Columbia Countdown

The space shuttle at long last is about to try making the drama of spaceflight into a routine

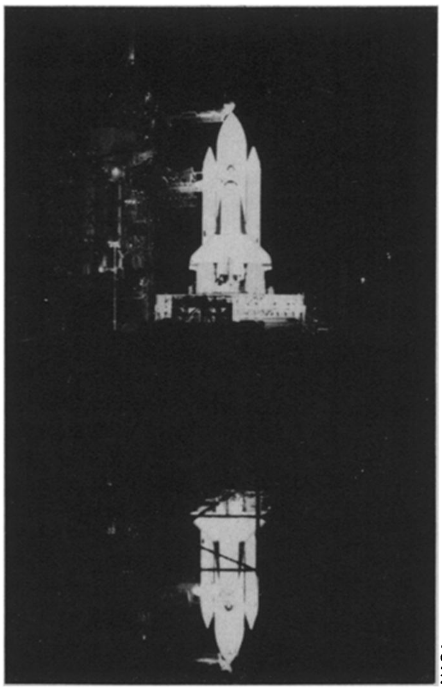
BY JONATHAN EBERHART

Frank Curtis is no astronaut. He works for the Boeing Co., whose aircraft couldn't get into orbit if he wanted them to, although a few years ago he did oversee the modification of a Boeing 747 into a vehicle that could carry the space shuttle bolted to its back for flight tests and ferrying. And it was on Feb. 18, 1977, just minutes after that 747 had landed safely from taking the shuttle on its first-ever trip off the ground, that Frank Curtis made a pleased comment about the flight that could stand as a motto for the far loftier and more elaborate goals of the space shuttle itself: "There's nothing better," he said, "than good old boring routine."

Space flights have never been routine, particularly the ones with astronauts aboard. Huge rockets, carefully chosen or even specifically designed for their diverse missions, give their all in single bursts of glory, pushing their payloads toward orbit before falling to burn up in the atmosphere or sink into the ocean depths. The shuttle, too, will go up and down, but its radical difference is that it will then do it again. . . and again. . . and again—literally commuting between the domains of earth and space. Each of the four or five craft now built or in the works is intended to make as many as 100 round trips, which, if the shuttle's design philosophy is to hold valid, must, in large measure, become routine. And the embodiment of that philosophy, far removed from the needle-sleek Saturn 5 rockets that sent Apollo spacecraft to the moon (once each), is perhaps the most ungainly looking conglomeration that ever poised on a launchpad.

Its centerpiece, called the orbiter, is the vehicle itself, a delta-winged glider 37 meters long and 24 m in wingspan, aboard which as many as seven people at once will spend up to a month at a time in space. Its crew compartment has as much room as a small house — 71.5 cubic meters — with a normal earth-type atmosphere at normal sea-level pressure. That nicety, a change from the rarified, pure-oxygen atmospheres of early space capsules, is part of making operations aboard the shuttle seem routine, since, although the craft will be piloted by highly trained astronauts like those of yore, it will soon be carrying passengers selected from among scientists, engineers and other humans lacking the professional spaceman's rigorous qualifications.

But the glider is only part of the package. It still has to get off the ground and into orbit, so mounted at its stern are three powerful rocket engines. They have been one of the shuttle's toughest design problems, built as they are around combustion chambers producing pressures three to four times as great as any previous operational rocket engines (and whose development effort was marked by test-stand fires, explosions, delays and escalating costs). And, as the National Aeronautics and Space Administration realized barely two months after the Jan. 5, 1972, decision to undertake the shuttle project, they are not enough. By a long shot. Mounted parallel to the orbiter's fuselage, therefore, are two huge solid-propellant boosters, each 8 m longer than the orbiter itself and each capable of producing well over twice the thrust of all three main engines combined. They will fire for only a little over two minutes (the "mains" will burn for eight) and then be jettisoned to parachute back to the ocean—parachute, because, as part of the shuttle's non-throwaway philosophy, they will be recovered and used again.


