Liquid Rocket Propellants Past And Present Influences And

Liquid propellant rocket engines have propelled all the manned space flights, all the space vehicles flying to the planets or deep space, virtually all satellites, and the majority of medium range or intercontinental range ballistic missiles.

Equips students with an up-to-date practical knowledge of rocket propulsion, numerous homework problems, and online self-study materials.

This book, a translation of the French title Technologie des Propergols Solides, offers otherwise unavailable information on the subject of solid propellants and their use in rocket propulsion. The fundamentals of rocket propulsion are developed in chapter one and detailed descriptions of concepts are covered in the following chapters. Specific design methods and the theoretical physics underlying them are presented, and finally the industrial production of the propellant itself is explained. The material used in the book has been collected from different countries, as the development of this field has occurred separately due to the classified nature of the subject. Thus the reader not only has an overall picture of solid rocket propulsion technology but a comprehensive view of its different developmental permutations worldwide.

The Centaur Upper Stage Rocket, 1958-2002

The Conversion of Liquid Rocket Fuels, Risk Assessment, Technology and Treatment Options for the Conversion of Abandoned Liquid Ballistic Missile Propellants (Fuels and Oxidizers) in Azerbaijan

An Introduction to the Engineering of Rockets

History of Liquid Propellant Rocket Engines

Liquid Rocket and Propellants

Rocketdyne

Liquid Rocket and Propellants

Rocket Propulsion has come of age. Although its potentialities and capabilities in many areas have been recognized for centuries, it is only in recent years that scientists have had the materials and the manufacturing techniques at their command so they could control and direct the tremendous forces available. Space exploration and manned flights by astronauts have brought the science of rocketry to the attention of the general public. It has also stimulated the interest of students at all level

Widely known and used throughout the astrodynamics and aerospace engineering communities, this teaching text was developed at the U.S. Air Force Academy. Completely revised and updated 2013 edition.

History of Liquid Rocket Engine Development in the United States, 1955-1980

Fundamentals of Astrodynamics

Solid Rocket Propulsion Technology

Investigation of Liquid Rocket Propellants

Rocket Propulsion Elements

Liquid Rocket Engine Combustion Instability

Hitherto the disposal of munitions was mostly concerned with obsolete stocks, but the political developments in the states of the former Soviet Union have necessitated the disposal of vast quantities of current and obsolete stocks. Obviously, open burning/open detonation cannot be used on such a large scale, not least for environmental considerations. There are two main technical problems associated with the disposal of munitions on the scale required. First, the materials are not simple wastes or rubbish. Their handling, storage, packaging and transportation are subject to very rigid regulation, and justifiably so, for obvious reasons. Second, they are very valuable goods, for which a high price has been paid by the holding states' economic systems. Mere destruction would mean the irretrievable loss of the value invested. But therein lies the problem. Goods like steel or brass scrap can easily be reclaimed, but hypergols and other rocket fuels (for instance) represent a true chemical challenge, while, under certain conditions, explosives may be diverted to civilian use. This, in summary, is the problem that the present book deals with: the two-pronged attack involving demilitarization and recycling technologies.

The book follows a unified approach to present the basic principles of rocket propulsion in concise and lucid form. This textbook comprises of ten chapters ranging from brief introduction and elements of rocket propulsion, aerothermodynamics to solid, liquid and hybrid propellant rocket engines with chapter on electrical propulsion. Worked out examples are also provided at the end of chapter for understanding uncertainty analysis. This book is designed and developed as an introductory text on the fundamental aspects of rocket propulsion for both undergraduate and graduate students. It is also aimed towards practicing engineers in the field of space engineering. This comprehensive guide also provides adequate problems for audience to understand intricate aspects of rocket propulsion enabling them to design and develop rocket engines for peaceful purposes.

Annotation Since the invention of the V-2 rocket during World War II, combustion instabilities have been recognized as one of the most difficult problems in the development of liquid propellant rocket engines. This book is the first published in the United States on the subject since NASA's Liquid Rocket Combustion Instability (NASA SP-194) in 1972. In this book, experts cover four major subject areas: engine phenomenology and case studies, fundamental mechanisms of combustion instability, combustion instability analysis, and engine and component testing. Especially noteworthy is the inclusion of technical information from Russia and China--a first.

