

## Electric Flight – Potential and Limitations

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### ABSTRACT

*During the last years, the development of electric propulsion systems is pushed strongly, most notably for automotive applications. For ground based transportation, the system mass is relevant, but of relatively low importance. This paper addresses the application of electric propulsion systems in aeronautics, where all systems are much more constrained by their mass. After comparing different propulsion system architectures the focus is cast on the energy storage problem and here especially on battery storage systems. Using first order principles the limitations and required technology developments are demonstrated by introducing battery powered electric propulsion systems to small and medium sized aircraft.*

### Abbreviations and Symbols

$b$  = wing span [m]

$C$  = capacity [Wh]

$D$  = drag force [N]

$E'$  = mass specific energy content [Wh/kg]

$f_e$  = empty mass fraction  $m_e / m$

$g$  = gravity acceleration [ $m/s^2$ ]

$L$  = lift force [N]

$m$  = mass [kg]

$m_{initial}$  = initial mass at takeoff [kg]

$m_e$  = empty mass without fuel and payload [kg]

$m_{final}$  = final mass at landing [kg]

$m_{battery}$  = battery mass [kg]

$m_{payload}$  = payload mass [kg]

$m_{pass}$  = mass per passenger [kg]

PAX = number of passengers

$P$  = power [W]

$P_{battery}$  = electric power provided by battery [W]

$R$  = range [m]

$t$  = time [s]

$T$  = thrust [N]

$V'$  = volume specific energy content [Wh/ $m^3$ ]

$v_\infty$  = flight speed [m/s]

$\eta$  = efficiency

$\rho_\infty$  = density of air [ $kg/m^3$ ]

# Electric Flight Potential And Limitations

**AW Rasmussen**



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**Electrified Aircraft Propulsion** Kiruba Haran,Nateri Madavan,Tim C. O'Connell,2022-05-26 What are the benefits of electrified propulsion for large aircraft What technology advancements are required to realize these benefits How can the aerospace industry transition from today s technologies to state of the art electrified systems Learn the answers with this multidisciplinary text combining expertise from leading researchers in electrified aircraft propulsion The book includes broad coverage of electrification technologies spanning power systems and power electronics materials science superconductivity and cryogenics thermal management battery chemistry system design and system optimization and a clear cut road map identifying remaining gaps between the current state of the art and future performance technologies Providing expert guidance on areas for future research and investment and an ideal introduction to cutting edge advances and outstanding challenges in large electric aircraft design this is a perfect resource for graduate students researchers electrical and aeronautical engineers policymakers and management professionals interested in next generation commercial flight technologies

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## **Table of Contents Electric Flight Potential And Limitations**

1. Understanding the eBook Electric Flight Potential And Limitations
  - The Rise of Digital Reading Electric Flight Potential And Limitations
  - Advantages of eBooks Over Traditional Books
2. Identifying Electric Flight Potential And Limitations
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Electric Flight Potential And Limitations
  - User-Friendly Interface
4. Exploring eBook Recommendations from Electric Flight Potential And Limitations
  - Personalized Recommendations
  - Electric Flight Potential And Limitations User Reviews and Ratings
  - Electric Flight Potential And Limitations and Bestseller Lists

5. Accessing Electric Flight Potential And Limitations Free and Paid eBooks
  - Electric Flight Potential And Limitations Public Domain eBooks
  - Electric Flight Potential And Limitations eBook Subscription Services
  - Electric Flight Potential And Limitations Budget-Friendly Options
6. Navigating Electric Flight Potential And Limitations eBook Formats
  - ePub, PDF, MOBI, and More
  - Electric Flight Potential And Limitations Compatibility with Devices
  - Electric Flight Potential And Limitations Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Electric Flight Potential And Limitations
  - Highlighting and Note-Taking Electric Flight Potential And Limitations
  - Interactive Elements Electric Flight Potential And Limitations
8. Staying Engaged with Electric Flight Potential And Limitations
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Electric Flight Potential And Limitations
9. Balancing eBooks and Physical Books Electric Flight Potential And Limitations
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Electric Flight Potential And Limitations
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Electric Flight Potential And Limitations
  - Setting Reading Goals Electric Flight Potential And Limitations
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Electric Flight Potential And Limitations
  - Fact-Checking eBook Content of Electric Flight Potential And Limitations
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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