SOLID ROCKET BOOSTERS pdf

1: Space Shuttle Solid Rocket Booster - Wikipedia

The Space Shuttle Solid Rocket Boosters (SRBs) were the first solid fuel motors to be used for primary propulsion on a vehicle used for human spaceflight and provided the majority of the Space Shuttle's thrust during the first two minutes of flight.

Into the Gulf It seems to be entirely appropriate that a vessel like ET must first cross the Gulf of Mexico, a body of water rich in the history of exploration, in order to reach its launch site at Kennedy Space Center and make the exploration of space by the space shuttle crews possible; a sea voyage to make possible a space voyage. Around the circumference of the Gulf, the outflow of several rivers is visible in colorful swirls that are probably a mixture of sediment, dissolved organic matter, and chlorophyll from algae and phytoplankton in coastal waters. The waters of the Gulf, like the St. Lawrence River to the north, have played a very significant role in making the exploration of the Americas possible, especially North America. The Gulf of Mexico is the ninth largest body of water in the world; a playground for millions of vacationers each year and an important crossroads for trade and maritime commerce for the United States, Mexico and the northern tier countries of South America. At any one moment www. The Gulf is actually a tiny inlet of the Atlantic Ocean, or an ocean basin pretty much surrounded by the North American continent and the island of Cuba. It is bounded on the northeast, north and northwest by the Gulf Coast of the United States, my stomping grounds for my entire adult life, on the southwest and south by Mexico, and on the southeast by Cuba. The shape of its basin is roughly an oval and is approximately nautical miles 1, km wide. Almost half of the basin is relatively shallow waters, but its deepest waters are 14, ft 4, m called the Sigsbee Deep, an irregular trough more than nautical miles km long. Aerial image of islands in the Mississippi Sound. The weather ahead of us today is predicted to be good, with seas of 2â€”3 feet and winds generally out of the SSW at 10 knots. We expect a quiet and uneventful passage at an average speed of 9 knots as the crew bends to a routine of performing its normal duties of running and maintaining the ship and resting when possible; routine duties performed by a ship underway by a crew in much the same way sailors have done in these waters for hundreds of years. We passed West Ship Island to our east, home to beautiful beaches, via a local ferry from Gulfport, and home to Fort Massachusetts. The fort and its many siblings such as Fort Macomb, which we have already passed in the Intracoastal Waterway, and the fort system that we find along the length of the Gulf Coast and Atlantic seaboard were envisioned to serve as a bulwark against enemy invasion fleets. Construction of Fort Massachusetts began in June under supervision of the Army Corps of Engineers and by early the outside wall of the fort had taken shape. In January Mississippi seceded from the Union, occupied the fort and precipitated one of the first actions of the Civil War in the state. On July 9, the Union ship Massachusetts came within range of the Confederate guns and a brief fight occurred, resulting in few injuries and little damage to either side. The action was the only military engagement in which Ship Island or the fort was ever directly involved. As many as 18, United States troops were stationed on Ship Island. The Gulf of Mexico is literally strewn with history. Spanish, English, French, and Portuguese explorers came this way in the s and beyond. Later, Spanish galleons loaded riches and treasure in Cartagena modern Columbia , sailed for Spain aiming across the Gulf for passage either through the Florida Straits or the passages through the Leeward Islands, or perhaps skirting along the northern coast of South America, hoping to avoid storms, privateers or pirates. The Monsters of the Gulf The Gulf is not considered particularly hostile most of the year. But the Gulf is the feeding ground of the greatest breed of sea monster on Earth; monsters that literally rise from the surface feeding on the warm waters of late summer and early fall, pulling massive amounts of energy skyward like ocean-going demons. Throughout much of history, they remained unnamed. Today we remember and know their names very well. These are the hurricanes. The English word for hurricanes was adopted from the Spanish word huracon which in turn was adopted from a similar word for storms used by the Arawak language of the Caribbean region. Spanish explorers, who knew well the dangers of sailing the north Atlantic, apparently were taken somewhat by surprise by the ferocity of storms in the Caribbean and Gulf and European explorers lost many valuable ships and sailors throughout the region. In recent years space explorers, NASA and international partner

