

APOLLO PROGRAM DIRECTIVE NO. 25

TO : DA/J. G. Shinkle

FROM: Samuel J. Shinkle
APOLLO PROGRAM DIRECTOR

SUBJECT: Action Assignments Relative to AS-204 Accident

ACTION : All Centers are to implement the requirements of this directive effective with the issuance date and on a continuing basis.

I. PURPOSE

The purpose of this Program Directive is to formalize responsibilities and reporting requirements for actions already underway and to define additional actions necessary as a result of the AS-204 accident.

II. SCOPE

This Directive is concerned with actions required in the design, manufacture, test and operation of the Apollo Command and Service Modules and direct interfacing facilities, equipment and procedures.

III. RESPONSIBILITY

Primary responsibility is assigned for each action item. Each Center with a primary responsibility shall arrange for participation of the other Centers as appropriate.

IV. TIME COMPLIANCE

A written status report shall be provided by each Center on March 15 and 31, 1967. Additional reports will be assigned as required.

V. ALTERNATE ACTIONS

If, during the course of complying with the action directed herein, an alternate action is considered appropriate in the interest of feasibility or improved safety or performance, such alternate action shall be submitted to the Apollo Program Director for review.

ACTIONS REQUIRED

1. MATERIALS

a. Materials Selection, Placement and Use

MSC shall continue to review, and to change as necessary, both flight and non-flight materials in the Command Module cabin and in the space suit with the objectives of:

1. Replacing combustible materials with less-flammable or non-flammable materials.
2. Placement of materials to inhibit fire ignition.
3. Placement of materials to inhibit fire propagation, including maximum possible use of natural firebreaks.
4. Protection of potentially flammable materials with fire resistant containers.
5. Minimizing, by proper stowage, the amount of potentially flammable materials exposed in the cabin at any one time.
6. Assuring proper and limited use in the cabin of cleaning fluids, solvents and materials which may be flammable or have a flammable residue.

Toxicity and other properties of new materials substituted for current materials must continue to receive special attention, particularly for those materials used in the suit circuit.

b. Materials Selection Specifications, Approved Lists and Control Procedures

MSC shall re-examine and update as necessary:

1. The cabin and space suit materials selection specifications and approved materials list for both flight and non-flight materials.
2. Procedures for controlling the introduction of both flight and non-flight materials into the cabin during manufacture and test.

MSC shall coordinate with KSC where there is an interface with KSC operations.

2. EMERGENCY EGRESS:

a. Command Module

MSC shall complete the review of changes in the Command Module design and in procedures necessary for effective emergency crew egress and shall make the necessary changes before the next manned flight or manned ground test in a closed Command Module. This review shall consider aided and un-aided emergency egress during ground test operations in vacuum chambers (at MSC, KSC and NAA) and on the launch pad with due consideration also to the normal mission requirements. Particular attention shall be paid to the design tradeoffs of a simply-operated, rapid-opening hatch protected from inadvertent operation. MSC shall coordinate with KSC to insure compatibility with KSC facilities and procedures.

b. KSC Facilities

KSC shall review the vacuum chamber area and the launch pad facilities and make such changes in design and procedures as are necessary to assure effective emergency crew egress from the spacecraft. These changes shall be made prior to the next manned flight or manned ground test with a closed Command Module. Particular attention shall be paid to the access arm including the environmental chamber, the elevators and other escape path provisions. Necessary changes involving an interface with the flight crew or the spacecraft shall be coordinated with MSC.

c. MSC and NAA Facilities

MSC shall review MSC and NAA facilities and make such changes in design and procedures as are necessary for effective emergency crew egress before the next manned test in a closed Command Module.

3. FIRE DETECTION, SUPPRESSION AND EXTINGUISHMENT

MSC shall continue to review the design and procedural provisions for crew safety in the event of fire in the cabin. This review shall include the following items:

- a. Fire detection during flight and ground tests.
- b. Fire suppression and extinguishment during manned tests in vacuum chambers and for each mission phase including prelaunch.
- c. Emergency operational procedures for both ground and flight.

