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### General Style And Quality Requirements for Apollo Operations Handbook Normal/Backup and contingency procedures

National Aeronautics and Space Administration (NASA)

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SECTION I  
PROCEDURE UTILIZATION  
AND DATA

1-1. PURPOSES OF MALFUNCTION PROCEDURES.

1-2. The procedures initially identify possible malfunctions of the systems and subsystems in the command and service modules. Furthermore, the procedures analyze, isolate, and explain the causes, and provide alternate operations if feasible. The procedures are applicable to, and must fulfill the requirements in, three general categories as follows.

1-3. DURING TRAINING. The flight, MSFN, and ground support personnel should be able to derive optimum, sequential response guidance during malfunctions. The procedures should also expand a comprehensive understanding of the spacecraft systems characteristics when studied in conjunction with other data.

1-4. DURING MISSION. The flight crew and MSFN personnel should be able to utilize efficiently the logic flow diagrams. The diagrams could be extracted from the handbook and carried on-board.

1-5. MISSION RULES. The rules rely on the malfunction procedures for source data pertaining to the effects of malfunctions, and to the possible limitations of a partial system, backup system, or alternate operating modes.

1-6. REFERENCE DATA.

1-7. The procedure developer is required to provide the data upon which he has based his initial procedure and again each time the procedure is reviewed. The data can be comprised of both formal and informal documentation. This data should include but not be limited to the following.

- a. The rationale that dictated the symptoms chosen.
- b. The mission considerations which were investigated in writing the procedure.

## SECTION II

### SCOPE OF PROCEDURES

#### 2-1. GENERAL.

2-2. This section delineates the assumptions, rationale, and constraints which determine the overall parameters of the procedures.

#### 2-3. ASSUMPTIONS.

2-4. MSFN COORDINATION. It should be assumed that the flight crew will coordinate anomalies with MSFN when possible and appropriate. It is not the function of the malfunction procedures to constantly remind the flight crew of the presence or capability of the ground support complex. The procedures should be developed as independently of the ground as possible since tracking coverage limitations, communications difficulties, and time criticality may force this independence.

2-5. CONFIGURATION CONTROL. Checks of switch and circuit breaker configuration should generally not be included in the procedures. It should be assumed that the flight crew will verify switch and circuit breaker positions at an appropriate time in the procedure.

2-6. INSTRUMENTATION DISCREPANCIES. Checks of on-board indications versus down-link telemetry of the same parameters should not be included as procedural steps; it can be assumed that the flight crew will accomplish these checks when possible and appropriate. Non-obvious checks, such as using parameters which are telemetered but not displayed on-board, or using one parameter to verify another, should be included where appropriate for system analysis. The non-obvious checks should be inserted at a logical point in the procedure, such as when the results of procedural steps indicate an instrumentation discrepancy, or when no other steps can safely be taken without further knowledge.

2-7. SYSTEM KNOWLEDGE. The procedures should be written for users who have a general systems knowledge but are not system specialists.

#### 2-8. RATIONALE.

2-9. The malfunction procedures should be the result of a logically consistent approach in: (a) ascertaining if there are actions which may be imposed



on the system operator as a result of malfunction/mission phase relationships prior to initiating the diagnostic procedures and (b) ascertaining if subsystem reconfiguration subsequent to failure determination is influenced by the failure effect and subsequent mission activities. This rationale is shown in figure 1 in block diagram form.

#### 2-10. MISSION RULES RELATIONSHIP.

2-11. Malfunction procedures and mission rules both apply to system contingencies and, therefore, do interleave quite closely. For purposes of determining the parameters of malfunction procedures, the following distinctions should be understood.

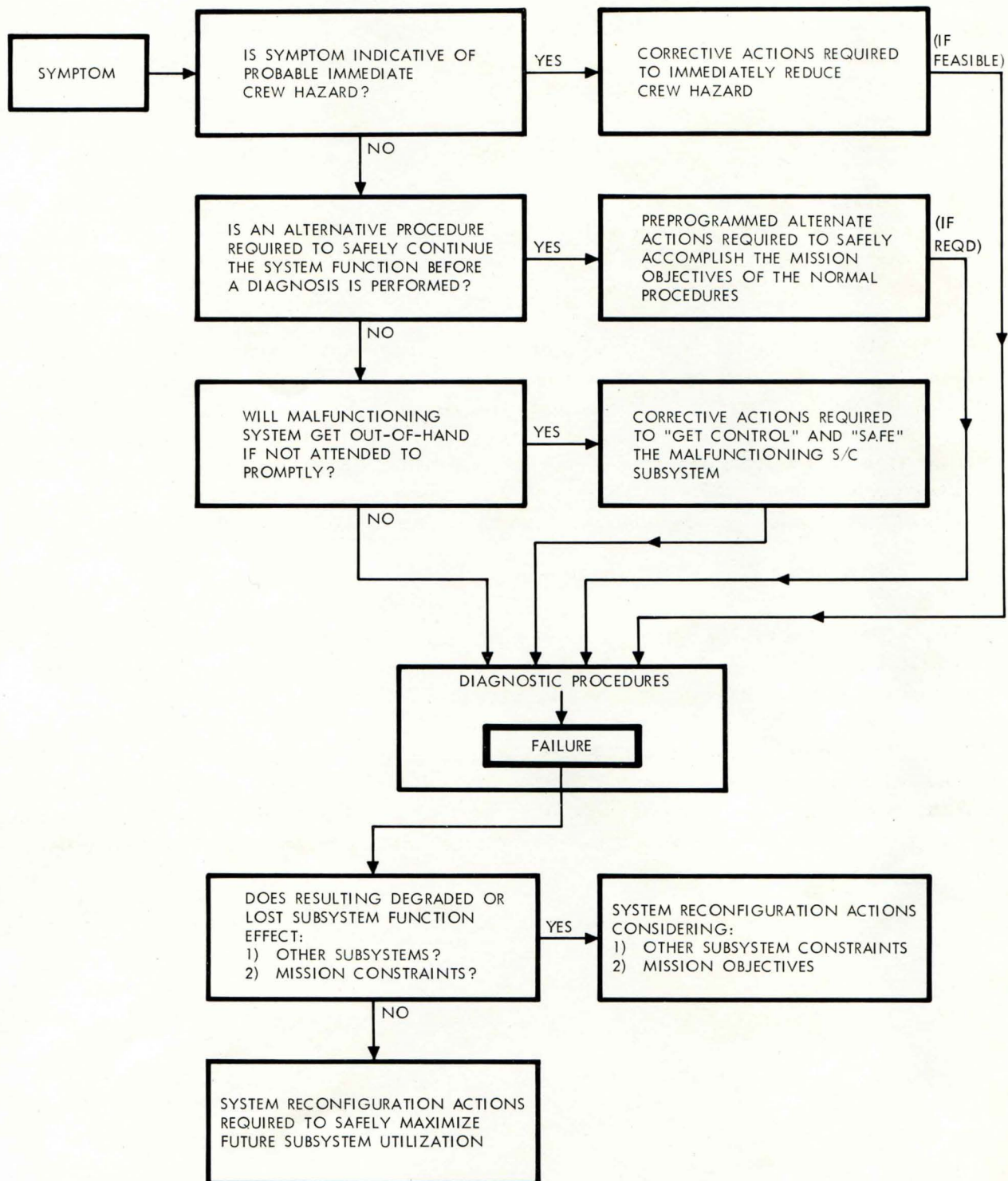
2-12. Mission rules (for spacecraft system contingencies) are predeveloped decisions to be implemented in the event of system malfunctions; the rules do not define the process of recognition or verification (diagnosis) of the malfunction. Conversely, the malfunction procedures do not specify changes in the mission plan (abort, deletion of mission objectives) as a result of a system malfunction; the procedures do, however, explain the effect of the malfunction on the spacecraft and mission operation.