astronauts, on board the International Space Station, have provided hundreds of images of hurricanes from their position of relative safety some miles overhead. Among those images is one of Hurricane Ike just about to hit the Texas and Louisiana coast, its massive Cyclops eye, staring back into space at the astronauts. NASA Plowing their way across the mid Atlantic from the west coast of Africa as tropical depressions and later as tropical storms, hurricanes gather their strength, bide their time and spin up for the final dash to land. They often turn north to die in the colder Atlantic; they often plow ahead into the Greater Antilles like Puerto Rico, Hispaniola, the Bahamas and Cuba, where they ravage the much too often ravaged. They may drive straight north into Florida proper orâ€¦ they may spin their way into the Gulf, where their strength builds and towers to tens of thousands of feet of unbridled energy and then, when ready, advance relentlessly to the coast. NASA does a great deal of planning to be ready for these monsters and to protect its employees. In a hurricane came ashore with no warning in Galveston and killed 6, In , Ike took more lives in Galveston, but not near as many as in Carla hit Texas in with mile-per-hour winds; Camille hit Mississippi in with mph winds; Frederic rolled over Alabama in , smashed up Gulf Shores and knocked down my television antenna in Tuscaloosa miles from the coast; Opal hit the Florida panhandle in with mph winds; Andrew hit Louisiana in with mph winds; Ivan hit Alabama and the Florida panhandle in with mph winds. In Dennis hit the Florida panhandle with mph winds; Katrina hit Alabama, Mississippi and Louisiana in with mph winds and caused the deaths of 2, and massive damage; and also in , Rita followed Katrina to hit Texas and Louisiana. Depending on the source, since hurricanes have killed 9, and taken hundreds of billions in property on the Gulf Coast. What does Liberty Star do if a hurricane is on the horizon? Liberty Star quickly gets out of the way or does not sail at all â€” Liberty Star with its VIP precious cargo on board Pegasus will take no chances with the untamed and unpredictable monsters of the Gulf. Author sroy Posted on.

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2: "Solid Rocket Propulsion"

Solid-fuel rocket boosters (SRBs) are large solid propellant motors used to provide thrust in spacecraft launches from initial launch through the first ascent stage. Many launch vehicles, including the Ariane 5, GSLV MK3, Atlas V, and the NASA Space Shuttle, have used SRBs to give launch vehicles much of the thrust required to ascend from the launch pad.

Ignition[edit] SRB ignition can occur only when a manual lock pin from each SRB safe and arm device has been removed. The ground crew removes the pin during prelaunch activities. At T minus five minutes, the SRB safe and arm device is rotated to the arm position. A PIC single-channel capacitor discharge device controls the firing of each pyrotechnic device. Three signals must be present simultaneously for the PIC to generate the pyro firing output. These signals â€" arm, fire 1 and fire 2 â€" originate in the orbiter general-purpose computers GPCs and are transmitted to the MECs. The GPC launch sequence also controls certain critical main propulsion system valves and monitors the engine ready indications from the SSMEs. The MPS start commands are issued by the onboard computers at T minus 6. At T minus three seconds, the vehicle base bending load modes are allowed to initialize referred to as the "twang", movement of approximately The fire 2 commands cause the redundant NSDs to fire through a thin barrier seal down a flame tunnel. This ignites a pyro booster charge, which is retained in the safe and arm device behind a perforated plate. The booster charge ignites the propellant in the igniter initiator; and combustion products of this propellant ignite the solid rocket motor initiator, which fires down the entire vertical length of the solid rocket motor igniting the solid rocket motor propellant along its entire surface area instantaneously. Lift-off and ascent[edit] Timing sequence referencing in ignition is critical for a successful liftoff and ascent flight. The explosive hold-down bolts relieve through the launch support pedestals and pad structure the asymmetric vehicle dynamic loads caused by the SSME ignition and thrust buildup, and applied thrust bearing loads. That rotating moment is initially countered by the hold-bolts. With the SRBs reaching full thrust, the hold-down bolts are blown, releasing the vehicle stack, the net rotating moment is zero, and the net vehicle thrust opposing gravity is positive, lifting the orbiter stack vertically from the launch pedestal, controllable through the coordinated gimbal movements of the SSMEs and the SRB exhaust nozzles. As the forces on the vehicle change due to propellant consumption, increasing speed, changes in aerodynamic drag, and other factors, the vehicle automatically adjusts its orientation in response to its dynamic control command inputs. The net result is a relatively smooth and constant then gradually decreasing gravitational pull due to acceleration, coupled with a diminishing aerodynamic friction as the upper atmosphere is reached and surpassed. A backup cue is the time elapsed from booster ignition. The separation sequence is initiated, commanding the thrust vector control actuators to the null position and putting the main propulsion system into a second-stage configuration 0. The SRBs separate from the external tank within 30 milliseconds of the ordnance firing command. The bolt contains one NSD pressure cartridge at each end. The aft attachment points consist of three separate struts: Each strut contains one bolt with an NSD pressure cartridge at each end. The upper strut also carries the umbilical interface between its SRB and the external tank and on to the orbiter. There are four booster separation motors on each end of each SRB. The solid rocket motors in each cluster of four are ignited by firing redundant NSD pressure cartridges into redundant confined detonating fuse manifolds. The separation commands issued from the orbiter by the SRB separation sequence initiate the redundant NSD pressure cartridge in each bolt and ignite the BSMs to effect a clean separation. Range safety system[edit] A range safety system RSS provides for destruction of a rocket or part of it with on-board explosives by remote command if the rocket is out of control, in order to limit the danger to people on the ground from crashing pieces, explosions, fire, poisonous substances, etc. Both were capable of receiving two command messages arm and fire transmitted from the ground station. The RSS was used only when the shuttle vehicle violates a launch trajectory red line. The antenna couplers provide the proper impedance for radio frequency and ground support equipment commands. The command receivers are tuned to RSS command frequencies and provide the input signal to the distributors when an RSS command is sent. The command decoders use a code plug to

