Nasa space shuttle manual

Below is an excerpt from NASA's new book Space Shuttle Owners Workshop Manual.Chapter 3: Anatomy of the Space Shuttle ————————————Author David Baker worked with NASA on Gemini, Apollo, and Space Shuttle programs between 1965 and 1984. He has written more than 80 books on space flight technology, including his latest, NASA Shuttle Owners' Workshop Manual.The Shuttle Orbital is a reusable vehicle designed to transport astronauts and cargo into space and from space. It is the size of a dc-9 and is designed to withstand harsh launches and landings including vibration, high acoustic levels from rocket engines, high acceleration levels and various thermal loads on different parts of the structure. The layout is dominated by only two requirements - carry a payload design of up to 65,000 pounds into orbit, and fly back down through the atmosphere like an airplane, landing like a glider so that it can be used again. Because of these requirements, the shuttle is shaped to look like an airplane but operate like a spaceship. The Orbital Shuttle structure consists of nine separate sections, or elements: the front fuselage, the control system module ahead of the reaction, the middle of the fuselage, the payload compartment door, the fuselage, the vertical tail, two orbital maneuvering/reaction control modules and the wing. The requirements are greater than usual in the case of a conventional aircraft, because the loads imposed on the structure are unique to the shuttle. Because of this, the North American Aviation Project Team had no precedent on which if they would base their prototype. It was the first of its kind, without the advantage of any previous learning curve, and one of a kind without parallels. Very few aircraft designed for operation are breaking completely new ground in their operating conditions. Two of them can be considered as such: the Mach 3 Lockheed SR-71 spy plane and the 1400mph Concorde, the world's first commercially viable supersonic airliner. But the Shuttle will follow its own development path. At first, it was an experimental vehicle designed to adapt later to operational requirements, which included the transfer of satellites into space. It would also be intended to put large modules into orbit for the space station and carry a wide range of satellites and spacecraft that would be deployed on different trajectories, some of which would be sent to the outer regions of the solar system with rocket engines attached to them. The front fuselage——————-This consists of upper and lower sections, separated horizontally, that fit like a cot over an airtight crew compartment where astronauts live and work when they are not space walks or transfers to another spacecraft. The front fuselage is made of aluminium alloy 2024-T81 with bed-string panels, frames and bulkheads. Stringers are located 35in apart while frames 30-36in apart, chained to string panels. Crew under pressure fastened to rewind the fuselage in four places. It has a welded structure to achieve the ship's airtight pressure, capable of providing a shirt sleeve environment and maintaining the crew with an atmosphere of oxygen and nitrogen at sea level pressure (14.7 pounds/sq inches). The distribution of spacecraft systems is housed within a typically simple design using standard aircraft production methods. Courtesy NASAThe crew compartment has three levels. There is only one path in or out of the orbiter on earth, through a 40-inch diameter circular side hatch that, with the orbiter on the landing gear, opens down or, with the orbiter on the launch pad, to the side. It can also be used to escape from the Orbiter if it cannot land after re-entering the atmosphere. The middle deck area is available directly when the vehicle is on the ground, with the flight deck above and the compartment below. In weightlessness, access to flight and mid-deck areas is a matter of simply floating through one of two manholes, each 26 in x 28 inches under the pressure of the crew compartment 171/2ft high, 161/2ft long and forward cylindrical section of the nose 10.6 feet in diameter. It also provides a gateway that allows astronauts to leave the crew compartment and move to an unhereized cargo bay, which forms the bulk of the mid-fuselage assembly. In the crew compartment are 11 main windows: 6 wrapped around the top of the flight deck, 2 in the aft bulkhead that goes straight into the payload compartment, 2 in the flight deck roof and 1 in the side hatch on the left side of the crew compartment near the middle deck. Forward-fast windows are used by two pilots to enter and land, as well as for some operations in orbit. The two rear and upper facing windows are used for approaching and docking maneuvers, as well as for monitoring activity in the payload compartment. The six forward windows are the thickest one ever assembled with optical quality and consist of three separate glasses: the most intimate to withstand the pressure of the crew compartment, the middle, providing an optically transparent thermal shock layer, and the outer glass providing both thermal and shock protection. Both the internal and external glasses are each 0.6 inches thick. The inner and middle glass is attached to the crew