#### 2-13. SCOPE OF MALFUNCTIONS.

2-14. The procedures should cover all significant single failures. Failure isolation should be completed only to the point where the resultant status and necessary corrective action is determined.

2-15. In general, double unrelated failures should not be covered. This is necessary to prevent the procedures from becoming unmanageably complex. When, however, the necessary steps of a procedure include logical branches which represent double failures, it is often more convenient to cover them than not.





SM-2A-1360

Figure 1. Procedure Development Rationale

## SECTION III

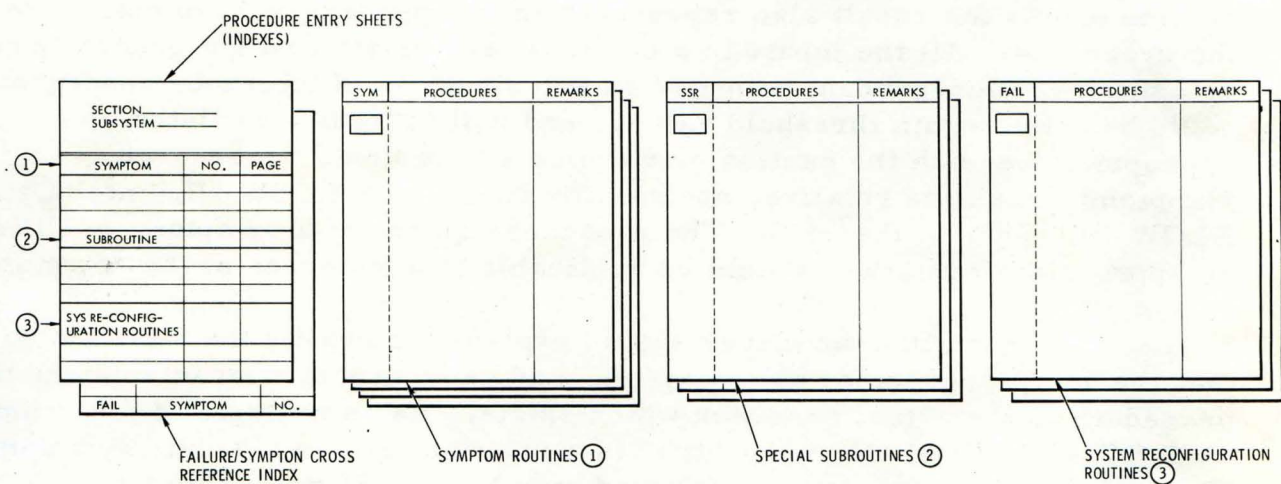
## FORMAT AND CONTENT

## 3-1. GENERAL.

3-2. The format, layout, and content of malfunction logic flow diagrams are explained in this section. The procedures are arranged by systems and subsystems. The format for each system consists of procedure entry sheets (indexes), failure/symptom cross reference index, symptom routines, special subroutines, and system reconfiguration routines. (Refer to figure 2.) The use of the latter two routines will depend on the complexity of the system and/or procedures.

## 3-3. PROCEDURE ENTRY SHEETS.

3-4. The procedure entry sheets identify the system and subsystem to be covered. They also provide the indexes for locating symptom routines, special subroutines, and system reconfiguration routines by procedure number and page number.



SM-2A-1359

Figure 2. Malfunction Procedure Formats



### 3-5. FAILURE/SYMPTOM CROSS REFERENCE INDEX.

3-6. This index is simply a cross reference between a failure and its symptom. This will be an aid to the user since one symptom can be the indication of any number of single failures. This index will follow the procedure entry sheets for each system and/or subsystem.

### 3-7. SYMPTOM ROUTINES.

3-8. Symptom routines contain the primary malfunction procedures and are backed up by special subroutines (paragraph 3-21) and system reconfiguration routines (paragraph 3-22). A three column format is used for symptom routine logic flow diagrams. A description and use of each of these columns is described in the following paragraphs.

3-9. SYMPTOM COLUMN. The symptom is the original cue which alerts the crew to an abnormal condition in a spacecraft system or component. A symptom can be a caution-warning light, a meter reading, or a condition of a system product (engine does not fire, intercom lost, MSFN reports loss of TV signal, etc.).

3-10. The primary purpose of the Symptom column is to allow entry into the procedure. Symptoms which are available without procedural steps may be grouped together allowing entry into the procedures at a point closer to resolution, minimizing the procedural branching required. A result of a procedural step (i. e., TEMP remains high) will not be listed in the Symptom column unless the result also represents an independent point of entry into the procedure. All the inputs to a caution/warning status light generally can be considered independent points of entry, since out of tolerance conditions could be noted within threshold values, and will therefore be listed as appropriate beneath the caution or warning status light. In general, symptoms should be relative, not specific (i. e., "O<sub>2</sub> FLOW HI," not "O<sub>2</sub> FLOW ABOVE" \_\_\_ lbs/hr.). The procedure given for a symptom, qualified by appropriate remarks, should be applicable to any degree of the symptom.

3-11. The procedure developer should explain and qualify the situation so that the user understands the symptom, and can use judgment in applying the procedure to the actual condition which exists. As an example of this point "SM RCS-PRESS-MANF ind - high" is a relative, not an absolute, symptom. The actual symptom being investigated may be 1 or 50 psia higher than normal, with an increasing or decreasing rate. In the "Symptom" column below the symptom block should be stated such information as: "Normal regulated pressure 178-184 psia," "Light on if: PRESS-MANF—<155 psia, ->215 psia," etc. If more detailed data is needed for the user to understand



the relative importance of the symptom and the urgency with which he must treat the symptom, place this information in the "Remarks" column across from the symptom block. (Refer to figure 3.)

3-12. Some symptoms must be treated differently as a function of mission condition and/or spacecraft configuration. Where this is necessary the different treatments must be included either by using notes to qualify the application to the various mission conditions, including separate paths within the procedure, or by listing the different cases as separate symptoms (as in "SPS PRESS It on during thrusting" and "--- during non-thrusting." To achieve this goal, the procedure developer must ask the following questions:

- a. Is the symptom indicative of probable immediate crew hazards?
- b. Is an alternative procedure required to safely continue the system function before a diagnosis is performed?
- c. Will the malfunctioning system get out of hand if not attended to promptly?

3-13. Those symptoms which indicate a threat to crew safety require a separate branch from the symptom to some form of emergency procedure prior to entering the diagnostic routine. Symptoms which are mission or system configuration critical will require a logic block in the procedure column which states the conditions being considered. This logic block will then lead to preprogrammed procedures that of necessity occur before any diagnostic steps may be taken and to normal control/diagnostic steps when the condition is not considered critical.

3-14. If the symptom can be classified as independent of crew safety and mission or system configuration critical conditions, then the symptom will lead directly to the diagnostic procedure without any intermediate logic blocks.

3-15. The developer should examine each failure case considered to verify that the prescribed procedure does rationally cover all the conditions which could occur. It is feasible, however, that a single procedure for a symptom would apply regardless of mission condition or spacecraft configuration.