Necessary changes in design or procedures shall be identified and an implementation plan submitted. MSC shall arrange for appropriate KSC coordination where there is an interface with KSC facilities or procedures.

4. FLAMMABILITY TESTING:

MSC shall continue flammability and fire extinguishing test programs to determine ignition and combustion characteristics of cabin materials as functions of atmosphere and acceleration levels, and the usefulness of depressurization, inert gases, chemicals and water for extinguishing cabin fires. The program shall include tests of the following types:

- a. Basic tests of standard material samples
- b. Full scale simulations of present cabin configurations
- c. Full scale simulations of new cabin configurations.

Attention shall be given to standardization of test procedures to permit meaningful intercomparisons of data. An overall test plan including the test procedures shall be submitted.

5. CABIN ATMOSPHERE:

MSC shall document the recent review which reaffirmed the choice of a one-gas cabin and suit atmosphere for use in space. The results of studies underway to determine necessary changes in cabin atmosphere and related procedures for other mission environments and ground tests shall be submitted with an implementation plan.

6. IGNITION SOURCES:

MSC shall continue the review of the design of the Command and Service Modules to identify and to eliminate probable fire ignition sources. Procedures shall be implemented by MSC to insure that future design changes or waivers are examined from the standpoint of probable ignition sources.

7. ENVIRONMENTAL CONTROL SYSTEM:

MSC shall conduct a Critical Design Review of the Environmental Control System (ECS) with the objective of identifying and assessing the impact of changes required to:

- a. Make the system more fire resistant
- b. Make the system leakfree
- c. Use a substitute coolant fluid for the current one
- d. Eliminate the solder joints in the plumbing
- e. Increase ease of installation, testing and maintenance.

In addition, the implications of leakage or spillage of fluids, particularly water glycol, into the cabin shall be determined in terms of toxicity and flammability, effects on possible ignition sources and procedures for proper cleaning and drying. Necessary special testing shall be done and the results documented. MSC shall be responsible for the overall ECS CDR including arrangements for appropriate KSC and MSFC participation. An implementation plan for necessary changes shall be submitted.

8. CABIN SUBSYSTEMS:

In addition to the ECS review, MSC shall review all other subsystems containing oxygen or possibly combustible or toxic fluids or gases within the cabin of the Command Module to determine the extent to which it is necessary and feasible to make the subsystems more fire resistant. Recommendations for necessary changes shall be submitted with an implementation plan.

9. ELECTRICAL POWER SYSTEM:

MSC shall re-evaluate the Critical Design Review of the Command and Service Module power systems and cabling to determine actions necessary to insure:

- a. That cable fabrication and routing provide for mechanical and electrical reliability, ease of installation without undue stress, maintenance, adequate inspection and protection from damage.
- b. That previously approved deviations from MSC Design Standards DS 22 and DS 40 regarding wiring installation and accessories are appropriate.
- c. That the necessity for connecting/disconnecting electrical connectors in the cabin (including instrumentation circuits) with power on be eliminated.

An implementation plan for necessary changes shall be submitted.

10. EMERGENCY EQUIPMENT:

KSC shall re-examine all test operations for determination of hazardous operations associated with space vehicle testing and shall review the requirements for emergency equipment in launch complexes and the industrial area. Additional necessary emergency equipment shall be provided and those responsible for its use trained in its operation. Procedures shall be implemented for re-examination of requirements as changes in procedures or configuration make it necessary. MSC shall conduct a similar review and implement necessary changes in areas at MSC and NAA associated with potentially hazardous manned tests.

11. EMERGENCY TRAINING:

a. Ground Crews

KSC shall review current emergency training methods and implement any necessary actions to assure that all personnel directly engaged in manned testing in vacuum chambers, on the launch pad, or other

hazardous operations or engaged in emergency assistance to personnel in hazardous areas be properly identified and trained. MSC shall conduct a similar review and implement necessary changes at MSC and NAA.

b. Flight Crews

MSC shall review and update flight crew emergency training to reflect system changes incorporated as a result of the AS-204 accident.