compartment, while the outer glass is attached to the top of the forward fuselage. Critical sizes of the orbiter were formed by the requirement to provide a cargo bay 60 feet long and 15 feet in diameter. Courtesy of NASA Overall the internal volume of the crew compartment is 2,325cu ft and the atmosphere, maintained at 14.7lb/sq's, is a constant 80/20 mixture of nitrogen and oxygen. Typically, four seats are provided on the upper flight deck with three more seats on the middle deck area. Although additional places can be installed for emergencies or for needs, the shuttle usually flies with an addition of seven astronauts. Two Two places (left position occupied by the commander) are occupied for all launches, re-entry and large pulse burns in orbit. Other places for mission specialists are astronauts who are not necessarily selected for their piloting skills, but who are there for missions and various scientific tasks, as well as to assist in moving payloads to or from the cargo hold and for space walks (called EVA or out of automotive activities). Mission specialists' seats are laid during orbital operations and re-installed for re-entry and landing. In accordance with the requirements of the mission, beds can be installed in the middle deck area, as well as a galley for cooking. The waste management facility (toilet) is installed in the middle of the deck, too, and this area provides a 140cu ft stacking area with modular lockers for astronaut gear, personal hygiene equipment and for experiments - a total of 42 identical boxes, each 11in x 18in x 21in. Below the middle deck is a compartment of equipment. This is where astronauts can access waste management equipment, air revitalization systems, pumps, fans, lithium-hydroxic canisters to remove carbon dioxide exhaled by the crew, and five more storage facilities for the crew. The mid-deck area also serves as a home cylindrical gateway, with an internal diameter of 5ft 3in and a length of 6ft 11in, and two 40in diameter circular holes and pressure rigid hatches. One hatch is on the front side inside the middle of the deck, the other on the opposite side of the gateway and is attached directly to the head, which, when opened, allows access to the payload compartment. The gateway can also be mounted on the inside of a payload compartment attached to a tunnel adapter, leading to an airtight research module such as Spacelab or Spacehab, where astronauts can operate in an environment with sleeve-shirts on scientific experiments conducted from the ground and installed in racks. The gateway is large enough to contain two fully fit crew members at the same time. The control module is ahead of the reaction removable for maintenance, and its removal provides access to the bottom of the nose and the top of the chassis. The front fuselage also supports the Reaction Control Module (RCSM), which carries nasal engines to control the relationship in space. This section is removable for maintenance, fuel replenishment (fuel and oxidizer) tanks and participation in plumbing. THE RCSM is removed and processed in the Orbital Processing Center (OPF), where the spacecraft rotates after each flight and prepares for the next launch. The front fuselage also contains forward-winding. Escape from the crew compartment is possible during descent when the orbiter is not the target and is likely to either ditch or crash the ground without reaching strips, but only if it is in a controlled slip. Because of the shape of the orbiter and its large delta wing, the astronaut jumps from the side of the in all likelihood to hit the cutting edge of the wing itself. To throw the astronaut behind the wing, the evacuation pole can be quickly mounted on the inside of the Orbiter mid deck, extended to its full length of 101/2ft and projected through an open hatch. Wearing a partial pressure suit and a parachute, the astronaut washed the looped lanyard over the pole and jumped from the side hatch. Instead of thrusting back against the wing or fuselage along the slipstream, the lanyard and attached astronaut will slide down the pole and catapult into the slingshot maneuver from Orbiter.Commitment to the emergency evacuation method will be done with the Orbiter going down through 60,000ft; When the Orbiter reaches 30,000ft the speed has dropped to 230mph. At an altitude of about 25,000 feet, a crew member assigned to the jump master prepares equipment, and the orbiter's flight control system maintains an attack angle of 15 degrees. With the escape pole tilted down from the side hatch it only takes 90 seconds for all seven crew members to free themselves, the latter at an altitude of about 10,000 feet. The orbiter would have crashed, but the crew would have escaped. Two additional emergency evacuation procedures cover the situation on the ground after landing, through the evacuation of the slide from the side hatch and from the emergency hatch on the roof of the flight deck. Continue on the next page. The payload compartment is half the total length of the orbiter and is designed to cope with the bends it will experience in space from extreme temperatures. The middle fuselage —————-This is the structural backbone of the orbiter, which includes the cargo bay and