning sensor system can lead to incorrect data and unstable flight conditions.

Increased weight:

Ice build-up on the rotors, frame or other components increases the overall weight of the multicopter, which affects flight performance and puts more stress on the engines.

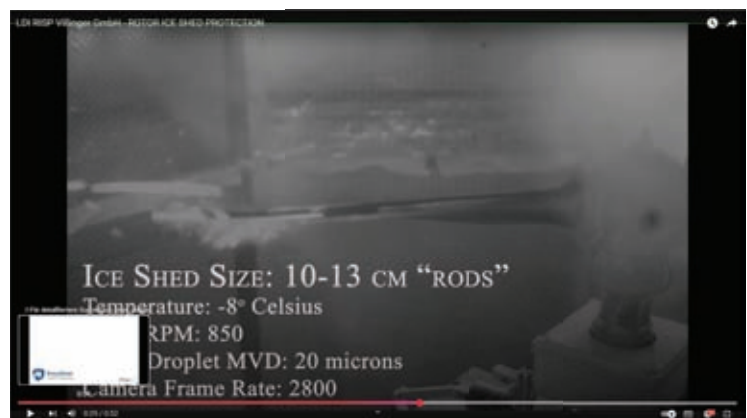
RISP rotor shed ice protection system

A protection system to prevent hazardous ballistic impact from rotor shed ice named RISP (Patent: A50377/2017) has been developed by Markus Villinger and Jose Palacios. RISP is capable to prevent from large pieces of ice sliding off the tip of the blade after delamination. The rotor blade ice protection systems are designed for main rotor blades and tail rotor blades as well as for aircraft propellers. The systems feature highest durability and efficiency - low power consumption and clean aerodynamics. RISP systems may be designed for a wide variety of Rotors - often even as a retrofit system and may be used in combination with other ice protection systems. ✓



ice shed with protection

受保护的情况下的冰块脱落情况

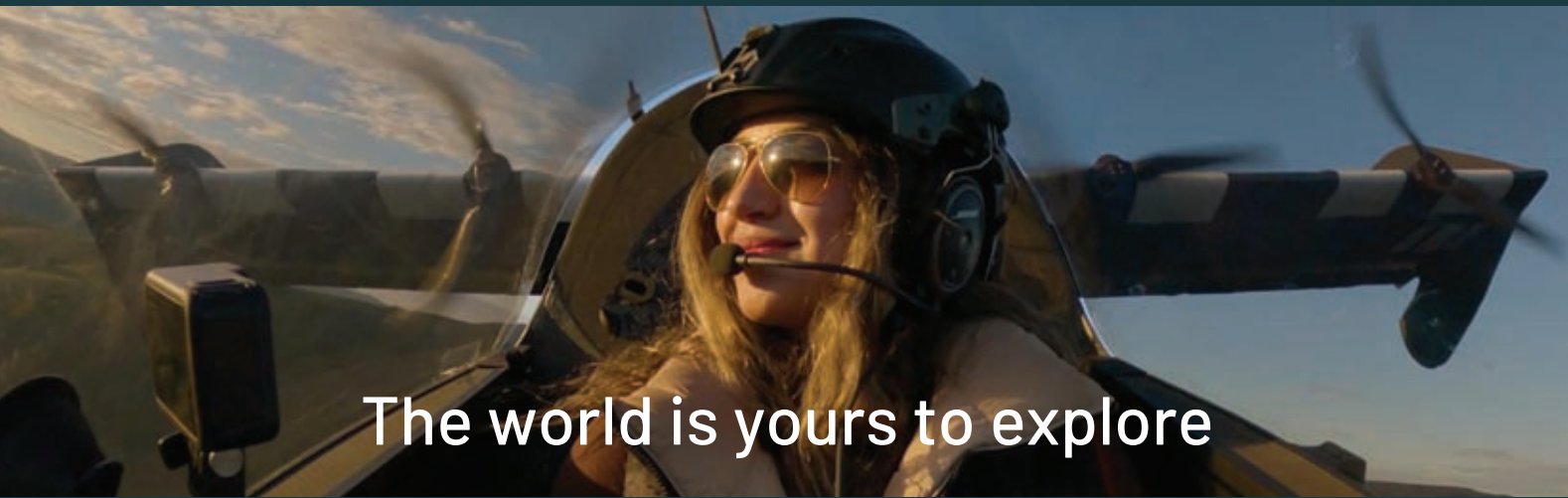


ice shed without protection

未受保护的情况下的冰块脱落情况

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PT6 Replacement

MGM 的电动支线飞机电驱愿景

Since more than a year the Motor is already running on a testbench. And will start certification soon.

