

# Diluted Oxygen Is Approved For Apollo Cabin at Launch

The spacecraft for the first manned Apollo mission will use a launch pad cabin atmosphere of 60 percent oxygen and 40 percent nitrogen, rather than pure oxygen which will continue to be used in orbit.

NASA announced the change March 14.

The change will apply only to the spacecraft cabin atmosphere during ground operations and will require no changes to the existing spacecraft environmental control system, which supplies pure oxygen in flight.

Crews will continue to breathe pure oxygen in their space suits before and during the launch phase, at a pressure slightly higher than the cabin to avoid leakage into the suit. After insertion into orbit the spacecraft environmental control system will gradually replace the 60/40 cabin atmosphere with pure oxygen.

More than 140 flammability tests conducted with a full-scale boilerplate spacecraft at MSC since October 1967 show that modifications to the Apollo spacecraft since the Apollo 204 accident of January 1967 have drastically reduced the hazard of fire in the vehicle.

Ignition sources have been minimized and many materials have been changed to prevent flame propagation. Several new materials not available during initial Apollo design have been introduced. A fire extinguisher and new hatch for crew egress have been developed.

Tests were conducted in a pure oxygen atmosphere at orbital pressures of six pounds per square-inch, a 60/40 diluted oxygen atmosphere at launch pad pressures of 16 psi, and 16 psi in pure oxygen.

Tests of pure oxygen at pressures of 16 psi showed that although ignition was difficult, intentionally ignited fires tended to spread in that atmosphere. In about half the tests the fires failed to extinguish themselves and instead, spread beyond acceptable limits. In the other two test conditions the modified spacecraft was judged acceptable.

In evaluating an atmosphere for prelaunch use in the Apollo spacecraft cabin, a major consideration was to provide an adequate amount of oxygen to assure man's ability to perform, while reducing the danger of the fire to an acceptable level. A 60 percent oxygen mixture will be livable at all times in flight, thus providing a backup to the space suit system for the crew.

Detailed physiological review of the 60 percent oxygen-40 percent nitrogen atmosphere on the launch pad included considerations of the operational characteristics of the spacecraft and life support equipment. Test data on the spacecraft and equipment will be obtained in full-scale manned altitude chamber runs to substantiate the operational procedures developed for checkout, launch and flight.

Shortly before liftoff the spacecraft will be separated from the

ground system supplying the 60/40 atmosphere. Following launch, the cabin atmosphere will be replenished by pure oxygen, while the nitrogen level continues to decrease because of controlled leakage. A level of approximately 95 percent oxygen will be reached in four to six days. The crew will be adequately protected from a physiological standpoint during all phases of the atmosphere change.

The decision to use a diluted-oxygen atmosphere while in Apollo launch pad operations will require changes in spacecraft operation, but no changes in the spacecraft and only moderate engineering changes in ground support equipment.

The principal new requirement will be to assure that during prelaunch phases the oxygen content in the mixture supplied to the spacecraft is accurately determined and continuously maintained and that the oxygen supply to the suit loop is not contaminated through inward leakage of the cabin atmosphere.

The crew procedures during the period the diluted-oxygen atmosphere is in the cabin will be only slightly affected by the use of this atmosphere. Before launch, a vent valve must be opened to permit the controlled slow venting which will gradually change the cabin atmosphere. Within eight hours of flight, and after verification by existing onboard oxygen measuring instrumentation, the crew will close this valve.