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# Engineers puzzled about Apollo parachute failure

SPACE CENTER, Houston (P) —Spacecraft engineers remain puzzled, after a month of study, about what caused the collapse

of a parachute during the final descent of Apollo 15 last month. Space agency officials said the probable causes were narrowed down to two, but now these have essentially been eliminated, leaving behind a mystery.

One of Apollo 15's three parachutes opened properly and then collapsed during the final 23,500 feet of the spacecraft's descent to splashdown in the Pacific Ocean.

Failure of the chute caused the spacecraft to hit the water about 2 miles per hour faster than it would have with all three chutes functioning perfectly. None of the astronauts, completing man's longest and most productive lunar voyage, was injured.

Swimmers were able to recover only one of the three parachutes for post flight analysis. The only other clue engineers had were films taken of the final descent.

The experts first narrowed the possible causes of the failure down to two: Recontact with the

forward heat shield which is jettisoned just before the parachutes pop out of the falling spacecraft; and corrosion by oxidizer from the spacecraft's small rocket thrusters. The oxidizer is jettisoned while the spacecraft is on its parachutes.

Engineers thought the forward heat shield, which pops away from the spacecraft automatically could have hit the chute that failed after the falling spacecraft was slowed by the parachutes.

However, an official said, "It looks like the heat shield was about 700 feet below the command module when the parachute collapsed."

North American Rockwell, which builds the Apollo spacecraft, used a heat shield and a mock up of the spacecraft and its parachutes in attempts to duplicate the failure. The tests, however, showed the heat shield would bounce harmlessly off the parachutes.

The oxidizer, a chemical called

nitrogen tetroxide, "eats nylon like crazy," said an engineer. The parachutes and shrouds are nylon. The oxidizers normally combine with a fuel, monomethyl hydrazine, in the small thruster engine to create a rocket action.

During the final descent, the chemicals are burned away so the rockets will be disarmed when the spacecraft is on the water.

Sometimes, an engineer said, the fuel runs out before the oxidizer, causing the highly corrosive chemical to be released without being burned. This, he said, has caused small, pinhole burns in the parachutes of past Apollo missions.

If this happened during Apollo 15, he said, there would have been at least some small burns on all three parachutes, including the one which was recovered.

"No such burns were found," he said.

Engineers still haven't decided what must be done to assure that later Apollo missions don't have the same problem.

"No hardware changes are likely," said an official. "Any change will probably be in procedures." This could include not discharging the rocket propellant until after the spacecraft is aboard the recovery ship, and delaying deployment of the parachutes for several seconds after the heat shield is jettisoned.

Failure of just the one parachute caused only a teeth-jarring bump, an official said.

But if two parachutes failed, the result could be much more serious.

"With only one parachute, you would hit going about 34 miles an hour," said an official. "If they caught an ocean wave just right, the astronauts might survive without injury. But it would be nip and tuck. You're approaching the structural limitations of the spacecraft."

Which means that if the spacecraft caught a wave moving up as the craft came down, the spaceship could break apart and very likely injure the crew.

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