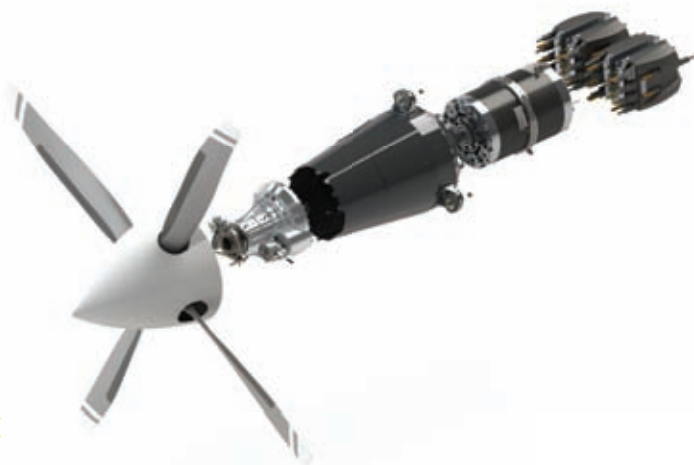
九月，瑞士伯尔尼贝尔莫斯机场的天空：飞行着像这三架 Pipistrel Velis 电动飞机。

MGMs Vision for electrifying Commuter aircraft and more

The Pratt & Whitney propeller turbine is probably the most widely used aircraft propulsion unit in the world. The Czech e-motor pioneer MGM Compro developed a 400 kW e-motor in an EU-funded program, which not only fits perfectly into the cowling of the original, but can also drive similar propellers. MGM developed the complete set of motor, controller and inverter. ✓

普惠螺旋桨涡轮机可能是世界上使用最广泛的飞机推进装置。捷克航空电动摩托先驱 MGM Compro 在欧盟资助的项目中开发了一款 400 kW e-Motor，它不仅完美适配原机整流罩，还可以驱动类似的螺旋桨。MGM 开发了整套电机、控制器和逆变器。

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The 400 kW electromotor is driven the propeller over a gearbox

许多电动飞机仍在开发中，但 Pipistrel Velis 已经开始销售，并且已经在许多航校中使用。在这次电动航展上人们甚至可以欣赏到多架该机在伯尔尼上空编队飞行。

e-Commuter



Smartflyer 发布

CEO and founder of smartflyer Michael Holz at the roll out (images: Markus A. Jegerlehner)
最漂亮的电动飞机之一是电动的 Silence，它被 Dufour Aerospace 用作测试飞机。

smartflyer Roll out



The fact that the smartflyer comes from Switzerland can also be seen in the promotional material of the company.
从该公司的宣传材料中也可以看出，smartflyer 来自瑞士。

After long years of constant planning, on November 2024, Switzerland had a big e-flight moment. The Swiss company unveiled its first full prototype of the SF1, a 4-seat electric aircraft with a serial hybrid powertrain. Later, with the Range Extender Motor Extender combustion engine, the range should grow up to 800 km. ✓

经过多年的不断规划，2024 年 11 月，瑞士迎来了伟大的电动飞行时刻。这家瑞士公司展示了其首款全尺寸 SF1 原型机，这是一架配备串联混合动力系统的 4 座电动飞机。首次飞行将采用电动方式，之后将使用增程器发动机，航程相应增加到 800 公里。



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e-Commuter

VoltAero 的 Cassio 电动飞机即将首飞

The preview of the new facilities
in Saint Agnant.
九月，瑞士伯尔尼贝尔莫斯机场的
天空：飞行着像这三架 Pipistrel
Velis 电动飞机。



Voltaeros Cassio ramping up for the maiden flight

With the first AERO fly-in “Future meets History” at the end of August in Aalen-Elchingen, the 8th “Electrify In Switzerland” from September 6th to 8th in Bern-Belp and the “Airtec” in Augsburg, there were three electric flight events in German-speaking countries. In addition to flight demonstrations, there were also some interesting news. In Bern, the Swiss Rolf Stuber showed the complete prototype of his Smartflyer SF1 for the first time. The four-seater SF1, made entirely of carbon fiber, stands out for its distinctive traction propeller on the tail unit. In Aalen, the Dornier DS 2C amphibian, electrified by Kasaero and powered by the Hyfly H167 fuel cell system, was on display and is due to takeoff soon. ✓

今夏在欧洲主要有三场电动航空相关的活动，8 月底在阿伦-埃尔欣根举行的首场“未来与历史相遇”AERO航展主办的配套飞行集会、9月6日至8日在瑞士伯尔尼举行的第八届瑞士电动飞行展以及德国奥格斯堡的Airtec论坛。除了飞行表演之外，还有一些有趣的新闻。在伯尔尼，瑞士人 Rolf Stuber 首次展示了他的 Smartflyer SF1 电动飞机的全尺寸原型机。四座 SF1 完全由碳纤维制成，因其垂尾上安装的电机螺旋桨而引人注目。由 Kasaero 公司进行电动改型的道尼尔 DS 2C 飞机在阿伦展出，并将很快投入运营，该机由 Hyfly 公司研制的 H167 燃料电池系统提供动力。



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Jean Boty former CTO of Airbus and founder and CEO of VoltAero with his Cassio 330 at the Paris Airshow 2023

许多电动飞机仍在开发中，但 Pipistrel Velis 已经开始销售，并且已经在许多航校中使用。在这次电动航展上人们甚至可以欣赏到多架该机在伯尔尼上空编队飞行。

Maiden Flight

道尼尔 DS2C H167 电动飞机首次离地

The first flight took place in the beginning of November on the airfield Aalen Elchingen

The first hopp of the electric Dornier DS2C H167

About 100 years ago, Dornier was at the forefront of seaplane development. In 2024, the name again stands for the latest development. The DS 2C took flight as an electric seaplane. The ultralight aircraft (MtoW 650 Kg) was converted to an electric version by the German company Hyfly. It made its maiden flight in mid-November in Germany.