3-16. PROCEDURE COLUMN. This column presents the step-by-step tasks required to:

- a. Establish criticality of malfunction to mission phase relationship.
- b. Gain control of the situation, i. e., stop divergent rates, gross leaks; protect threatened components, etc.



c. Determine the source and nature of the problem—find out what failed, what caused it to fail, and the resultant operational status of the subsystem.

d. Establish alternate modes of operation relative to malfunction effects and mission constraints as required.

3-17. When the symptom is under control, the procedure should attempt to determine what caused the failure before utilizing redundant components, thereby minimizing the probability of exposing the redundant component to the same hazardous condition which caused the first to fail.

3-18. Where a symptom represents several failure possibilities, the logical flow should first favor time criticality, then efficiency (most probable failures, or those most easily considered). General statements should not be included in this column, but should be remote evented to the Remarks column. However, warning and caution notes should be included to inform the crew of undesirable conditions.

3-19. REMARKS COLUMN. This column is intended to include information as follows:

a. Amplifying additional remarks related to the symptom, i. e., Relief valve vents at \_\_\_\_psia, Burst disc ruptures at \_\_\_\_psia, or to notify the user of the urgency that he must treat a particular symptom, etc.

b. Amplifying remarks which relate to a decision and/or action items (e. g., why a step is taken, possible system time lag, etc.).

c. Explain resultant system status or operational capability after a failure has been identified, i. e., how subsystem is degraded, can degraded subsystem support primary mission, early termination of mission, etc.

d. Cautions or Warnings, as necessary, to cover conditions that may exist because of a failure.

3-20. SPECIAL SUBROUTINES AND SYSTEM RECONFIGURATION ROUTINES.

3-21. The special subroutines (figure 2) provide procedures too complex or lengthy for the symptom routine format (e. g., manual thrust vector control). The subroutines may be entered from several symptom routines. These subroutines will be referenced in the malfunction procedure.

3-22. The reconfiguration routines (figure 2) provide procedures utilized subsequent to system failures (e. g., fuel cell shutdown). The routines initially consider the mission constraints and the relationship of the effects of the failure on other subsystems. These routines will be referenced in the malfunction procedure.



3-23. Normally in both the special subroutines and the reconfiguration routines, the use of step-by-step switching and logic tasks would be more complex than a corresponding narrative statement. As an example, removing a faulty fuel cell from the line prior to shutting it down is simple, but the variables involved (present fuel cell-to-bus tie configuration and desired reconfiguration) defy practical listing at the switching level. Therefore, the following, simpler format will be used providing it clearly defines the action required, including any subsequent branching.

1. Reconfigure fuel cell bus ties such that Main Bus A and B are both powered (as desired) by the remaining fuel cells.
2. FC1 (2, 3)-MN BUS A and B sw - OFF
3. FC1 (2, 3)-MB BUS A and B TB - BP
4. FC1 (2, 3)-REACS sw - OFF
5. FC1 (2, 3)-REACS TB - BP
6. FC1 (2, 3)-PUMPS sw - OFF

If the simpler format does not clearly define the complex action, the procedure must be formulated similar to the symptom routines.

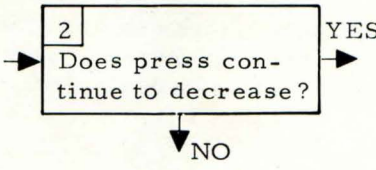
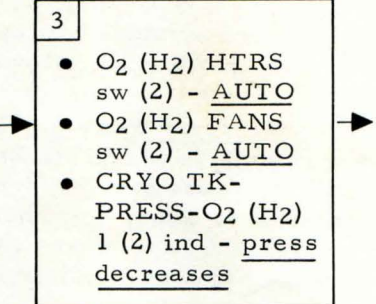
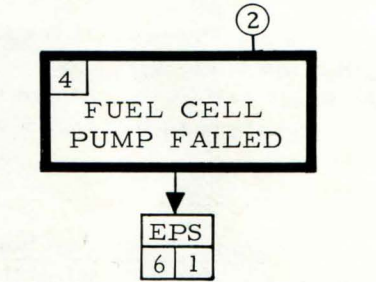
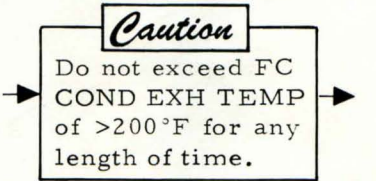
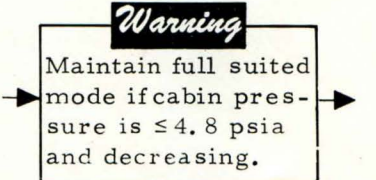
#### 3-24. MALFUNCTION ROUTINE SYMBOLS.

3-25. To readily identify a symptom, action, decision, failure, etc., several types of logic block symbols are used in the malfunction procedures. These symbols and their use are described in the following paragraphs.



Description	Symbol						
<p>3-26. SYMPTOM COLUMN LOGIC BLOCKS. The two types of symptom blocks, used for entry into the malfunction procedures, are the "C/W Status Light" and "Other Symptom" blocks. These two blocks, along with supporting information under each block, should explain and qualify the situation so the user fully understands the symptom or condition that exists. All symptoms will be arranged by systems, i. e., G/N, SCS, SPS, RCS, etc., and will be numbered in sequence starting with number 1 for each system. A sub-symptom that is directly related to a major symptom is identified by using the same number followed by a lower case letter, 1a, 1b, 1c, etc. Symptom logic block descriptions are as follows:</p> <p>a. <u>C/W Status Light Block</u>. This symptom block will have the appearance of a panel status light, with the name of the light within the block. The color of the light will appear directly below the block. Any additional explanatory notes, i. e., C/W parameters which trigger the light on, etc., should also appear under the block. This symbol will, in most cases, represent a major symptom.</p> <p>b. <u>Other Symptom Block</u>. The other symptom block covers all malfunction symptoms not covered by C/W status light blocks. This will include such items as abnormal meter readings, intercom lost, TV not transmitting, SC tumbling, etc. Since these blocks will have only one exit branch, describe only a single condition for a particular symptom (e. g., 02 FLOW HI not 02 FLOW HI OR LOW). This type of block can be as a major symptom or as a secondary entry point for sub-symptoms which are directly related to a major symptom. Directly below the block, list such information as: low pressure limit and/or high pressure limit (depending on a particular symptom), normal operating pressure range, etc.</p>	<div data-bbox="1166 640 1442 752" style="border: 1px solid black; padding: 5px; text-align: center;">             CRYO PRESS           </div> <p style="text-align: center;">LIGHT COLOR</p> <p>Light on if:</p> <p>H<sub>2</sub> - ≤ 220 psia - ≥ 270 psia</p> <p>O<sub>2</sub> - ≤ 800 psia - ≥ 950 psia</p> <p>1a. <div data-bbox="1159 1003 1429 1111" style="border: 1px solid black; padding: 5px; display: inline-block;">             O<sub>2</sub> (H<sub>2</sub>) Tank 1 (and/or 2) press low           </div></p> <p>Low press limits:</p> <p>H<sub>2</sub> - 220 psia O<sub>2</sub> - 800 psia</p>						
<p>3-27. PROCEDURE COLUMN LOGIC BLOCKS. The procedure column presents a step-by-step logic flow diagram of actions and decisions to be used to isolate or correct a malfunction symptom. This information is presented with several types of logic blocks. Blocks containing crew actions will use the abbreviated checklist style format, not a general statement to perform a task. Each procedural step will be identified by a dot. The meaning and use of all procedure column blocks is as follows:</p> <p>a. <u>Procedural Block</u>. This block is actually an action/decision block. It will contain a step number, an identification or description of the action to be performed, and the sequence of crew actions required to accomplish a desired function. The lower or decision portion of the block contains a question relative to a panel display or S/C condition. This is the point where branching to alternate procedure paths will occur.</p>	<div data-bbox="1130 1675 1481 1930" style="border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30px; text-align: center;">1</td> <td>ISOLATE SURGE TK</td> </tr> <tr> <td colspan="2"> <ul style="list-style-type: none"> <li>• O<sub>2</sub> PRESS IND sw - SURGE TANK</li> <li>• O<sub>2</sub>-SURGE TK vlv - OFF</li> </ul> </td> </tr> <tr> <td colspan="2" style="text-align: center;">O<sub>2</sub> FLOW ?</td> </tr> </table> </div> <div style="text-align: right; margin-top: -20px;">       HI →     </div> <div style="text-align: center; margin-top: 10px;">       ↓ LOW     </div>	1	ISOLATE SURGE TK	<ul style="list-style-type: none"> <li>• O<sub>2</sub> PRESS IND sw - SURGE TANK</li> <li>• O<sub>2</sub>-SURGE TK vlv - OFF</li> </ul>		O <sub>2</sub> FLOW ?	
1	ISOLATE SURGE TK						
<ul style="list-style-type: none"> <li>• O<sub>2</sub> PRESS IND sw - SURGE TANK</li> <li>• O<sub>2</sub>-SURGE TK vlv - OFF</li> </ul>							
O <sub>2</sub> FLOW ?							



