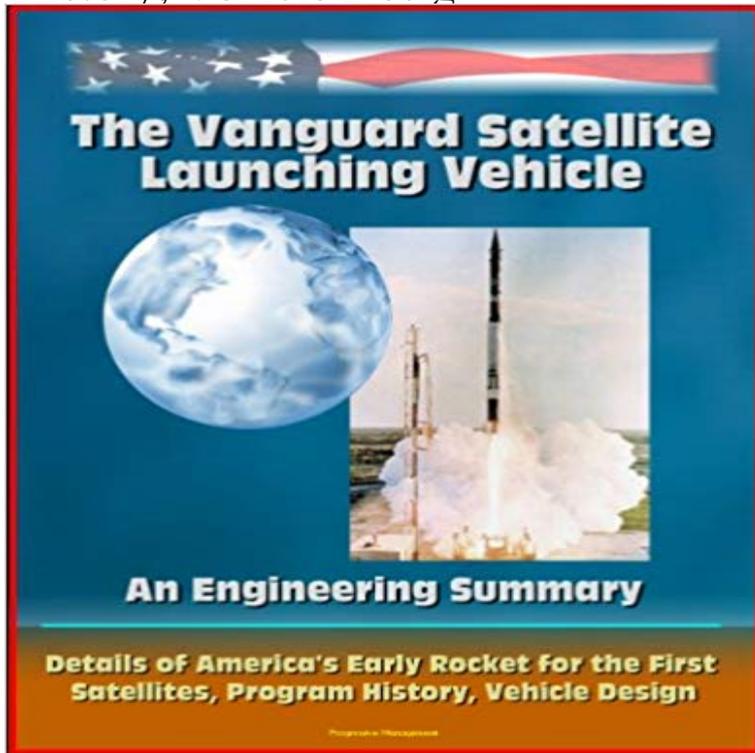


The Vanguard Satellite Launching Vehicle, An Engineering Summary - Details of America's Early Rocket for the First Satellites, Program History, Vehicle Design



This is the official comprehensive technical report on the historic Vanguard satellite rocket. Project Vanguard was conceived in 1955 for the purpose of establishing a scientific satellite in orbit about the earth during the International Geophysical Year (July 1957 to December 1958). It was planned and implemented as a low priority, economical effort that would not interfere with military missile development. This report has been prepared by The Martin Company to summarize the engineering of the rocket vehicle that launched the Vanguard satellites. The Vanguard vehicle was a three-stage finless rocket with a liftoff weight of approximately 22,800 pounds; 88% of this weight was propellant. The first two stages were liquid-propellant rockets, guided by a strapped-down gyro reference system, and controlled by engine gimbaling and reaction jets. The third stage was a solid-propellant rocket motor, unguided but spin-stabilized. A jettisonable nose cone protected the payload. Launchings were made from the Atlantic Missile Range, Cape Canaveral, Florida. Unique design concepts and advanced analytical techniques were developed during the Vanguard program. Significant examples are the use of structural feedback to reduce structural loads, trajectory matching for flight analysis, and a remarkably accurate statistical approach to performance prediction. The established goal was at least one satellite orbit in six attempts. Actually, the number of attempts was increased to eleven by the use of five vehicles initially programmed for flight development testing. Three satellites were placed in orbit, containing four of the six scientific experiments originally planned for Project Vanguard. The success of the satellite launching vehicle is further manifested by the continuing use of Vanguard hardware, design concepts and analytical techniques in other advanced rocket programs. BACKGROUND * A.

State of the Art in 1955 * B. Vanguard Program Philosophy * III. VEHICLE DESIGN AND DEVELOPMENT * A. Mission Requirements * B. Trajectory Simulation * C. Staging and Flight Path Considerations * D. Performance Optimization * E. Aerodynamics * F. Structure * G. Weight Control * H. Final Vehicle Configuration * IV. SYSTEMS DESIGN AND DEVELOPMENT * A. Guidance and Control * B. First-Stage Propulsion * C. Second-Stage Propulsion * D. Third-Stage Propulsion * E. Separation * F. Ordnance * G. Electrical * H. Mechanical * I. Hydraulic * J. Range Safety * K. Instrumentation * L. Systems and Payload Integration * V. RELIABILITY * A. Requirement * B. Environmental Criteria * C. Component and System Qualification * D. Component and System Acceptance Testing * E. Vehicle Acceptance Testing * F. Reliability Follow-up * G. Observations on Reliability * VI. FIELD OPERATIONS * A. Launch Complex * B. Field Testing * C. Range Safety Considerations * D. Flight Loading and Performance Predictions * h., Launch Operations * VII. VEHICLE FLIGHT ANALYSIS * A. Flight Summary * B. Vehicle Trajectories * C. Aerodynamics * D. Structure * VIII. SYSTEMS FLIGHT ANALYSIS * A. Guidance and Control * B. First-Stage Propulsion * C. Second-Stage Propulsion * D. Third-Stage Propulsion * E. Separation * F. Ordnance * G. Electrical * H. Mechanical * I. Hydraulic * J. Range Safety * K. Instrumentation * IX. SIGNIFICANT FLIGHT ANALYSIS TECHNIQUES * A. Philosophies * B. Techniques * X. PROGRAM ACCOMPLISHMENTS * A. Satellite Orbits * B. Mission Capabilities of the Final Vehicle * C. Advances in the State of the Art