NASA

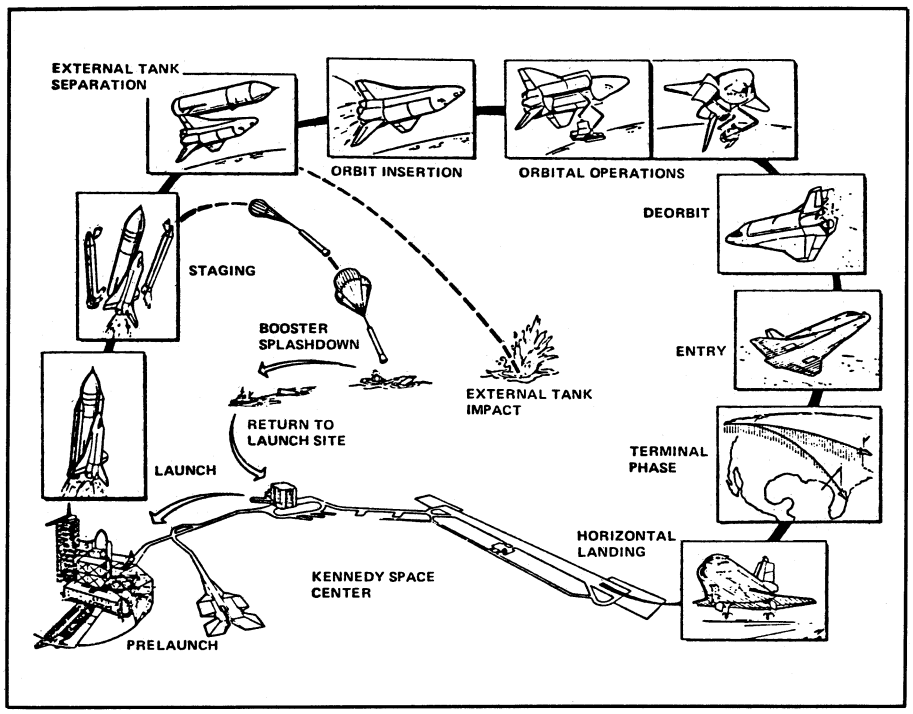
The only major old-style, one-shot, disposable part of the Space Transportation System — the shuttle's formal NASA name — is a vast fuel tank, 47 m long and 8.4 m in diameter, that carries the liquid hydrogen and oxygen to feed the voracious main engines. The tank's big, peaked cylinder is the main contributor to the shuttle's cumbersome launchpad appearance, and about 8.5 minutes into the flight, at an altitude of some 113 kilometers, it will separate from the orbiter and fall on a calculated path into the Indian Ocean. It is even equipped with a "tumble system" to ensure that it breaks up on entry, a shattered symbol of the Old Space Age being left behind.

Since Dec. 29, the first orbit-bound space shuttle, christened Columbia, has sat on launchpad 39A at NASA's Kennedy Space Center in Florida, waiting for what is hoped, as of this writing, to be an early April liftoff. One could readily double or triple the length of this article by reiterating the numerous delays that have made NASA gun-shy about publicly announcing new target dates, but after three years of training, astronauts John Young (a four-mission space veteran) and Robert Crippen (a rookie) will be ready for this initial trial, whenever it happens.

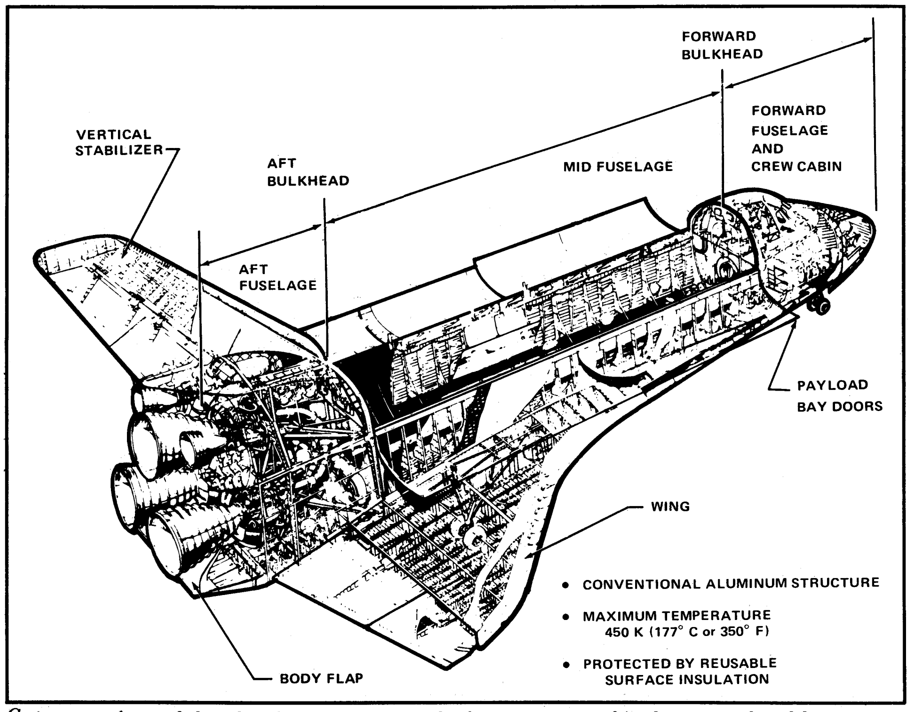
The flight is scheduled to last 54.5 hours — time for 36 trips around the earth — taking off from Florida, monitored from Johnson Space Center in Houston and finally gliding to a landing at Dryden Flight Research Center in California's Mojave Desert. There are numerous systems and procedures to be checked out during the mission, but the flight plan is a conservative one about which JSC director Christopher C. Kraft Jr. says that "a successful launch and a successful landing represent 99.9 percent of the objectives." Malfunctions are always possible, and instead of struggling to eke out the full flight time, officials may decide for a variety of reasons simply to have the astronauts return the craft to earth. In fact, says Crippen, "I think the odds, with the way we've designed the mission right now, are that we'll probably come home early." On the other hand, notes Kraft, "There are a lot of tests we'd like to conduct when we're up there, and if everything is going well, we just might stay another day."