Rocket Propellants

Rocket Propellant Technology

Powering Humans Into Space

Fundamentals of Rocket Propulsion

The Chemistry and Technology of Solid Rocket Propellants (A Treatise on Solid Propellants)

Progress in Astronautics and Aeronautics

This book concentrates on modeling and numerical simulations of combustion in liquid rocket engines, covering liquid propellant atomization, evaporation of liquid droplets, turbulent flows, turbulent combustion, heat transfer, and combustion instability. It presents some state of the art models and numerical methodologies in this area. The book can be categorized into two parts. Part 1 describes the modeling for each subtopic of the combustion process in the liquid rocket engines. Part 2 presents detailed numerical methodology and several representative applications in simulations of rocket engine combustion.

This is a new release of the original 1960 edition.

This is a textbook about rocket engineering, concentrating on the nitrous oxide hybrid rocket engine, both small and large. It's also a book about the science of chemical rockets in detail: three of the chapters are full of in-depth rocket science describing how all chemical rockets work. After a first chapter brushing up on the science and maths you'll need, the book describes the choice and safe use of hybrid rocket propellants, and how they're handled in practice. Then there are the rocket science chapters. Then you learn how to design, construct, and operate, a large hybrid rocket engine capable of getting you into Space. The book also includes a practical guide to the testing of hybrid rocket engines large and small, and how to fly them safely. Included are full instructions for programming a rocket trajectory simulator in Microsoft Excel, and several appendices containing rocketry information and equations, and instructions on how to design a bell nozzle.

A History of European Liquid-propellant Rocket Engines for Aircraft

The Science and Design of the Hybrid Rocket Engine

Rocket and Spacecraft Propulsion

Modeling and Numerical Simulations

Liquid Rocket Propellants

Property Requirements for Liquid Rocket Propellants

This is the first major publication on liquid-rocket combustion devices since 1960, and includes 20 chapters prepared by world-renowned experts. Each chapter focuses on a specific aspect of liquid-propellant combustion and thrust chamber dynamics, and is incorporated into the volume in a well-organized, cohesive manner. There are contributions from nine different countriesChina, France, Germany, Italy, Japan, the Netherlands, Russia, Sweden, and the United States.

Rocket and air-breathing propulsion systems are the foundation on which planning for future aerospace systems rests. A Review of United States Air Force and Department of Defense Aerospace Propulsion Needs assesses the existing technical base in these areas and examines the future Air Force capabilities the base will be expected to support. This report also defines gaps and recommends where future warfighter capabilities not yet fully defined could be met by current science and technology development plans.

This is the first book in the literature to cover the development and testing practices for liquid rocket engines in Russia and the former Soviet Union.Combustion instability represents one of the most challenging probelms in the development of propulsion engines. A famous example is the F-1 engines for the first stage of the Saturn V launch vehicles in the Apollo project. More than 2000 full engine tests and a vast number of design modifications were conducted to cure the instability problem.This book contains first-hand information about the testing and development practices for treating liquid rocket combustion-instability problems in Russia and the former Soviet Union. It covers more than 50 years of research, with an emphasis placed on the advances made since 1970.The book was prepared by a former R&D director of the Research Institute of Chemical Engineering, NIICHIMMASH, the largest liquid rocket testing center in the world, and has been carefully edited by three well-known experts in the field.

An American Institute of Aeronautics and Astronautics Series

Principles, Practice and New Developments

Demilitarisation of Munitions

Solid Rocket Propellants

Liquid Propulsion: Historical Overview, Fundamentals and Classifications of Liquid Rocket Engines

Science and Technology Challenges

For the early history of rocketry up through the work of Dr. Robert Goddard in the early 1940s, the author referenced the history books of T.A. Heppenheimer and Frank Winter. The rest of the book is a chronicle of both the author's own memories and experiences as a member of the Rocketdyne team, as well as those of other keys members of this elite group.

The revised edition of this practical, hands-on book discusses the launch vehicles in use today throughout the world, and includes the latest details on advanced systems being developed, such as electric and nuclear propulsion. The author covers the fundamentals, from the basic principles of rocket propulsion and vehicle dynamics through the theory and practice of liquid and solid propellant motors, to new and future developments. He provides a serious exposition of the principles and practice of rocket propulsion, from the point of view of the user who is not an engineering specialist.