Description	Symbol
<p>b. <u>Decision Block</u>. This block represents a decision that will branch procedures to alternate paths. The block will ask a question that is relative to a panel display, a function, or condition. Several decision blocks may appear one after another to arrive at a specific condition. The block will contain a step number followed by a question which requires a decision.</p>	
<p>c. <u>Action Block</u>. The action block is used to identify crew actions only. It is used to group actions to which a note or remark may be applicable. The actions could be the terminal steps of a procedural sequence.</p>	
<p>d. <u>Failure Block</u>. This block contains a step number and a brief description or statement of the failure. The block is outlined with a heavy border to readily identify the failure. A reference symbol usually appears with this block to identify a status of system statement in the remarks column. If special sub-routines or reconfiguration routines are required after the failure block, they will be referred to by a remote event symbol.</p>	
<p>3-28. <u>SPECIAL NOTE BLOCKS</u>. Three types of special note blocks are used in malfunction logic diagrams. These blocks are as follows:</p>	
<p>a. <u>Caution Block</u>. The caution block appears in the procedure or remarks column usually before the action or condition it describes. It alerts the crew to conditions which may degrade the operational integrity of the system and/or affects the safety of the crew. Caution blocks will not have a step number.</p>	
<p>b. <u>Warning Block</u>. This block also appears within the procedure or remarks column, usually before the action or condition it describes. It alerts the crew to a condition that if not corrected immediately, will have critical crew safety consequences. Warning blocks will not have a step number.</p>	



## Description

## Symbol

c. Special Notes. Notes may follow action items in procedural blocks to describe a status or condition the crew should be aware of prior to the next step. The notes will not involve crew safety.

3-29. REMOTE EVENT SYMBOLS. Three types of remote event symbols will appear in the procedure column. They are identified as follows:

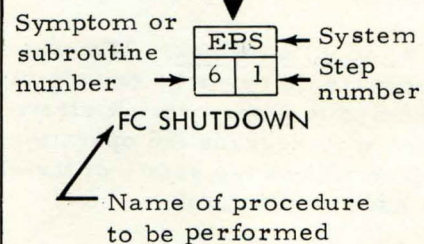
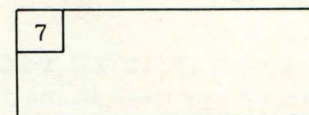
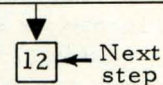
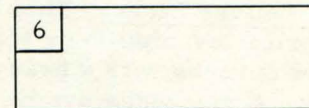
a. Reference Symbol. This symbol refers to an applicable remark in the Remarks column. The remark may identify a failure in more detail, describe the status of the system or subsystem that exists, explain the urgency at which the failure must be treated, etc. The two reference symbols should line up with one another whenever possible.

b. Next Procedural Step. This symbol refers to a step within the same symptom. It may follow a procedural, decision, action, or failure block. The number within the symbol refers to the next step to be followed.

c. Remote Event Symbol. The remote event symbol refers to a step not within the same symptom. In fact, the symbol may refer to a symptom and step number of another system. This symbol will usually follow a procedural, decision, or failure block. Directly below the symbol will be the title of procedures to be performed.

5	UPRIGHT S/C
• FLOAT BAG sw (3) - FILL <b>NOTE:</b> Nominal uprighting time with two compressors is ≈6 minutes	

	REMARKS
②	② FC pump failure caused by contamination or internal pump failure





3-30. QUANTITATIVE VALUES.

3-31. All quantitative values used in malfunction procedures to define pressure, temperature, voltage, flow, quantity, etc., shall be true rather than indicated (true values adjusted for instrumentation errors). Latest instrumentation calibrations will be used during flight.

3-32. NOMENCLATURE, ABBREVIATIONS, AND ENGINEERING SYMBOLS.

3-33. The nomenclature, abbreviations, and engineering symbols as specified in the List of Standardized Apollo (CSM) Panel Nomenclature and Abbreviations, SD 67-633, will be used.

3-34. DIAGRAM AND LAYOUT PARAMETERS.

3-35. The logic flow diagrams will be originated by the engineering department on 2-up page masks. All procedure lettering shall be as large or larger than standard IBM type to ensure adequate space for final layout by the art group. The production group will typewrite all data on waxed paper utilizing standard IBM characters. The art group will paste-up the data and finalize the diagrams utilizing an erasable pencil on 2-up page masks. The page masks are available from the production department.

3-36. The layout and sequencing of data for each system (figure 2) by the production department will include the following.

- a. Procedure entry sheets start at the top of a right hand page.
- b. Symptom routines, special subroutines, and system reconfiguration routines start at the top of a page.
- c. If any routine or subroutine requires more than one page, the procedure starts at the top of a left hand page.
- d. Special subroutines and system reconfiguration routines start on a separate sheet.
- e. Unless otherwise specified in a through d, all sheets are printed on both sides.

3-37. QUALITY

3-38. Prior to final printing and distribution of the malfunction procedures, Department 671 will submit advance copies to the NASA for review. During this review period, Department 671 will analyze the data to ensure compliance with the requirements of this report and for configuration currency



commensurate with the cutoff date. Upon receipt of the NASA review comments, Department 671 will compile all intra-department and NASA comments. The composite comments will then be submitted to the engineering department for consideration and incorporation. In the event that new data must be created by the engineering department in response to the comments, the foregoing review cycle will be repeated.



