

**Taming Liquid Hydrogen:**  
**The**  
**Centaur**  
**Upper Stage Rocket**  
**1958–2002**



**Virginia P. Dawson and Mark D. Bowles**

# Taming Liquid Hydrogen The Centaur Upper Stage Rocket 1958

**RC Schank**



## **Taming Liquid Hydrogen The Centaur Upper Stage Rocket 1958 :**

*Taming Liquid Hydrogen* Virginia Parker Dawson,2004      *Taming Liquid Hydrogen: The Centaur Upper Stage Rocket 1958-2002* ,2004      **Taming Liquid Hydrogen** National Aeronautics Administration,Virginia Dawson,Mark Bowles,2013-10

During its maiden voyage in May 1962 a Centaur upper stage rocket mated to an Atlas booster exploded 54 seconds after launch engulfing the rocket in a huge fireball Investigation revealed that Centaur's light stainless steel tank had split open spilling its liquid hydrogen fuel down its sides where the flame of the rocket exhaust immediately ignited it Coming less than a year after President Kennedy had made landing human beings on the Moon a national priority the loss of Centaur was regarded as a serious setback for the National Aeronautics and Space Administration NASA During the failure investigation Homer Newell Director of Space Sciences ruefully declared Taming liquid hydrogen to the point where expensive operational space missions can be committed to it has turned out to be more difficult than anyone supposed at the outset After this failure Centaur critics led by Wernher von Braun mounted a campaign to cancel the program In addition to the unknowns associated with liquid hydrogen he objected to the unusual design of Centaur Like the Atlas rocket Centaur depended on pressure to keep its paper thin stainless steel shell from collapsing It was literally inflated with its propellants like a football or balloon and needed no internal structure to give it added strength and stability The so called pressure stabilized structure of Centaur coupled with the light weight of its high energy cryogenic propellants made Centaur lighter and more powerful than upper stages that used conventional fuel But the critics argued it would never become the reliable rocket that the United States needed Others especially military proponents of Centaur believed that accepting the challenge of developing liquid hydrogen technology was an important risk to take Despite criticism and early technical failures the taming of liquid hydrogen proved to be one of NASA's most significant technical accomplishments Centaur not only succeeded in demonstrating the feasibility of liquid hydrogen as a rocket fuel but it also went on to a brilliant career as an upper stage for a series of spectacular planetary missions in the 1970s Ironically this success did little to ensure the future of the Centaur rocket Once the Shuttle became operational in the early 1980s all expendable launch vehicles like Centaur were slated for termination Centaur advocates fought to keep the program alive      *Taming Liquid Hydrogen* Virginia Parker Dawson,2004

**NASA 50th Anniversary Proceedings: NASA's First 50 Years: Historical Perspectives** Steven J. Dick,National Aeronautics and Space Administration,2010-07-07 On 29 July 1958 President Dwight D Eisenhower signed the National Aeronautics and Space Act creating the National Aeronautics and Space Administration NASA which became operational on 1 October of that year Over the next 50 years NASA achieved a set of spectacular feats ranging from advancing the well established field of aeronautics to pioneering the new fields of Earth and space science and human spaceflight In the midst of the geopolitical context of the Cold War 12 Americans walked on the Moon arriving in peace for all mankind Humans saw their home planet from a new perspective with unforgettable Apollo images of Earthrise and the Blue Marble as well as the

pale blue dot from the edge of the solar system A flotilla of spacecraft has studied Earth while other spacecraft have probed the depths of the solar system and the universe beyond In the 1980s the evolution of aeronautics gave us the first winged human spacecraft the Space Shuttle and the International Space Station stands as a symbol of human cooperation in space as well as a possible way station to the stars With the Apollo fire and two Space Shuttle accidents NASA has also seen the depths of tragedy In this volume a wide array of scholars turn a critical eye toward NASA s first 50 years probing an institution widely seen as the premier agency for exploration in the world carrying on a long tradition of exploration by the United States and the human species in general Fifty years after its founding NASA finds itself at a crossroads that historical perspectives can only help to illuminate

**NASA Historical Data Book: NASA launch systems, space transportation, human spaceflight, and space science, 1989-1998** ,1988 **NASA Historical Data Book: NASA launch systems, space transportation** ,1988 The Development of Propulsion Technology for U.S. Space-Launch Vehicles, 1926-1991 J. D.

Hunley,2013-03-15 In this definitive study J D Hunley traces the program s development from Goddard s early rockets and the German V 2 missile through the Titan IVA and the Space Shuttle with a focus on space launch vehicles Since these rockets often evolved from early missiles he pays considerable attention to missile technology not as an end in itself but as a contributor to launch vehicle technology Focusing especially on the engineering culture of the program Hunley communicates this very human side of technological development by means of anecdotes character sketches and case studies of problems faced by rocket engineers He shows how such a highly adaptive approach enabled the evolution of a hugely complicated technology that was impressive but decidedly not rocket science Unique in its single volume coverage of the evolution of launch vehicle technology from 1926 to 1991 this meticulously researched work will inform scholars and engineers interested in the history of technology and innovation as well as those specializing in the history of space flight

*Air & Space Power Journal fall 05* , *Historical Studies in the Societal Impact of Spaceflight* Steven J. Dick,2015