Ignition!An Informal History of Liquid Rocket PropellantsRutgers University Press

A Comprehensive Survey of Energetic Materials

Ignition

An Informal History of Liquid Rocket Propellants

Liquid Rocket Thrust Chambers

Testing and Development Practices in Russia

Liquid Rocket Valve Components

Developed and expanded from the work presented at the New Energetic Materials and Propulsion Techniques for Space Exploration workshop in June 2014, this book contains new scientific results, up-to-date reviews, and inspiring perspectives in a number of areas related to the energetic aspects of chemical rocket propulsion. This collection covers the entire life of energetic materials from their conceptual formulation to practical manufacturing; it includes coverage of theoretical and experimental ballistics, performance properties, as well as laboratory-scale and full system-scale, handling, hazards, environment, ageing, and disposal. Chemical Rocket Propulsion is a unique work, where a selection of accomplished experts from the pioneering era of space propulsion and current technologists from the most advanced international laboratories discuss the future of chemical rocket propulsion for access to, and exploration of, space. It will be of interest to both postgraduate and final-year undergraduate students in aerospace engineering, and practicing aeronautical engineers and designers, especially those with an interest in propulsion, as well as researchers in energetic materials.

This newly reissued debut book in the Rutgers University Press Classics Imprint is the story of the search for a rocket propellant which could be trusted to take man into space. This search was a hazardous enterprise carried out by rival labs who worked against the known laws of nature, with no guarantee of success or safety. Acclaimed scientist and sci-fi author John Drury Clark writes with irreverent and eyewitness immediacy about the development of the explosive fuels strong enough to negate the relentless restraints of gravity. The resulting volume is as much a memoir as a work of history, sharing a behind-the-scenes view of an enterprise which eventually took men to the moon, missiles to the planets, and satellites to outer space. A classic work in the history of science, and described as "a good book on rocket stuff···that's a really fun one" by SpaceX founder Elon Musk, readers will want to get their hands on this influential classic, available for the first time in decades.

A modern pedagogical treatment of the latest industry trends in rocket propulsion, developed from the authors' extensive experience in both industry and academia. Students are guided along a step-by-step journey through modern rocket propulsion, beginning with the historical context and an introduction to top-level performance measures, and progressing on to in-depth discussions of the chemical aspects of fluid flow combustion thermochemistry and chemical equilibrium, solid, liquid, and hybrid rocket propellants, mission requirements, and an overview of electric propulsion. With a wealth of homework problems (and a solutions manual for instructors online), real-life case studies and examples throughout, and an appendix detailing key numerical methods and links to additional online resources, this is a must-have guide for senior and first year graduate students looking to gain a thorough understanding of the topic along with practical tools that can be applied in industry.

Liquid Fuel Rocket Research

Rocket Propulsion

Rocket Development

Chemical Rocket Propulsion

Ignition!

Prof. Dr. -Ing. Wolfgang Spyra Brandenburg University of Technology in Cottbus, Germany The demilitarization and conversion of military properties wor- wide has been a topic of growing importance since the end of the Cold War. The slowing of the arms race brought on by weapons treaties and relaxed tensions between NATO and Warsaw Pact nations caused sto- piles of conventional weapons to become superfluous. The need to process and dispose of such weapons began more quickly in NATO countries. This demilitarization process began shortly after the reunification of Germany and was largely completed by the mid to late 1990's. The remaining process, no small task in itself, of converting lands formerly used by the military into safe and environmentally acceptable landscapes may continue for decades to come. Due to a lack of resources and technology, the process of demilitarization in the former Warsaw Pact countries has launched more slowly. In 2002 both Georgia and Moldova finished projects which destroyed their stocks of liquid ballistic missile components. Both these projects were carried out through the cooperative support of trans-national organizations, private contractors, and research institutions. The Republic of Azerbaijan now finds itself at the beginning of its demilitarization process. Stored at the country's military depots are over 2000 tons of missile fuels, oxidizer, and chemical additives. This hazardous waste is kept in tanks intended only for temporary transport and storage.

This book is intended for students and engineers who design and develop liquid-propellant rocket engines, offering them a guide to the theory and practice alike. It first presents the fundamental concepts (the generation of thrust, the gas flow through the combustion chamber and the nozzle, the liquid propellants used, and the combustion process) and then qualitatively and quantitatively describes the principal components involved (the combustion chamber, nozzle, feed systems, control systems, valves, propellant tanks, and interconnecting elements). The book includes extensive data on existing engines, typical values for design parameters, and worked-out examples of how the concepts discussed can be applied, helping readers integrate them in their own work. Detailed bibliographical references (including books, articles, and items from the "gray literature") are provided at the end of each chapter, together with information on valuable resources that can be found online. Given its scope, the book will be of particular interest to undergraduate and graduate students of aerospace engineering.

