Additional tests are planned to determine combustion characteristics in simulated Command Module interiors. The Command Module for these tests will be a boilerplate spacecraft and will include tests with both present and modified interior arrangements.

Special tests have been and are being performed to understand the combustion characteristics of various materials in zero gravity. Test results to date indicate that, after ignition, flames disapear due to lack of convection currents, then reappear when convection is reestablished. We believe that in a spacecraft there will be sufficient movement of the atmosphere by fans or crew motion so that this cannot be counted on as a reliable method of fire extinguishment.

The results of the many tests run to date have not been encouraging. Additional effort is under way, however. and every possibility is being reexamined. Careful consideration must be given to the tradeoffs involved. The provision of a limited capability for fire extinguishment at the expense of reduced reliability and increase in the possibility of a toxic environment must be carefully weighed before any decision is possible.

Cabin materials

With regard to the materials used and contained in the spacecraft cabin, I would like to summarize why we attach so much significance to materials selection and control.

For a fire to exist there must be an atmosphere containing sufficient oxygen to support combustion; there must be a source of ignition; and there must be combustible materials available to be ignited. As far as the atmosphere is concerned, an atmosphere which will support life will also support combustion. Therefore, the first answer to the fire hazard problem must be fire prevention in terms of strict control of both potential ignition sources and combustible materials.

The fact is now clear that we will not be able to eliminate completely ignition sources in the cabin. We will continue to take every precaution to minimize possible ignition sources, but we cannot expect perfecton. This means that the remaining technique of fire prevention—materials selection and the control of the geometry of their use—demands our utmost in care and attention.

Objectives

Our objectives in the selection and use of materials are many.

First, we are reviewing the latest developments in material technology so as to replace potentially combustible materials with less flammable or non-flammable materials. Some needs can only be met using potentially flammable materials; the astronauts' food is an example. However, care must be taken that at every opportunity, materials are selected which give us the most fire protection while still satisfying the basic need.

Second, we want to locate materials physically so as to inhibit ignition (fig. 21, MC67–5955). Ordinarily this requires that any potentially combustible materials be kept some distance away from possible ignition sources.

Third, we want to arrange materials to inhibit fire propagation. This is usually accomplished by assuring physical separation between small pieces of materials which might be potentially combustible.

Fourth, we want to store potentially flammable materials in fire resistant containers.

Fifth, we want to minimize the amount of potentially combustible materials exposed in the cabin at any one time, either on the ground or in flight.

Sixth, we want to exercise rigorous control over the introduction of materials into the cabin during manufacture and test. This includes both flight articles such as the astronauts' spacesuits and non-flight articles, such as test procedures books.

We believe we have exercised care in every one of these areas in the past. However, in light of the AS–204 accident, we are reviewing each area to make sure that we are doing everything that we should.

I would like to report in more detail on our status in the area of new materials.

Relative propagation rates

This chart shows the relative propagation rates of nomex, which is the material used in our spacesuits, as compared with two new materials: teflon and fiberglass (fig. 22, MC67–5964). As you can see, the rate of propagation of fire does vary