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RESEARCH REPORT

# Unsettled Issues Regarding the Certification of Electric Aircraft

Ravi Rajamani, PhD
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# About the Editors

**Dr. Ravi Rajamani** is an independent consultant working on applying model-based and data analytics techniques to aerospace and other complex systems, especially in the areas of controls, prognostics and health management, and all forms of propulsion. He has published six books including *Electric Flight Technology: The Unfolding of a New Future*. In addition, Dr. Rajamani is the author of many book chapters, journal papers, conference proceedings, and patents. Prior to his current job, he worked at Meggitt, United Technologies Corporation, and General Electric. He has a PhD from the University of Minnesota; an MBA from the University of Connecticut; an MSc from the India Institute of Science, Bangalore; and a BTech from India Institute of Technology, Delhi. He is active within various SAE technical committees and serves as the chair of the Integrated Vehicle Health Management Steering Group. He currently serves as the Editor in Chief of the *SAE International Journal of Aerospace* and is part of the editorial board of two other journals. He has visiting research positions at the University of Connecticut and at Cranfield University.

**Anna Mracek Dietrich** is a leader in the urban air mobility and electric vertical takeoff and landing (eVTOL) industries with a focus on policy, regulatory affairs, government relations, and industry consensus standards. Working with private and public clients, she is at the forefront of laying the groundwork for a transportation future that is safe, reliable, and acceptable to communities and regulators alike. With experience as the founding Chief Operating Officer at Terrafugia, Anna brings a broad range of skills and an entrepreneurial spirit to whatever she does.

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# Unsettled Issues Regarding the Certification of Electric Aircraft


## Abstract

The aerospace industry has begun to grapple with the reality of certifying electric aircraft (EA), signaling the maturing of the field. Many industry players are ramping up their activities to respond to imminent technical, safety, and regulatory challenges. In the forefront, manufacturers are working on new designs and innovative propulsion architectures for conventional and novel aircraft. While there are gaps in the understanding of the requirements as well as the processes for certification of these aircraft, some leading standards development organizations (SDOs) such as SAE International, ASTM International, and RTCA are stepping in to address many of these issues—ably supported by representatives from regulatory agencies. These SDOs have representatives from aircraft and engine manufacturers, operators, and major suppliers. Even with active help from these experts, the dust has not yet settled on all the rules and regulations that will guide the applicants in their quest for type certification. We believe this report is coming at an appropriate juncture in time to discuss the certification challenges faced by EA manufacturers in both the small (normal) and large (transport) categories. It will not cover autonomous vehicles, even though there is a tendency to conflate electric propulsion with autonomy. Autonomous flight is a rich topic that can best be served with a report dedicated to that topic alone.

The recommendations coming out of this document address technical, business, and process issues related to the certification of EA. Of special importance are the new rule changes in the normal category (Title 14 Code of Federal Regulations [14 CFR] Part 23, Amendment 64) that shift from a prescriptive philosophy to what is known as performance-based rules (PBRs); we will discuss how they affect the EA sector. In recent times, there has been a trend in the aviation sector of using electrical energy to power systems that have long used mechanical means such as hydraulics. But in EA, these components will be employed at criticality levels not previously witnessed in conventional aircraft. These components include motors, battery systems, actuators, auxiliary power units (APUs), and generators, among others. This report discusses many of the open issues with respect to certification of components and systems with the hope that the various stakeholders involved in this endeavor take note as they continue to move forward. We believe that with the first light-sport category EA certified in Europe in the summer of 2020, this is the right time to discuss some of the open issues regarding certification at all levels. The pace is only going to accelerate as other applicants present their various designs to the regulators and seek type certificates.

NOTE: SAE EDGE™ Research Reports are intended to identify and illuminate key issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE™ Research Reports is to stimulate discussion and work in the hope of promoting and speeding resolution of identified issues. These reports are not intended to resolve the challenges they identify or close any topic to further scrutiny.



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