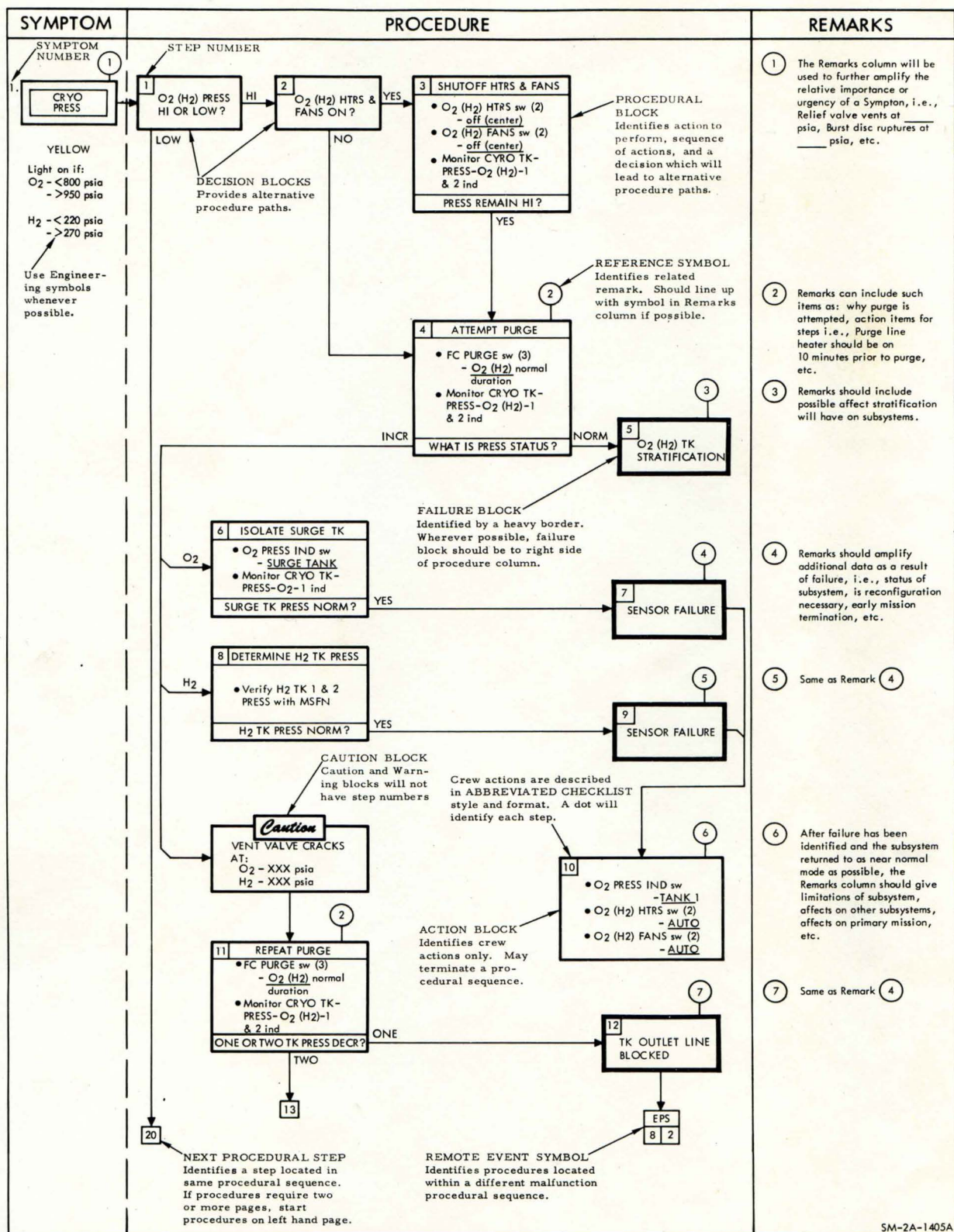


Figure 3. Typical Malfunction Procedure



Accession No. \_\_\_\_\_

SD 67-671A

GENERAL STYLE AND  
QUALITY REQUIREMENTS  
for  
APOLLO OPERATIONS HANDBOOK  
CREW MALFUNCTION PROCEDURES

1 August 1967

Reissued 1 October 1967



This issue voids and supersedes the  
1 August 1967 issue in its entirety.

NORTH AMERICAN AVIATION, INC.  
SPACE DIVISION



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## INTRODUCTION

This style guide provides the data necessary for the administration and preparation of the crew malfunction procedures, a section of the SM2A-03-(Series) Apollo Operations Handbooks.

To ensure consistencies in procedures prepared by various departments and contractors, the NASA implemented certain requirements which are reflected in this style guide. The requirements include the general rationale to be employed while utilizing prescribed rules of formatting and content, a block diagram of the malfunction procedure development rationale, and a sample procedure which illustrates the various types of logic blocks and other data used in writing the malfunction procedures.



CB/SWIGERT

OCT 30 1967

SD 67-935

GENERAL STYLE AND  
QUALITY REQUIREMENTS  
for

APOLLO OPERATIONS HANDBOOK  
NORMAL/BACKUP AND CONTINGENCY  
PROCEDURES

1 October 1967



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GENERAL STYLE AND  
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for

APOLLO OPERATIONS HANDBOOK  
NORMAL/BACKUP AND CONTINGENCY  
PROCEDURES

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## SECTION I

### GENERAL REQUIREMENTS

#### 1-1. TYPE OF HANDBOOK TO BE PREPARED.

1-1.1. The AOH, Volume 2, is a real time flight operational document. It presents comprehensive real time procedures that assist the mission controllers in carrying out their function of supporting the flight crews. In addition, the accompanying rationale throughout the handbook provides the controllers with material not contained in the Flight Crew Abbreviated Checklist available to the astronauts. The AOH is also valuable as a training aid to the mission controllers, astronauts, simulator operators, and others during the intensive training period preceding each flight.

1-1.2. The AOH, Volume 2, contains expanded Normal/Backup and Contingency operational procedures with supporting rationale. The procedures are specific, in that they provide detail control and display requirements, sequenced such that any specific mission phase can be successfully accomplished with maximum efficiency.

1-1.3. The supporting rationale provides the user of AOH, Volume 2, with a variety of valuable information. Included is backup material, clarification of obscure data, limitations placed on particular procedures, and amplification of unique operating methods established by joint NASA/NAA agreements. All such data may be required to augment the Flight Crew Abbreviated Checklist, which consists only of procedures.

#### 1-2. INTENDED AUDIENCE.

1-2.1. The intended audience for the AOH includes the Apollo flight crews, the mission flight controllers, the spacecraft simulator operators, and others whose area of responsibility lies primarily within the categories of spacecraft test and checkout procedures, and/or flight operational procedures.

#### 1-3. SPECIFICATIONS.

1-3.1. The AOH, Volume 2, is prepared in accordance with the following applicable documents:

- a. The Documentation Requirements of Contract No. NAS9-150. Exhibit I.



- b. Specification, Apollo Operations Handbook, Command and Service Module (Ref) ACN 1376.
- c. SD 67-633—List of Standardized Apollo (CSM) Panel Nomenclature and Abbreviations.
- d. ICD MH01-05174-414—Nomenclature, Markings and Color (CM/LM Control and Display Standardization).
- e. SD 67-671—Apollo Operations Handbook Crew Malfunction Procedures General Style and Quality Requirements.

#### 1-4. ELEMENTS OF THE AOH.

Volume 2 of the AOH basically consists of sections 4 and 5. However, a total of five elements make up the volume, and are listed as follows:

##### 1-4.1. Front Matter.

Front matter consists of those pages containing introductory-type material and general information concerning the handbook. This takes in all of the pages that precede the operational procedures sections.