12. GROUND COMMUNICATIONS:

KSC shall chair a working group with design and mission operations representatives from MSC, KSC, MSFC, OMSF, OTDA, GSFC, and AFETR to conduct a review of the ground communications system among the MSOB, CIF, MCC-H and launch complexes 34, 37 and 39. The review should include the number and characteristics of circuits; the number of drops on each circuit; interconnections of networks; monitoring and control provisions; checkout and maintenance procedures; and configuration control. Specific recommendations and an implementation plan for necessary changes for both long and short term improvements shall be submitted.

13. SPACECRAFT COMMUNICATIONS:

MSC shall re-evaluate the Critical Design Review of the Command and Service Module communication system in order to insure adequate communications during ground tests and flight missions. An implementation plan for any necessary changes shall be submitted.

14. SPACECRAFT ONBOARD OPERATIONS MONITORING:

a. Tests at KSC

MSC shall determine a means of using present onboard television and voice communications to monitor operations within the spacecraft during hazardous ground tests and, if possible, during the launch phase of flight tests. Compatible ground equipment and procedures shall be identified by KSC to record the spacecraft data. A joint implementation plan shall be submitted by KSC and MSC.

b. Tests at MSC and NAA

MSC shall determine a means of monitoring (using present onboard television and voice communications) and recording the operations within the spacecraft during hazardous ground tests at NAA and MSC. An implementation plan shall be submitted.

15. QUALIFICATION REQUIREMENTS:

MSC shall re-evaluate qualification requirements for equipment exposed to the cabin environment to insure that adequate testing in appropriate environments has been or is accomplished. All equipment in the cabin that uses, controls or distributes electrical energy and contains unsealed potential ignition sources shall be qualified by an explosion test appropriate to the cabin atmosphere.

16. PROCEDURES PREPARATION:

KSC in coordination with MSC and MSFC shall assure that final approved checkout procedures including revisions are given to personnel participating in tests at least 24 hours in advance of the start of the tests. Waivers to this requirement shall be approved in writing by the Launch Director.

17. PROCEDURES MANUAL:

The Apollo Program Director will establish a working group (with KSC, MSC, MSFC, and OMSF membership) concerned with test procedure preparation, coordination, and approval. The working group shall prepare a manual for use in launch vehicle and spacecraft checkout and test operations at KSC. This manual shall contain the definitions of the KSC interfaces with MSC and MSFC as far as procedures and planning are concerned. Responsibilities and procedures for both contractor and NASA groups shall be included. The following areas shall be covered:

- a. Checkout Procedures, Test Preparation Sheets, Contract Work Authorizations
 - 1. Methods and schedule for developing, reviewing, approving, publishing, and distributing test and checkout procedures
 - 2. Coordination with spacecraft and GSE configuration
 - 3. Coordination with flight crew and their checklists
 - 4. Review for hazardous operations and emergency requirements
 - 5. Incorporation of specific emergency instructions
 - 6. Change procedures, routine and expedited, both before and after tests start with required coordination and documentation procedures
 - 7. Control and documenting of trouble shooting during tests
 - 8. Approval requirements and authority, routine and expedited
 - 9. Review of test sequences by quality control personnel
 - 10. Relationship of spacecraft, launch vehicle, and integrated checkout procedures for major tests
- b. Test Planning
 - 1. Pre-test briefings
 - 2. Criteria for readiness of test and checkout procedures, configuration and crews
 - 3. Pre-test constraints and open item reviews of flight and ground support hardware and appropriate documentation
 - 4. Safety and emergency procedures briefings
 - 5. Voice tape recording of as-run procedures
 - 6. Quality control review of test results and feedback

18. MANNED TESTING PREREQUISITES

KSC, MSC and MSFC shall develop and implement a statement of tests and actions prerequisite to further manned testing in a closed cabin.