The book is a treatise on solid propellants in nine chapters, covering the history, chemistry, energetics, processing and characterization aspects of composite solid propellants, internal ballistics, advanced solid propellants, safety, quality and reliability and homogenous or double base propellants. The book also traces the evolution of

solid propellant technology in ISRO for launch vehicles and sounding rockets. There is a detailed table of contents, expanded index, glossary, exhaustive references and questions in each chapter. It can be used as a textbook for science and engineering students, as a reference book for researchers and as a companion to scientists and engineers working in the research, development and production areas of solid propellants.

Modern Engineering for Design of Liquid-Propellant Rocket Engines

Aspects of Modeling, Analysis, and Design

Combustion Instabilities in Liquid Rocket Engines

Taming Liquid Hydrogen

Reuse and Recycling Concepts for Conventional Munitions and Rocket Propellants

Liquid Rocket Propulsion History Colloquium, AAS Annual Meeting, Los Angeles, 1989 : Proceedings of an AAS History Colloquium

Over the course of the history of today's rockets, liquid rocket engines have been used as primary propulsion for most space launch vehicles and early ballistic missiles. The basic idea of modern liquid rocket propulsion was first published in 1903. In the early 1900s, various design concepts were introduced, built and tested to explore the feasibility of liquid propulsion technology. The first successful flight with a liquid-propellant sounding rocket was made in 1926. A large engine development effort started in the 1930s as part of the world's first ballistic missile program with its first deployment in 1944. Subsequently, several major engine efforts were undertaken for longer range ballistic missiles, enabling intercontinental ballistic missile (ICBM) capability in 1957. Space launch vehicles evolved immediately from ICBMs and opened the door to space in 1957 and finally to the moon in 1969. Since then, various classes of operational liquid rocket engines have been designed, developed and flown with a continued increase in confidence. In general, liquid rocket engines enable a wide range of space lift capabilities from small to large payloads. Many satellites, spacecrafts and upper stages also use smaller liquid rocket engines, typically called thrusters, for orbit maneuvering or reaction control. Today, continued improvements in performance, reliability, operability and cost are sought through various research and development efforts.

Propellants contain considerable chemical energy that can be used in rocket propulsion. Bringing together information on both the theoretical and practical aspects of solid rocket propellants for the first time, this book will find a unique place on the readers' shelf providing the overall picture of solid rocket propulsion technology. Aimed at students, engineers and researchers in the area, the authors have applied their wealth of knowledge regarding formulation, processing and evaluation to provide an up to date and clear text on the subject.

THE DEFINITIVE INTRODUCTION TO ROCKET PROPULSION THEORY AND APPLICATIONS The recent upsurge in global government and private spending and in space flight events has resulted in many novel applications of rocket propulsion technology. Rocket Propulsion Elements remains the definitive guide to the field, providing a comprehensive introduction to essential concepts and applications. Led by industry veteran George P. Sutton and by Professor Oscar Biblarz, this book provides interdisciplinary coverage including thermodynamics, aerodynamics, flight performance, propellant chemistry and more. This thoroughly revised ninth edition includes discussion and analysis of recent advances in the field, representing an authoritative reference for students and working engineers alike. In any engineering field, theory is only as useful as it is practical; this book emphasizes relevant real-world applications of fundamental concepts to link "thinking" and "doing". This book will help readers: Understand the physics of flight and the chemistry of propulsion Analyze liquid, solid, gas, and hybrid propellants, and the engines they fuel Consider high-temperature combustion, stability, and the principles of electric and chemical propulsion Dissect the workings of systems in common use around the world today Delve into the latest advances in materials, systems, propellants, and more Broad in scope, rich in detail, and clear in explanation, this seminal work provides an unparalleled foundation in aerospace engineering topics. Learning through the lens of modern applications untangles complex topics and helps students fully grasp the intricacies on a more intuitive level. Rocket Propulsion Elements, Ninth Edition merges information and utility building a solid foundation for innovation.

Internal Combustion Processes of Liquid Rocket Engines

A Review of United States Air Force and Department of Defense Aerospace Propulsion Needs

Fundamental Concepts of Liquid-Propellant Rocket Engines