its doors, and provides forward support to the fuselage, fuselage and wings. Built by General Dynamics in San Diego, California, it's about 60 feet long and 17 feet wide with a height of 13 feet and it weighs about 13,500lb. It is assembled from twelve basic, vertical, frame assemblies, each with special weight-saving boron/aluminium farms for strength, with enhanced skin and longer. The top two edges of the midfuzel are particularly strong. In addition to supporting windowsills for the payload compartment doors, they also take bend loads for the entire Orbiter and it is from these and longer that the payload has hung. Unique at that time orbitals were first manufactured, skins for the middle fuselage were not collected comprehensively with the help of numerical control. The floor of the middle fuselage consists of a hand-held wing box, and the wings themselves are attached to the outer surface of the area. The first few shuttle flights provided important measurements about stresses and temperatures that were higher than expected when the designers assembled midfuselage. To strengthen this area, engineers attached curly straps to tie all the stringers together, thus essentially creating what constitutes a box-section. Early orbiters were retro-equipped with vulcanized silicone rubber inserts for absorption more evenly throughout the bottom of the midfus structure. The payload compartment (or cargo bay, as it is sometimes known) is capable of handling equipment up to 60 feet long and 15 feet in diameter and is covered by two doors, left and right of the central line. Each door is assembled from five sections connected by circumnavigation connections and connected to the midfuselage window sill by 13 loops, of which 8 are floating to allow the expansion and reduction of the middle part of the fuselage due to mechanical stresses and to the wide fluctuations in temperature Orbiter experiences in space. Five loops are fixed. The payload compartment is a relatively airtight structure achieved by a seal that runs right around the outer edge of each door. The payload compartment is not under pressure, but the seals prevent heat from leaking from the top of the orbiter into the cabin. As the Orbiter re-enters the nose-up atmosphere, the payload bay doors are experiencing relatively low temperatures, protected as they are from heat build-up on the main subsurface Shuttle.Structural loads from the wings, main engines and afft flap of the body carried the U-shaped fuselage section, which also provides void for the cargo hold. The courtesy of NASAEach door is 60ft long by 10 feet across the radius, locked on the rest of the structure by 16 latch along the central line and 8 latches at each end, front fuselage and fuselage flippers. The doors are made of composite material of graphite-epoxy resin and Nomex, saving about 23 percent of the weight of a similar structure from aluminum. Because the right door (as the top view looks forward) carries a latch mechanism, it weighs 2,535lb, compared to 2,375lb for the left door. Doors open at an angle of 175.5 degrees. The inner surface of the door payload compartment each supports four radiator panels running along the entire length of the bay, each panel measuring 15 feet long and 10 feet along the curve. They are there to control the amount of heat removed from the inside of the orbiter and released into space to reduce overheating from the spacecraft's systems or from the energy of the Sun. The two forward panels are hinged in order to bend upwards by about 35 from the door of the payload compartment when they are open after reaching orbit, thereby allowing heat to be ejected from both sides of the radiator. Two rear panels are fixed, but additional panels can be held for some missions. The radiators were manufactured by LTV (now part of Lockheed Martin), and NASA upgraded them after delivery to prevent damage to micrometeoroids. They consist of a series of pipes, each of four deployable panels carrying 68, with each of the 4-foot (fixed) panels supporting 26 pipes, all with a diameter of about 0.1 inches. The pipes are connected to Freon cool loops, separate systems on the door panels that control the temperature inside the Orbiter. The modifications consisted of metal strips located above each tube to prevent the impact of space debris, creating a puncture and threatening the mission. Aft Fuselage ————This section includes a vertical tail structural mount, a hinged body flap and a so-called thrust structure containing three main rocket engines and plumbing needed to bring fuel and oxidizer from an external tank. It also supports two removable orbital maneuvering/reaction control systems (OMS/RCS) pods. These pods carry fuel tanks, plumbing and rocket engines to maneuver in space and to keep the orbiter in the right position in orbit and early stages of re-entry, where the air pressure is too low for aerosur tank elements to control the vehicle like an airplane. Made mainly of graphite epoxy resin composite material and aluminum, each pod measures 21.8 feet long and 11.4 feet wide on its after end, and approximately 8.4 feet wide at the end. The fuselage section is dominated by a traction structure designed to transfer cargo from the