##### 1-4.2. Section 4, Normal/Backup Procedures.

Section 4 shall contain the flight crew normal (automatic or manual) and backup operating procedures for the specific spacecraft and its assigned mission.

Backup and prime crew procedures shall be included to cover all operational requirements from the time of backup crew ingress prior to launch through prime crew postlanding functions.

The normal procedures are used if all systems and trajectories are "GO" and the CSM is operating according to expectations. Backup procedures are those used to accomplish the objective of the normal procedures when equipment or system failure, or some other anomaly prevents use of the normal procedures. Performance data, as necessary to support the procedures, shall be integrated into the procedures at appropriate locations.



The contents of section 4 shall consist of the following subsections (by spacecraft) in the order shown.

a. Spacecraft 101 Only

<u>Subsection</u>	<u>Title</u>
4. 1	Backup Crew Prelaunch
4. 2	Prime Crew Prelaunch
4. 3	Boost-Insertion & Separation
4. 4	Rendezvous
4. 5	Systems Management
4. 6	G&C Reference Data
4. 7	G&C General
4. 8	IMU Alignment
4. 9	Coasting
4. 10	Orbit Change Preparation
4. 11	G&N Orbit Change
4. 12	SCS Orbit Change
4. 13	Deorbit & Entry Preparation
4. 14	G&N Deorbit & Entry
4. 15	SCS Deorbit & Entry
4. 16	Earth Landing
4. 17	Postlanding



## b. Spacecraft 103 and Subs

<u>Subsection</u>	<u>Title</u>
4. 1	Backup Crew Prelaunch
4. 2	Prime Crew Prelaunch
4. 3	Boost-Insertion & Separation
4. 4	Translunar Injection
4. 5	LM Interface
4. 6	Rendezvous
4. 7	Systems Management
4. 8	G&C Reference Data
4. 9	G&C General
4. 10	IMU Alignment
4. 11	Coasting
4. 12	Orbit Change Preparation
4. 13	G&N Orbit Change
4. 14	SCS Orbit Change
4. 15	Deorbit & Entry Preparation
4. 16	G&N Deorbit & Entry
4. 17	SCS Deorbit & Entry
4. 18	Earth Landing
4. 19	Postlanding



1-4.3. Section 5, Contingency Procedures.

Section 5 shall contain abort, malfunction, and emergency procedures required by the flight crew for the specific spacecraft and its assigned mission.

- a. Section 5.1. Abort Procedures\* shall contain flight crew operating procedures for all abort modes. All action items (automatic or manual) shall be timelined from the point of abort initiation.
- b. Section 5.2. Malfunction procedures shall be prepared in accordance with Apollo Operations Handbook Crew Malfunction Procedures General Style and Quality Requirements, SD 67-671.
- c. Section 5.3. Emergency Procedures\* shall contain pad and flight procedures which deal with emergency situations requiring immediate action to avoid or alleviate hazards to the crew. The format shall be the same as the normal/backup procedures.

1-4.4. Appendix B. (Appendix A is in Volume 1.)

Figures B-1, B-2, and B-3, Crew Displays and Controls.

1-4.5. Index.

The size and contents of the AOH, Volume 2, make it necessary that an alphabetical index be compiled and incorporated at the back of the handbook.

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\*Performance data, as necessary to support the procedures, shall be integrated into the procedures at appropriate locations.



## SECTION II

## FRONT MATTER

The front matter shall include the following in the sequence indicated:

- Title page
- List of effective pages (A page)
- Foreword
- Table of contents
- List of illustrations
- List of tables

## 2-1. TITLE PAGE.

Refer to figure 2-1 for a typical title page.

## 2-2. LIST OF EFFECTIVE PAGES (A PAGE).

The list of effective pages shall include all of the pages in the handbook, including those of the front matter and all blank pages. The number of entries shall be kept to a minimum by listing blocks of consecutive page numbers as a single entry. The format shall be as shown in figure 2-2. The A page shall back up the title page.

## 2-3. FOREWORD.

The foreword, which shall be placed on a right-hand page, shall contain NASA contract information as follows:

"NASA comments or suggested changes to this handbook should be addressed to the Spacecraft Systems Branch, FCSD, MSC, Office Code CF22, Telephone HU3-5558."

## 2-4. TABLE OF CONTENTS.

The table of contents shall list the numbers and titles of sections and main paragraphs (primary and first subordinate sideheads) with their initial page numbers. Regardless of the number of pages required, the table of contents shall always commence on a right-hand page.



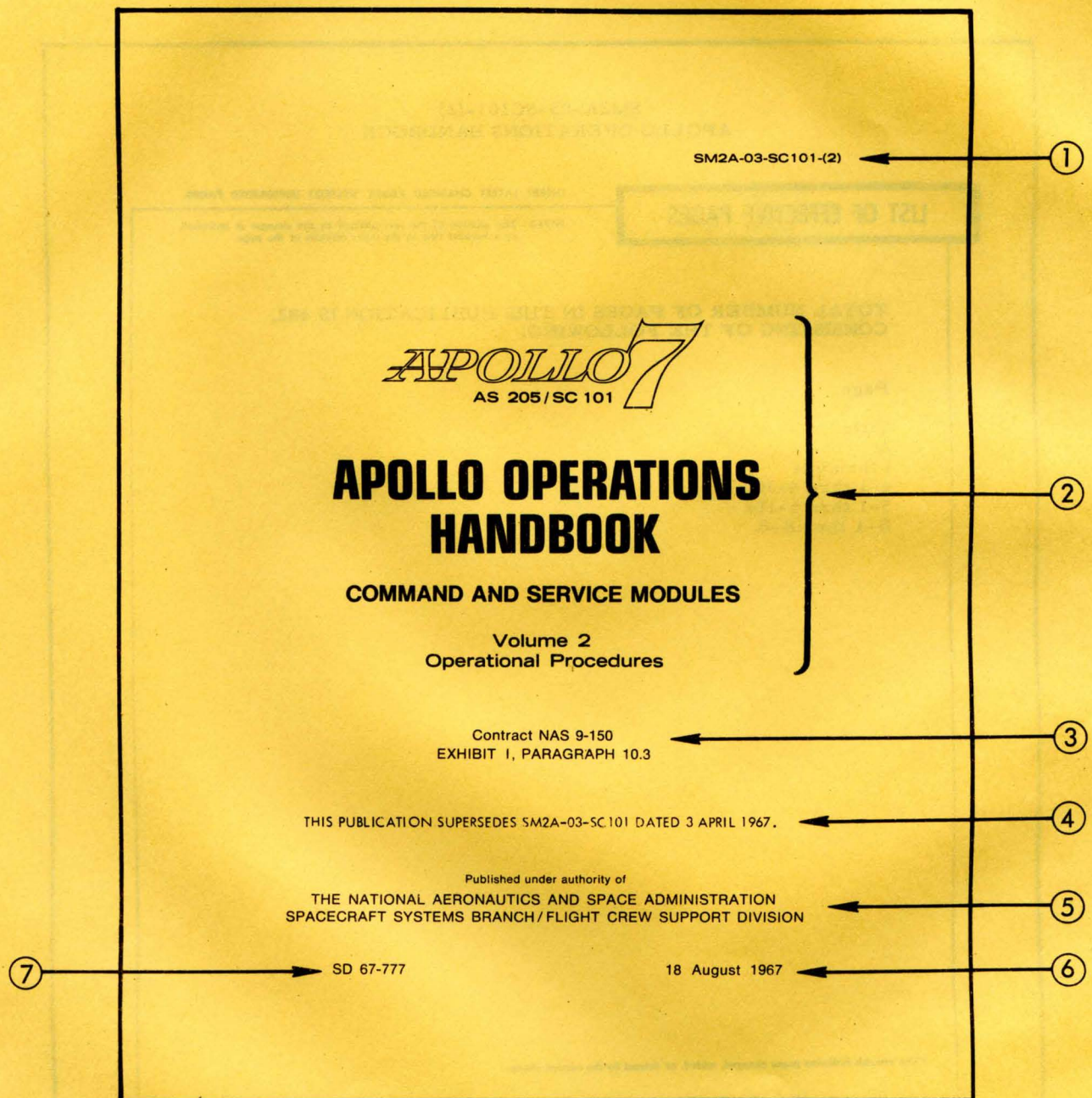
## 2-5. LIST OF ILLUSTRATIONS.

