

On the Efficiency of Automotive H₂/O₂ PE Fuel Cell Systems

**Felix N. Büchi¹, Mathias Reum¹ Stefan A. Freunberger¹
and Antonio Delfino²**

¹Electrochemistry Laboratory, Paul Scherrer Institut
CH-5232 Villigen PSI / Switzerland

²Conception et Développement Michelin
Route André-Piller 30
CH-1762 Givisiez / Switzerland

Abstract

Efficiency is the key argument for the application of polymer electrolyte fuel cells in automotive applications. Efficiency of the fuel cell system depends on a number of interdependent parameters. These are on the one hand the properties of the electrochemical components as well as the chosen operating conditions. On the other hand efficiency of the complete system also strongly depends on the characteristics of the balance of plant components (BoP).

The use of pure oxygen reduces the ORR over-voltage, as the oxygen partial pressure can easily be increased from typically 0.4 bar by an order of magnitude. Membrane conductivity is easier maximized with the reduced volume flow at the cathode and higher possible gas pressures. The use of pure oxygen also eliminates the need for an air compressor, the main parasitic power consumer in the BoP.

In conventional automotive systems, typically 15 – 20% of the stack power is lost for the operation of the BoP, the main power consumer being the air compressor. Typical tank to electric power efficiencies are in the order of 45%. The use of pure oxygen as the oxidant increases on the one hand the cell efficiency at the same current density and requires greatly reduced BoP parasitic power. At similar operation points, therefore the tank to electric power efficiency increases by about 20%.

Introduction

It seems probable, that future production of hydrogen will go through routes of water splitting either by electrolysis or thermochemical pathways. Pure oxygen will be a byproduct of those hydrogen generation processes. This opens up the possibility to use pure oxygen instead of air for the conversion of hydrogen to electricity in fuel cells. This paper investigates the use of pure oxygen on the overall fuel cell system efficiency for the automotive application as compared to air, including the energetic cost for the production of oxygen.

Solution Manual For Fuel Cell Engines

Daniel F McAuley



Solution Manual For Fuel Cell Engines:

Engine and Transmission Oils, Fuels, and Additives for Army Aircraft, 1992 *Solutions Manual for Principles of Physical Chemistry, 3rd Edition, Solutions Manual* Hans Kuhn, David H. Waldeck, Horst-Dieter Försterling, 2024-10-25 This is a Solutions Manual to Accompany with solutions to the exercises in the main volume of Principles of Physical Chemistry Third Edition This book provides a unique approach to introduce undergraduate students to the concepts and methods of physical chemistry which are the foundational principles of Chemistry The book introduces the student to the principles underlying the essential sub fields of quantum mechanics atomic and molecular structure atomic and molecular spectroscopy statistical thermodynamics classical thermodynamics solutions and equilibria electrochemistry kinetics and reaction dynamics macromolecules and organized molecular assemblies Importantly the book develops and applies these principles to supramolecular assemblies and supramolecular machines with many examples from biology and nanoscience In this way the book helps the student to see the frontier of modern physical chemistry developments The book begins with a discussion of wave particle duality and proceeds systematically to more complex chemical systems in order to relate the story of physical chemistry in an intellectually coherent manner The topics are organized to correspond with those typically given in each of a two course semester sequence The first 13 chapters present quantum mechanics and spectroscopy to describe and predict the structure of matter atoms molecules and solids Chapters 14 to 29 present statistical thermodynamics and kinetics and applies their principles to understanding equilibria chemical transformations macromolecular properties and supramolecular machines Each chapter of the book begins with a simplified view of a topic and evolves to more rigorous description in order to provide the student and instructor flexibility to choose the level of rigor and detail that suits them best The textbook treats important new directions in physical chemistry research including chapters on macromolecules principles of interfaces and films for organizing matter and supramolecular machines as well as including discussions of modern nanoscience spectroscopy and reaction dynamics throughout the text **Direct and General Support Maintenance Manual**, 1977 The Hydrogen Energy Economy United States. Congress. House. Committee on Energy and Commerce. Subcommittee on Energy and Air Quality, 2003 **Airships** Iver P. Cooper, 2025-05-15 Many people may know about the blazing crash of the Hindenburg in 1937 but are possibly unaware that it had made 62 flights before its final journey including one transporting author Leslie Charteris creator of The Saint The disaster however did not end the airship era blimps escorted convoys during World War II and were a part of air defense systems in the 1950s and 1960s Airships still fly today and new models are in the construction phase This book examines this branch of aviation history delving into the science and engineering of airships and their design flaws weather difficulties and operational errors The chapters focus on function lift propulsion materials ground handling and so forth The book concludes with speculations about future airship designs and missions **Approach**, 1959 The naval aviation safety review **The Electric Vehicle**

Conversion Handbook HP1568 Mark Warner,2011-06-07 A guide on how to convert any gas or diesel powered vehicle to electric power Includes ownership advantages basic EV operation subsystems components basic EV operation project vehicles and conversion kits Phraseological Dictionary English - German Roland Kraus,Peter Baumgartner,2011-10-14 The dictionary lists the general vocabulary nouns verbs adverbs adjectives which occurs in practically all technical texts This vocabulary should be mastered by all those who actively or passively work with technical texts since it provides the structures into which the technical terms of various fields of technology are embedded The keywords are provided with numerous model sentences illustrating their usage and offering the user a variety of suggestions for his her own formulations

Department of Defense Authorization for Appropriations for Fiscal Year 1982 United States. Congress. Senate. Committee on Armed Services,1981 About Sustaining Supply Technology for Manned Spacecraft Christian Zschoch,2020-02-19 At the present time space travel is characterized by separately developed technologies of the space traveling nations Depending on fixed financial budgets and expensive technology companies the developed spaceships are strongly designed just for a specific mission profile in order to reduce costs and risks as far as possible Because of their less sustainable supply concept these spacecraft allow only a limited mission duration and require regular supply deliveries in addition On the other hand side mission periods continue to lengthen with the planned exploration of Mars asteroids or other objects that are even more distant These missions will require high sustainable supply concepts in order to enable autonomous and long term life support of human mission participants The now existing solutions do not yet meet these requirements so the current approach of spacecraft design had to undergo a conceptual review The research made in the context of this work led to the design of a new generation of spacecraft which supports with its optimized hull construction such extended long term missions in terms of durability variability and life support All its embedded biological and chemical processes have on the one hand the primary aim to enable humans a long stay in space and on the other hand to be independent of an external mission supply The performed research activities also included the necessary mechanical and energetical functions for which an extreme lifetime extension of up to 60 years was aimed **Storck Guide**

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Table of Contents Solution Manual For Fuel Cell Engines

1. Understanding the eBook Solution Manual For Fuel Cell Engines
 - The Rise of Digital Reading Solution Manual For Fuel Cell Engines
 - Advantages of eBooks Over Traditional Books
2. Identifying Solution Manual For Fuel Cell Engines
 - 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 Solution Manual For Fuel Cell Engines
 - User-Friendly Interface
4. Exploring eBook Recommendations from Solution Manual For Fuel Cell Engines
 - Personalized Recommendations

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

- 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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