prevent any command signal other than the proper command signal from getting into the distributors. The distributors contain the logic to supply valid destruct commands to the RSS pyrotechnics. The first message, called arm, allows the onboard logic to enable a destruct and illuminates a light on the flight deck display and control panel at the commander and pilot station. The second message transmitted is the fire command. A command is sent from the orbiter to the SRB just before separation to apply battery power to the recovery logic network. A second, simultaneous command arms the three nose cap thrusters for deploying the pilot and drogue parachute , the frustum ring detonator for main parachute deployment , and the main parachute disconnect ordnance. The recovery sequence begins with the operation of the high-altitude baroswitch , which triggers the pyrotechnic nose cap thrusters. This ejects the nose cap, which deploys the pilot parachute. This allows the pilot chute to pull the drogue pack from the SRB, causing the drogue suspension lines to deploy from their stored position. The frustum is then pulled away from the SRB by the drogue chute. The main chute suspension lines are pulled out from deployment bags that remain in the frustum. The frustum and drogue parachute continue on a separate trajectory to splashdown. After specified time delays using redundant 10 and second reefing line cutters , the main chute reefing lines are cut and the chutes inflate to their second reefed and full open configurations. The main chute cluster decelerates the SRB to terminal conditions. These parachutes are the largest that have ever been used â€” both in deployed size and load weight. The RSRM nozzle extension is severed by a pyrotechnic charge about 20 seconds after frustum separation. Because the parachutes provide for a nozzle-first impact, air is trapped in the empty burned out motor casing, causing the booster to float with the forward end approximately 30 feet 9. Formerly, the main chutes were released from the SRB at impact using a parachute release nut ordnance system residual loads in the main chutes would deploy the parachute attach fittings with floats tethered to each fitting. The current design keeps the main chutes attached during water impact initial impact and slapdown. Pumping air into and water out of the SRB causes the SRB to change from a nose-up floating position to a horizontal attitude more suitable for towing. The retrieval vessels then tow the boosters and other objects recovered back to Kennedy Space Center. The cause of the accident was found by the Rogers Commission to be "a faulty design unacceptably sensitive to a number of factors" of the SRB joints compounded by unusually cold weather the morning of the flight. A cold-compromised joint in the right SRB failed at launch and eventually allowed hot gases from within that rocket booster to sear a hole into the adjacent main external fuel tank and also weaken the lower strut holding the SRB to the external tank. The leak in the SRB joint caused a catastrophic failure of the lower strut and partial detachment of the SRB, which led to a collision between the SRB and the external tank. With a disintegrating external tank and severely off-axis thrust from the right SRB, traveling at a speed of Mach 1. During the subsequent downtime, detailed structural analyses were performed on critical structural elements of the SRB. Analyses were primarily focused in areas where anomalies had been noted during postflight inspection of recovered hardware. One of the areas was the attachment ring where the SRBs are connected to the external tank. Areas of distress were noted in some of the fasteners where the ring attaches to the SRB motor case. This situation was attributed to the high loads encountered during water impact. To correct the situation and ensure higher strength margins during ascent, the attach ring was redesigned to encircle the motor case completely degrees. This plume would trigger the breakup of the vehicle 14 seconds later. Additionally, special structural tests were performed on the aft skirt. During this test program, an anomaly occurred in a critical weld between the hold-down post and skin of the skirt. A redesign was implemented to add reinforcement brackets and fittings in the aft ring of the skirt. United Space Boosters Inc. They were the longest running prime contractor for the Space Shuttle that was part of the original launch team. Many other companies supplied various components for the SRBs:

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3: solid rocket booster â€“ Page 2 â€“ Sailing With NASA

Solid Rocket Boosters: The Solid Rocket Boosters (SRBs) operate in parallel with the main engines for the first two minutes of flight to provide the additional thrust needed for the Orbiter to escape the gravitational pull of the Earth.

Lockheed Martin When the space program kicked into high gear in the early s the equipment necessary to move the very large components of spacecraft did not exist. In fact, the lack of necessary equipment almost became a limiting factor when preparing spacecraft designs and considering how to move them to launch sites, the primary location being Kennedy Space Center, Fla. Spacecraft could be built, but now they had to be moved. Army CH helicopters to move large components from long distances for testing at Marshall. Behind the locomotive car is the Vehicle Assembly Building. The train is hauling solid rocket booster segments from the STS mission. After a mission, the spent boosters are recovered, cleaned, disassembled, refurbished and reused. After hydrolasing the interior of each segment, they are placed on flatbed trucks and individual booster segments are transferred to a railhead located at the railroad yard. Today, components that make up the solid rocket motors segments and aft exit cones are transported cross-country via rail beginning in Utah where they are manufactured. With the help of multiple railroad companies, these components typically spend less than two weeks riding over the rail before arriving at the Kennedy Space Center. Once the components are offloaded, assembled, and ultimately flown in space, they are recovered, disassembled, inspected, and ultimately the segments are transported back to Utah on the same rail that brought them to Kennedy. At this stage in the process the hardware is refurbished and made ready for future flight opportunities. Solid rocket booster components forward assemblies, aft skirts are manufactured at the Assembly and Refurbishment Facility at KSC and transported via ground support equipment over the Kennedy road system to the respective Kennedy facilities where these components are integrated with the solid rocket motor segments. Solid rocket booster hardware and solid rocket motor hardware, when integrated together, make up the space shuttle reusable solid rocket booster. Essentially, NASA is a railroad man as well. Space shuttle solid rocket motor segments are transported cross-country via rail from Utah, where they are manufactured, to the Kennedy Space Center, Fla. The space shuttle orbiter flies everywhere it goes, except for short distances over ground at Kennedy. Ross Future space program hardware will likely make use of this same or similar means of transportation for movement from point of origin to the Kennedy Space Center for launch operations. It has been said that logistics is everything. Author sroy Posted on.

4: launch - Why were Solid Rockets chosen for the SLS - Space Exploration Stack Exchange

SOLID ROCKET BOOSTERS The two SRBs provide the main thrust to lift the space shuttle off the pad and up to an altitude of about , feet, or 24 nautical miles (28 statute miles).

5: European solid rocket passes key test - www.enganchecubano.com

Northrop Grumman manufactures the five-segment solid rocket boosters for NASA's Space Launch System (SLS). These are the largest solid rocket motors ever built and are rated for human flight. Each motor consists of five rocket motor segments, thrust vector control and an aft exit cone assembly; it.

6: solid rocket booster â€“ Sailing With NASA

The solid rocket booster segments arrive at KSC via rail from Brigham City, UT, and are offloaded at that Rotation Processing and Surge Facility (RPSF) just north of the Vehicle Assembly Building (VAB).

7: Solid rocket booster - Wikipedia

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Solid rocket booster hardware and solid rocket motor hardware, when integrated together, make up the space shuttle reusable solid rocket booster. Essentially, NASA is a railroad man as well. Space shuttle solid rocket motor segments are transported cross-country via rail from.

8: Solid rocket booster | Revolvy

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9: Northrop Grumman eyes synergy between OmegA and SLS solid rocket boosters â€“ www.enganchecu

Introduction to Solid Rocket Propulsion recurrent costs of a large solid propellant booster are lower than those of a large liquid propellant booster in the western countries, agreed that performance is better for liquid propellant.

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