A list of illustrations shall immediately follow the table of contents, and shall show the figure number, title, and page number of each illustration. If an illustration consists of more than one page, only the initial page number is listed.

## 2-6. LIST OF TABLES.

Although tabular data appears throughout the handbook in the procedure and remarks columns, it is not identified as such, and thus the requirement for a list of tables is not applicable. The tabular data is so closely associated with particular procedures that reference to it in itself is of little value without the procedure it supplements.





- |                    |                         |                    |
|--------------------|-------------------------|--------------------|
| ① DOCUMENT NUMBER  | ④ RELEASE STATEMENT     | ⑥ PUBLICATION DATE |
| ② TITLE-MISSION-SC | ⑤ PREPARATION DIRECTIVE | ⑦ SD NUMBER        |
| ③ CONTRACT NUMBER  |                         |                    |

Figure 2-1. Typical Title Page



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INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

**LIST OF EFFECTIVE PAGES**

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 482,  
CONSISTING OF THE FOLLOWING:

Page

Title

A

i thru viii

4-1 thru 4-302

5-1 thru 5-162

B-1 thru B-8

\*The asterisk indicates pages changed, added, or deleted by the current change.

Manuals will be distributed as directed by the NASA Apollo Project Office. All requests for manuals should be directed to the NASA Apollo Spacecraft Project Office at Houston, Texas.

Basic Date 18 August 1967 Change Date \_\_\_\_\_ Page A

Figure 2-2. Typical A Page



### SECTION III

#### PROCEDURE REQUIREMENTS

##### 3-1. PROCEDURE STYLE.

3-1.1. Normal/Backup procedures and supporting rationale (remarks), shall be presented in two-column format consisting of a Procedure column and a Remarks column.

3-1.2. The procedures shall be specific, brief, and distinct. As a rule, each instructional step shall form a line having a maximum of 38 characters including spaces, hyphens, and dashes. Spacecraft panel nomenclature has been especially shortened to satisfy the 38-character requirement, and to promote overall brevity of the procedures.

3-1.3. Rationale supporting related instructions shall be presented in the Remarks column. Rationale or remarks need not follow the 38 character concept, but should, however, be as brief and distinct as possible. Unnecessarily long sentences and paragraphs hinder the sequential continuity of the procedures.

##### 3-2. PROCEDURE FORMAT.

3-2.1. As delineated in paragraph 1-4, Volume 2 is divided into a number of subsections. The format of material presented in each subsection shall conform to established ground rules as exhibited in this style guide.

3-2.2. Typical procedural instructions are displayed in figure 3-1, and depict the accepted manner of presentation. Individual characteristics of pertinent procedural elements as indicated by codes in figure 3-1 are described as follows:



STA/T STEP	PROCEDURE	PANEL	REMARKS
4.13	ORBIT CHANGE PROCEDURES		Subsection title (first order)
4.13.1	G&N ORBIT CHANGE (P40)		Main heading or procedure title; states subject of procedures that are to follow (second order)
4.13.1.1	<u>ΔV Preparation</u>		Subprocedure title; shows transition & indicates that block of steps & substeps that follow are subordinate to the main heading (third order)
1	Obtain ΔV parameters		} Numbered steps
2	G&C BASIC except Jet and Channel Select - as desired FDAI-SCALE - 5/5 FDAI-1 - rates <5°/sec		
3	SC CONT - CMC		
4	Load DAP (fig. 4.6.2) CMC MODE - HOLD FDAI-SCALE - 5/1 FDAI-1 - rates <1°/sec Check boresight star		Step (fourth order) Substep (fifth order) Sub-substep (sixth order)
5	Maneuver to ΔV attitude		Step
a.	G&N Maneuver Monitor FDAI		} Lettered steps
or b.	Manual Maneuver RHC - maneuver to final gimbal angles		

Basic Date \_\_\_\_\_ Change Date \_\_\_\_\_ Page \_\_\_\_\_

①

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Figure 3-1. AOH Procedure Format (Sheet 1 of 7)



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Basic Date \_\_\_\_\_ Change Date \_\_\_\_\_ Page \_\_\_\_\_

STA/T STEP	PROCEDURE	PANEL	REMARKS
4.1	<p>BACKUP CREW PRELAUNCH CHECKS</p> <p>This subsection consists of operational and configuration checks performed by the backup flight crew prior to prime crew ingress to the command module. It is assumed that a complete prelaunch checkout, including loose gear stowage, has been performed by ground support personnel prior to backup crew ingress, and that all systems are in an active configuration at this time. Procedures include the following:</p> <ul style="list-style-type: none"> <li>• Preliminary Procedure</li> <li>• EMS Prelaunch Tests</li> <li>• Panel Configuration Checks</li> <li>• Pre-egress Procedures</li> </ul>		
4.13.1	G&N ORBIT CHANGE PROGRAM (P40)		
	<p>The purpose of this procedure is:</p> <ul style="list-style-type: none"> <li>• To compute preferred CSM attitude and IMU orientation for an SPS thrusting maneuver.</li> <li>• To maneuver the CSM to the thrusting attitude (R60).</li> </ul>		
LMP 7	SPS PRPLNT TK-PRESS-F & OXID ind (2) - 170-195 psia		
8	Perform ECS Monitoring Check 1 & 3, para 4.4.4		
3	Normal operating pressure after tank is pressurized with He is 170-195 psia. GSE servicing pressure is 110 psia.		