Compared to the gliding, steerable shuttle orbiter, says Young, the Gemini and Apollo spacecraft were "kind of like flying a brick. . . .If you hadn't done the right thing in the first minute and a half of your entry, you were going to land somewhere different than you planned to." Still, steerable or not, the shuttle will be landing without power, so it only gets one chance at its chosen site — which can vary depending on the orbit during which the descent begins. In case the California site is not in position (or is covered with water, as it is now), alternative landing strips have been selected in New Mexico, Hawaii, Okinawa, Spain and even back in Florida.

There are also a lot of options in case something goes wrong during launch, the first of which, if the shuttle is still on the pad, has the astronauts clambering out of the orbiter, sliding down a wire from the launch tower to the ground, getting into a heavily armored military tank and driving to safety. After liftoff, there are ejection



Profile of a typical shuttle mission ends with preparations for the next launch.



Illustrations: NASA

Cutaway view of the shuttle orbiter reveals the structure of its huge payload bays.

seats, plus a number of emergency flight plans ranging from steering the orbiter through a U-turn and landing back at KSC to an "abort-to-orbit" mode in which, if the engines cut off prematurely, the crew will simply settle for a lower orbit than originally planned — from which they could conceivably conduct the entire scheduled mission anyway.

The nominal flight plan begins, understandably, with getting into orbit, by means of successive firings of yet two more rocket engines, together called the Orbital Maneuvering System, or OMS. After the first two "OMS burns," the orbiter should be in a circular orbit about 240 km above the earth. There, the crew will open the doors of the orbiter's cavernous payload bay — literally opening the curtains of the stage on which many of the shuttle's most essential activities will be played out in the coming years.

Business for the shuttle will include launching new satellites and retrieving old ones for repair, delivering interplanetary probes to altitudes where their own attached propulsion systems can send them off to other worlds, sustaining scientists and their instruments for periods as long as a month and providing a ferry service for people and equipment engaged in the construction of far larger structures that must be put together in orbit. The payload bay, designed to carry cargoes as big as the European Space Agency's Spacelab research module or weighing up to 29,500 kilograms, has two vast doors, each 18.3 m long and 4.6 m in width. Getting them open, however, is of paramount importance even if there is no payload inside. (The first flight will carry only "black boxes" to monitor the condition of the orbiter itself.) The reason is that they cover four large cooling panels that must be exposed to space to help get rid of the accumulating heat from the crew and from the vast numbers of electronic systems on the flight deck. With the doors closed, the orbiter is limited to six trips around the earth — about nine hours — which is as much cooling as can be provided by "evaporative flash cooling" from six onboard water tanks.

With the doors open, the astronauts will set about the first of a series of calibrations of their inertial guidance system, which tracks star positions to keep the elaborate onboard computer system informed about the craft's orientation in space. The computers, in fact, are one of the most revealing aspects about the complexities of making manned space flight even approach routine. "We recognized early on," says Richard P. Parten, chief of JSC's spacecraft division, "...that in order to make the space shuttle an economical space transportation system it would be necessary to dramatically reduce the amount of ground control support required once the vehicle becomes operational." Thus the orbiter carries five identical main computer systems, working in parallel in case some malfunction, and "voting" in case they disagree. Massive memory units hold 134 million bits of information, and the whole package is capable of running virtually an entire flight, with any one of the computers able to handle all the vital jobs even if the other four are not working.

Several hours after the payload doors open, additional OMS firings will raise the orbit to its final height, about 278 km above the earth. Thereafter will follow the many systems checks and analyses, with no spacewalks scheduled at all unless there's a problem in re-closing the doors for the descent.

If all goes well, the second of the four scheduled test flights could come as soon as six months after the first, with the shuttle being declared "operational by late 1982. But NASA's goal is to be able launch a shuttle as often as every two weeks — surely approaching the category of "routine." The long line of ambitious missions already planned for the shuttle will be the distinctly non-routine part of the New Space Age, but as far as launchings and landings are concerned, says a NASA official at JSC, "when it gets nice and dull, that's when we'll be home free." □