

Space shuttle examined

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At almost precisely 7:00 a.m. on Sunday, April 12, 1981, the world's first re-useable manned spacecraft was successfully launched into orbit around the earth.

A lot has been written about the Space Shuttle's maiden voyage, describing it from launch to landing; yet relatively little has been said about the vehicle itself, or what it will be doing over the next decade or two.

The space shuttle is a large,

roughly airplane-shaped vehicle that combines a rocket (launch vehicle, to use the jargon of the trade) and a spacecraft. It has been described as the first true spaceship, a description which is not far from the truth; it is not only the most powerful launch vehicle in the world, it is also the largest and most sophisticated manned vehicle ever built.

Over 160 feet in length, the shuttle consists mostly of an enormous cargo bay. The cargo bay itself is so large that the entire Apollo spacecraft of a decade ago, both the lander

and the part that orbited the moon, could fit comfortably inside it.

(Perhaps a more interesting observation is that the Russian Salut 6 space station, currently orbiting the earth, would fit quite comfortably inside the shuttle's cargo bay).

Forward of the cargo bay is the crew compartment, consisting of a flight deck (equivalent to the cockpit of an airplane) and living quarters. The shuttle can support a crew of up to 7 people for a period of up to a week in orbit around the earth; this figure may be

extended over the coming years.

At the aft end of the vehicle are two sets of enormous engines, one for propelling the shuttle into orbit, and one for returning it to earth (and maneuvering while in orbit). The shuttle is launched vertically like a conventional launch vehicle, and returns as a high-speed glider to land on a 15,000-foot runway.

So much for the technical side of the shuttle, interesting though it is. The fact that it's the most advanced vehicle ever invented by the mind of

man does not explain why it's so important on a purely practical level, or why it's so newsworthy.

The primary driving force behind the creation of the space shuttle was economic. The space program costs money; not a lot of money, as we'll see later, but enough that it had become an easy target for budget cuts throughout the 1970's. Getting more for the dollar suddenly became critical, and so the idea of a re-useable spacecraft came to be.

The idea itself is simple: launching something into orbit around the earth is expensive; it's expensive because the launch vehicle used to do it is expensive; the satellite itself is (relatively) cheap. The trick is to somehow reduce the launch cost; the easiest way of doing that is to use the launch vehicle over and over again.

Ever since the space program first began, back in the fifties, all launchings have been essentially the same. A huge, complex, multi-stage rocket is built to exacting specifications. It must contain extremely powerful engines, fuel pumps, maneuvering thrusters (which in turn have fuel tanks and pumps), guidance systems, on-board computers, communications and telemetry equipment, and much much more. All this hardware must be extremely reliable; for manned missions, the reliability of each individual component had to have 99.99999 percent in order to keep the overall reliability at a reasonable level.

Once the launch vehicle is built, it gets used once and then thrown away. The first couple of stages are unceremoniously dropped into the briny sea; the third eventually re-enters the earth's atmosphere and burns up. A vehicle costing tens of millions of dollars is junked after a single use; it's as if you were to buy a new car, drive it once, and then scrap it. Estimates for the cost of sending cargo into earth orbit during the 1970's ranged as high as \$2,300 per pound.

Clearly this could not go on, if only for economic reasons. The solution was to put all the expensive parts of the launcher into a re-useable craft of some sort, which would return safely to earth for minor refurbishment and eventual re-launch. The final outgrowth of this basic idea was the space shuttle.

There are, however, other advantages to the shuttle aside from the cost savings. It is the first serious attempt to integrate the manned and unman-

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