three main engines. The engine holes are clearly visible. Photo: North AmericanLike mid fuselage, the aft fuselage is also a payload structure, transferring forces from the main engines through the Orbiter and through the rear wing of the manual structure, which is part of the mid-fuselage. While the medium fuselage acts as a strong back for the Orbiter, the aft fuselage serves to transfer cargo from the three main engines to the Orbiter and The Outer Tank. Comprised of an outer shell, thrust structure and internal secondary structure, the aft fuselage is about 18 feet long, 22 feet wide and 20 feet high. It serves as an interface with a main spar wing and provides the stern of the off bulkhead on the winding forward with midfuselage and payload bay consisting of machine and beaded sheet metal aluminum segments. The top of the bulkhead is attached to the front spar of the vertical tail. The internal thrust structure serves as a support for the three main engines (SSME) with a load reaction farm, engine fittings and drive support structures. The aft fuselage also supports SSME low-pressure turbocampes and fuel lines and attachment points to connect the Orbiter to an external tank. The internal thrust structure is primarily 28 machine, diffusion-bound farm members, where titanium strips are connected under heat and pressure, which, over time, fuses them into one, hollow mass, which is much lighter and much stronger than the trained parts. The outer shell of the thrust structure is formed from whole-cooked aluminum. The open areas are covered with heat-protective materials to help isolate the structure from the heat of re-entry. The secondary design, made of aluminium, supports a variety of brackets, machines and avionics that are percussion installed on the design itself. The body flap of a 21ft-wide aluminum structure where he he to the aft fuselage, and 181/4 feet wide on the rear edge. It is 7.24 feet long and can be turning 15.7 up and 26.55 down, so it can serve as a step trim for the orbiter during its descent through the atmosphere. The body flap also serves to protect the three SSMEs from the heat of re-entry. The vertical tail——————-This consists of a 26ft 4in high inclusion of a split steering wheel/brake speed, a fixed part of the fin is built from aluminum ribs and spars and is attached to the upper structural surface of the fuselage. The steering wheel is 16.6 feet high and 71/2 feet wide at the base, and has a similar fin design, but of two separate halves located on the hinge line. As the steering wheel two closed surfaces can move 27 on either side of the central line or, when working as a speed brake, drive shafts turn in opposite directions to extend the two halves of the steering wheel to a maximum of 49.3 each, representing a spread of 98.6. The wing--- Wide torque box provides a portable crossing wing to the center of the fuselage, and the front-facing aluminum panels provide a carbon-carbon shield mount. THE polite wing of NASAThe Orbiter is an aerodynamic lifting surface that provides the usual lift and control for the vehicle when it is in the Earth's atmosphere. Each wing has a glove, an intermediate section, a torque box, a front spar to which the cutting edge of thermal protection is attached, lifting surfaces along the edge and the main chassis well. The wing itself is built in multi-spry and spar arrangement, with frozen stringers supporting the outer skin. Each wing has a length of about 60 feet and a thickness of 5 feet and the front wing drawer aerodynamically combines the cutting edge in the middle of the fuselage wing glove, or fillet. It consists of aluminum ribs, pipes and tubular racks. The wing contains four main spars, each built of corrugated aluminum to minimize heat loads. The front spar is used to attach the curved carbon-carbon (RCC) heat shield and to form a rounded wing profile of the leading edge. The rear spar is the surface of the mount for the rear edge of the elevon loop. The two-piece elevons have conventional aluminum ribs and beam construction and are divided into two segments per wing, each segment supported by three loops. Attached to the flight control system hydraulic drives, each elevon travels a maximum of 40 up and 25 down. See also: 50th Human Space Flight: Glorious Past, Uncertain Future PhotoGallerySoviet Space Propaganda: Doctoral Photos of Astronauts That Day in TechApril 12, 1961: Tips of Gagarin's Orbit, The First Man in SpaceEach Suspended elevon is just over 12 feet long, 33/4ft wide on the outer edge and 6 feet on the edge boundary, where it is located next to the inner elevon, is 13.8 feet long and 8.7 feet wide on the edge of the inner boundary. The main chassis doors are 5 feet wide and 12.6 feet long and are located in the wing of the intermediate section. During the time The weight loss program for OV-103 (Discovery) and OV-104 (Atlantis) has been redesigned as a result of loads measured in flight by previous orbiters and turned out to be larger than predicted. To maintain a level of safety, OV-102 (Colombia) and OV-099 (Challenger) were used understudies and tins. Levels. haynes nasa space shuttle manual. nasa space shuttle owners workshop manual. nasa space shuttle transportation system manual