"Read You Loud and Clear!" Sunny Tsiao,2008 From the Dust Jacket Regardless of how sophisticated it may be no spacecraft is of any value unless it can be tracked accurately to determine where it is and how it is performing At the height of the space race 6 000 men and women operated NASA s Spaceflight Tracking and Data Network at some two dozen locations across five continents This network known as the STDN began its operation by tracking Sputnik 1 the world s first artificial satellite that was launched into space by the former Soviet Union Over the next 40 years the network was destined to play a crucial role on every near Earth space mission that NASA flew Whether it was receiving the first television images from space tracking Apollo astronauts to the Moon and back or data acquiring for Earth science the STDN was that intricate network behind the scenes making the missions possible Some called it the Invisible Network a hallmark of which was that no NASA mission has ever been compromised due to a network failure Read You Loud and Clear is a historical account of the STDN starting with its formation in the late 1950s to what it is today in the first decade of the twenty first century It traces

the roots of the tracking network from its beginnings at the White Sands Missile Range in New Mexico to the Tracking and Data Relay Satellite System TDRSS space based constellation of today The story spans the early days of satellite tracking using the Minitrack Network through the expansion of the Satellite Tracking And Data Acquisition Network STADAN and the Manned Space Flight Network MSFN and finally to the Space and Ground Networks of today Written from a nontechnical perspective the author has translated a highly technical subject into historical accounts told within the framework of the U S space program These accounts tell how international goodwill and foreign cooperation were crucial to the operation of the network and why the space agency chose to build the STDN the way it did More than anything else the story of NASA s STDN is about the unsung heroes of the space program **NASA historical data book, Volume 7: NASA Launch**

**Systems Space Transportation/Human Space Flight** ,1988 **NASA Historical Data Book, V. 7** ,1976 This volume of the NASA Historical Data Book is the seventh in the series that describes NASA s programs and projects Covering the years 1989 through 1998 it includes the areas of launch systems human spaceflight and space science continuing the volumes that addressed these topics during NASA s previous decades Each chapter presents information much of it statistical addressing funding management and details of programs and missions **Asteroids** Martin Elvis,2021-05-01 A unique wide ranging

examination of asteroid exploration and our future in space Human travel into space is an enormously expensive and unforgiving endeavor So why go In this accessible and authoritative book astrophysicist Martin Elvis argues that the answer is asteroid exploration for the strong motives of love fear and greed Elvis s personal motivation is one of scientific love asteroid investigations may teach us about the composition of the solar system and the origins of life A more compelling reason may be fear of a dinosaur killer sized asteroid hitting our planet Finally Elvis maintains we should consider greed asteroids likely hold vast riches such as large platinum deposits and mining them could provide both a new industry and a funding source for bolder space exploration Elvis explains how each motive can be satisfied and how they help one another From the origins of life to space billiards and space sports Elvis looks at how asteroids may be used in the not so distant future **Rockets and People: The moon race** Boris Evseevich Chertok,2005 NASA's First A Robert G.

Ferguson,2013 **Machinery and Energy Systems for the Hydrogen Economy** Klaus Brun,Timothy C.

Allison,2022-06-17 Machinery and Energy Systems for the Hydrogen Economy covers all major machinery and heat engine types designs and requirements for the hydrogen economy from production through storage distribution and consumption Topics such as hydrogen in pipeline transport for energy storage and as a power plant fuel are covered in detail Hydrogen machinery applications their selection criteria economics safety aspects and operational limitations in different sectors of the hydrogen economy are also discussed Although the book covers the hydrogen economy as a whole its primary focus is on machinery and heat engine design and implementation within various production transport storage and usage applications An invaluable resource for industry academia and government this book provides engineers scientists and technical leaders

with the knowledge they need to design and build the infrastructure of a hydrogen economy Provides design and application guidelines for hydrogen production transportation storage distribution and usage Addresses all safety issues related to hydrogen machinery and systems Discusses efficiencies costs and operational requirements for the hydrogen economy

The Cassini-Huygens Visit to Saturn Michael Meltzer, 2015-01-02 Cassini Huygens was the most ambitious and successful space journey ever launched to the outer Solar System This book examines all aspects of the journey its conception and planning the lengthy political processes needed to make it a reality the engineering and development required to build the spacecraft its 2 2 billion mile journey from Earth to the Ringed Planet and the amazing discoveries from the mission The author traces how the visions of a few brilliant scientists matured gained popularity and eventually became a reality Innovative technical leaps were necessary to assemble such a multifaceted spacecraft and reliably operate it while it orbited a planet so far from our own The Cassini Huygens spacecraft design evolved from other deep space efforts most notably the Galileo mission to Jupiter enabling the voluminous paradigm shifting scientific data collected by the spacecraft Some of these discoveries are absolute gems A small satellite that scientists once thought of as a dead piece of rock turned out to contain a warm underground sea that could conceivably harbor life And we now know that hiding under the mist of Saturn s largest moon Titan is a world with lakes fluvial channels and dunes hauntingly reminiscent of those on our own planet except that on Titan it s not water that fills those lakes but hydrocarbons These and other breakthroughs illustrate why the Cassini Huygens mission will be remembered as one of greatest voyages of discovery ever made      Rockets and People Boris Evseevich Chertok, 2005 V 1 no special title v 2 Creating a rocket industry v 3 Hot days of the Cold War v 4 The moon race      Rockets and People, Volume III, Hot Days of the Cold War ,

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