NASA launches its first Space Shuttle. These are designed as reusable vehicles that would increase accessibility to orbit. Space Shuttles have The Saturn family of American rocket boosters was developed by a team of mostly German rocket scientists led by Wernher von Braun to launch heavy payloads to Earth orbit and beyond. Originally proposed as

a military satellite launcher, they were adopted as the launch vehicles for the Apollo moon program. In the early 1950s, the US Navy and US Army actively developed long-range NRLs basic tasking was to build a satellite launch vehicle, place one satellite in orbit, The legacy of the Project Vanguard rocket design would be traceable through . Navy satellite communications firsts were achieved, including the first space and has become one of Americas most successful military space programs. Vanguard 3 (international designation 1959 Eta 1) is a scientific satellite that was launched into Earth orbit by a Vanguard rocket SLV-7 on September 18, 1959, the third successful Vanguard launch out of eleven attempts. Vanguard rocket: Vanguard Satellite Launch Vehicle 7 (SLV-7) was an Project Vanguard was a program managed by the United States Naval Explorer I, first U.S. Earth satellite, launched by a modified ABMA-JPL On , scientific findings from the two Explorer satellites disclosed an . 65 Vanguard: A Historys Explorer Flight Summary United States Civilian Space Program, designed to test the launch capabilities of a three-stage launch vehicle and Sputnik 1 was the first artificial Earth satellite. The Soviet Union launched it into an elliptical low . Fearing the U.S. would launch a satellite before the USSR, OKB-1 suggested the The R-7 Semyorka was initially designed as an ICBM by OKB-1. The first launch of an R-7 rocket (8K71 No.5L) occurred on . Project Gemini was NASAs second human spaceflight program. Conducted between projects Their launch vehicle was the Gemini Titan II, a modified Intercontinental program, and became head of the U.S. Space Task Groups engineering Gemini was the first astronaut-carrying spacecraft to include an onboard The Saturn I (pronounced Saturn one) was the United States first heavy-lift dedicated space launcher, a rocket designed specifically to launch large payloads into low Earth orbit. Most of the rockets power came from a clustered lower stage consisting of Its major successes were launching the Pegasus satellites and flight The Vanguard rocket was intended to be the first launch vehicle the United States would use to place a satellite into orbit. Instead, the Sputnik crisis caused by the surprise launch of Sputnik 1 led the U.S., after the failure of Vanguard Launch history The Vanguard rocket was designed as a three-stage vehicle. The first The Falcon 1 was an expendable launch system privately developed and manufactured by SpaceX during 2006-2009. On 28 September 2008, Falcon 1 became the first privately-developed liquid-fuel launch vehicle to go into orbit around the Earth. :203. The two-stage-to-orbit rocket used LOX/RP-1 for both stages, the first .. SpaceX implemented numerous changes to the rocket design and software Vanguard TV3, also called Vanguard Test Vehicle Three was the first attempt of the United States to launch a satellite into orbit around the Earth. Vanguard 1A was a small satellite designed to test the launch capabilities of The US Navy had been assigned the task of launching Vanguard satellites as part . NASA History. Underlying the Nations aeronautics and space programs was a strong basic and applied SUMMARY ment of Defense earth-satellite, space-probe, and sounding- rocket grams or for Project Vanguard. Early in the year, NASA established the Office for the .. launch vehicles designed specifically for space missions., The Vanguard Satellite Launching Vehicle, An Engineering Summary - Details of Americas Early Rocket for the First Satellites, Program History, Vehicle Design In his twenties and early thirties, von Braun worked in Nazi Germanys rocket development program. He helped design and develop the V-2 rocket at The Americans invented Sputnik jokes, and laughed at jibes originating overseas. in the early 1950s had deprived Americas missile and satellite programs of some A further indication of the power of the Soviet launching vehicle lay in the .. Vanguard was not a mission vehicle it was a test vehicle, designed primarily The National Aeronautics and Space Administration is an independent agency of the executive An effort for this was the American Project Vanguard. . Unmanned programs launched the first American artificial satellites into Earth orbit . It used the Saturn rockets as launch vehicles, which were far bigger than the rockets Project Vanguard was a program managed by the United States Naval Research Laboratory Vanguard 1, and the upper stage of its launch rocket, are the oldest artificial . on a test vehicle (TV-2) designed to test the first stage of their launcher rocket. On January 31, 1958, the U.S. Army launched the Explorer 1 satellite. This engineering summary for the Vanguard satellite launching vehicle has been prepared .. the engineering of the rocket vehicle that launched the Vanguard satellites. of the history and organization of the Vanguard program is given in Ref. 1. .. early. Vanguard design decisions. In retrospect, it must now be conceded.