Electrification is only the first step. "As we know that battery capacity is very limited and a seaplane needs a lot of energy, the goal is to fly the aircraft with a hydrogen fuel cell using gaseous compressed hydrogen," said Hyfly CEO Karl Käser. This engine is not only intended to power the DS2 C, but also as a replacement engine for any aircraft with a Rotax 912 or 912 IS. But the Dornier is the first to take off. Since the fuel cell requires a lot of cooling, it is positioned in the motor pylon above the wing in

大约 100 年前，道尼尔（Dornier）公司是水上飞机研发领域的先驱。2024 年，这个名字再次代表了最新研发成果。道尼尔公司的 DS 2C 作为电动飞机首飞。这款欧洲标准的超轻型飞机（最大起飞重量 650 千克）被德国 Hyfly 公司改装为电推进，11 月中旬在德国首飞。



Installation work on the electric drive unit
检查 DS 2C 的电驱



Karl Käser and Peter Stadthaler the founder of Hyfly proudly present the Sustainable Aviation Award from 2023. HyFly 项目的两位创始人 Karl Käser 和 Peter Stadthaler 在 2023 年 AERO 航展上荣获可持续航空奖。

the air stream, while the heavy tank and batteries are positioned in the wide fuselage to have a better center of gravity. The propulsion project H 167 is also supported by German government money and there is already the next aircraft waiting, it is a 2 seat Taifum motorglider. Besides the leading company Kasaero and the airframe partners there are more partners joining forces for this project:

The Hyfly project grew out of a joint feasibility study conducted by Kasaero and PS-HyTech in 2020 to explore the potential and benefits of fuel cell applications for light aircraft. The project received public funding that enabled the two companies to design, develop and integrate the system into a flying demonstrator. The Technical University of Würzburg-Schweinfurt (THWS) joined the team and is conducting laboratory and ground testing of the fuel cell system and propulsion. FlyingAD in Austria is supporting the project in the planning and execution of flight tests and practical evaluation. The power of the propulsion system is 70 kW at 200 rpm with the amrax motor.

The other objectives of the H 167 project are:

- An all-in-one modular propulsion system for aviation
- Delivers 70 kW of power
- 7 kg of hydrogen with five times the endurance of battery electric systems
- 700 bar automotive-grade hydrogen
- Configurable for various aircraft types, including ultralight (LTF-UL), CS-22 (TMG) and LSA.

Initial tests at the University of Stuttgart have been very promising, with a power output of 70 kW at 200 rpm using the Amrax motor driving a Neuform propeller. ✓

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而电气化只是该项目的第一步。“我们知道电池能量密度有限，而水上飞机需要大量能量，所以我们的目标是使用氢燃料电池和气态压缩氢气来飞行”，hyfly 公司负责人 Karl Käser 表示。该机使用的电驱不仅用于驱动 DS2 C，而且可以直接替换每架使用 Rotax 912 或 912 IS 发动机的现有飞机。道尼尔是第一个采用该电驱系统的飞机。由于燃料电池需要大量冷却，因此它被放置在气流中机翼上方的发动机挂架中，而氢气罐和电池则放置在机身中以获得更好的重心位置。H 167 电动飞机项目得到了德国政府资金的支持，下一架飞机已经在计划中，将是一架 2 座 Taifum 动力滑翔机。除了领先的 Kasaero 和机身合作伙伴之外，还有更多的合作伙伴加入了这个项目：HYFLY 项目源于 Kasaero 公司和 PS-HyTech 在 2020 年进行的一项联合可行性研究，旨在探索燃料电池应用对轻型飞机的潜力和好处。该项目获得了财政资助，使两家公司能够设计、开发并将系统集成到验证机中。维尔茨堡 - 施韦因富特技术大学 (THWS) 加入了该团队，并正在对燃料电池系统和动力系统进行实验室和地面测试。奥地利 FlyingAD 负责项目规划和飞行测试以及实际评估。该机使用 amrax 电机，性能为 70 kW，转速为 200 RPM。

H 167 项目的其他目标包括：

- 模块化一体化航空推进系统
- 70 kW 功率
- 7 千克氢气可提供比全电池电驱系统多五倍的续航
- 700 帕压力氢气罐，符合车规
- 可用于各种飞机类型，包括超轻型飞机（欧洲 LTF-UL）、CS-22 (TMG) 和 LSA

斯图加特大学的首次测试非常有希望使用 Amrax 电机驱动 Neuform 螺旋桨，电机功率 70 kW，转速为 200 RPM。



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