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Figure 3-1. AOH Procedure Format (Sheet 2 of 7)



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Basic Date	STA/T STEP	PROCEDURE	PANEL	REMARKS
13	CMP 12:00 6	FL V06 N87 (Mark Data) { Shaft      XXX.XX DEG Trun      XX.XXX DEG	2	
	4.13.1.2 G&N SPS Thrusting Procedures			
16	CMP 10:00 1	Key V37E 40E (Poss P05 or P51)	2	
Change Date	CDR, CMP 2	FL V06 N33 { GETI      00XXX. HR 000XX. MIN 0XX.XX SEC		
13	CDR,CMP 00:10 3	FL V06 N93 ΔV gyro angles X,Y,Z    XX.XXX DEG		
13	CMP 00:05	V33E		Gyro torquing permitted - IRIG's pulsed through desired range.
Page	4	Key V82E		Calls up R30.
13	5	FL V06 N40 TTI/cutoff      XXBXX. MIN-SEC VG              XXXX.X FPS ΔV (accumulated)    XXXX.X FPS Accept    ENTR Reject    PRO P20 (if running concurrently with P40)		

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Figure 3-1. AOH Procedure Format (Sheet 3 of 7)



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STA/T STEP	PROCEDURE	PANEL	REMARKS
ALL 2 CDR	G&C BASIC except Jet and Channel Select - as desired FDAI-SCALE - 5/5 FDAI-SOURCE - CMC  (R03 - DAP Data Load)	1,8 1	<p>Figure 4.6-2, DAP Data Load Procedures, provides all data necessary for selecting G&amp;N controlled deadband, maneuver rate, - - - - -, etc.</p> <p>Limit cycling and minimum deadband is maintained after maneuver is performed.</p>
3	Maneuver to ΔV attitude		
CDR CMP	<p>If P47, FDAI SELECT - 1</p> <p>a. Key V33E (terminates P47)</p> <p>or b. Key V32E (zeros display) FL V50 NO7 Key V37E 00E</p>	1	

Basic Date \_\_\_\_\_

Change Date \_\_\_\_\_

Page \_\_\_\_\_

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Figure 3-1. AOH Procedure Format (Sheet 4 of 7)



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STA/T STEP	PROCEDURE	PANEL	REMARKS
CMP	CM RCS PRPLNT TB (2) - BP	2	Indicates at least one valve closed in each system.
LMP	MAIN BUS TIE (2) - OFF	5	
CDR +00:01	AV THRUST-A - OFF	1	Guarded switch.
CDR	FLOOD-DIM - 1 or 2	8	
	CABIN PRESS REL vlv (2) - CLOSE	325	

CAUTION

MAIN BUS TIE switches must be left in OFF position, or power drain on batteries A, B, and C will result during postlanding.

WARNING

Do not close CABIN PRESS REL valves above 1000 feet, or negative cabin pressure may rupture CM at splashdown.

Basic Date \_\_\_\_\_

Change Date \_\_\_\_\_

Page \_\_\_\_\_

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Figure 3-1. AOH Procedure Format (Sheet 5 of 7)



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STA/T STEP	PROCEDURE	PANEL	REMARKS
CDR 00:00 6	THRUST ON PB - push EMS-SPS THRUST lt - on	1	
	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX X No ignition - check ECO lt No ECO - terminate maneuver X XXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
CMP	CM RCS pressurize (auto)	X X CM RCS-PRESS - X PRESS	Guarded switch.
	RCS control transfer (auto)	X X RCS-TRNFR - CM X	CM and SM positions are momentary.
CDR	LE motor fire (auto)	X X LES MOTOR FIRE X PB - press	Guarded pushbutton. Pitch control motor will not fire.
CMP 00:01	SCS/RCS enable (auto)	X X RCS-CMC - ON X	CM and SM positions are momentary.

ENTRY PROCEDURES

NORMAL BACKUP

Figure 3-1. AOH Procedure Format (Sheet 6 of 7)

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Basic Date \_\_\_\_\_ Change Date \_\_\_\_\_ Page \_\_\_\_\_



STA/T STEP	PROCEDURE	PANEL	REMARKS
5.3	EMERGENCY PROCEDURES		
	INTRODUCTION		
	Emergency procedures provide the crew with the necessary steps to quickly alleviate situations that have (or will) become both crew hazardous and time critical. These procedures require instant reaction on the part of the crew to prevent the conditions from becoming worse. In most instances the conditions are physically sensed by the crew rather than brought to their attention by the caution and warning system or voice communication from MSFN.		
5.3.1	FLIGHT EMERGENCY PROCEDURES		
5.3.1.1	<u>Fire/Smoke in CM</u>		Fire in the CM cabin is extremely hazardous because of the 100-percent oxygen atmosphere. However, the capability exists to quickly extinguish any fire originating inside the CM by depressurizing the cabin.
ALL	1 Unsited crewman don PGAs		
CDR	2 Set controls DIRECT O2 vlv - OPEN (CCW)	7	Suit circuit isolated from cabin atmosphere by differential pressure; also commences purge of suit circuit.
CMP	EMERG CABIN PRESS vlv - OFF	351	
	CABIN REPRESS vlv - close (CCW)		
	CABIN PRESS REL vlv (lower) - DUMP (safety latch off)	325	Lower valve has four positions. Approximately 2 minutes required to dump cabin.
	Open upper attenuation panel		Covers panels 381 and 382.
	SUIT CIRC RET SHUT-OFF VLV - C (closed, CW)	381	Mechanically isolates suit circuit from cabin atmosphere.
CDR	Close upper attenuation panel DIRECT O2 vlv - close (CW)	7	

EMERGENCY PROCEDURES

IN THE GENCY

Figure 3-1. AOH Procedure Format (Sheet 7 of 7)

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Change Date

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CodeDescription**①** Paragraphing and Subordination

The examples appearing under this code number (sheet 1) demonstrate the various orders of paragraphing, subordination, indenting, and the spacing between lines. Although the examples and explanations make all entries self-explanatory, the following is presented for further clarification.

- a. That third-order headings are underlined.
- b. That numbered steps may be a single command or a command with any number of substeps. Also, if any substep requires a result, it shall be indented and appear in the next line.
- c. That steps or substeps requiring more than one line of text shall have the subsequent lines indented.

**②** STA/T Column

The station (STA) is equivalent to the crewmember assigned to the spacecraft location where a procedure or step is performed. Station CDR (commander), CMP (command/service module pilot), and LMP (lunar module pilot) correspond to the left, center, and right crew couch position, respectively. CMP is also used as the station designator pertaining to the equipment bays inaccessible to the other crewmembers. When the three crewmembers are delegated to perform a task, the word "All" shall be used. (See sheet 4.) If two crewmembers are delegated to perform a task, both station designators shall be called out. Station designators shall always be displayed adjacent to the first step on each page.

The time (T) column may contain mission time, event time, altitude, or spacecraft events (e.g., 0.5 g), as appropriate. Each entry shall be positioned in the T column, but because of its length will extend into the step column. Where a step is a complete operation (no substeps), the T entry shall take the place of the usual step number.

**③** STEP column

The STEP is the numerical identification of the elements to be followed and their sequence in performing a procedure. Step numbers shall be a combination of the Dewey decimal numbering



CodeDescription

system, Arabic numbers, and letters used in a manner which properly subordinates respective procedures.

Additional ground rules have been established for the STA/T and STEP columns because of limited space in each. Examples of these deviations appear on sheet 3, and are described as follows:

- a. Where a single station designator (or "All") and a time entry apply to a substep (no step number); the station and time shall be placed side-by-side, with the time extending into the step column.
- b. Where a single station designator (or "All") and a time entry apply to a numbered step; the station shall be placed on the line above the applicable step, and the time on the line of the step.
- c. Where two station designators apply to a substep (no step number); they shall be placed side-by-side, with the second extending into the step column.
- d. Where two station designators apply to a numbered step; the first shall be placed on the line above the applicable step, and the second on the line of the step.
- e. Where two station designators and a time entry apply to a numbered step, or a substep (no step number); the stations shall be placed side-by-side on the line above the applicable step, with the second extending into the step column, and the time placed on the line of the step.

④

## PROCEDURE Column

The PROCEDURE is an overall task or group of properly sequenced steps that are involved in performing a complete function or operation.

⑤

## PANEL Column

The PANEL column contains the location of a particular control or display by panel number. If one operation requires the use of more than one panel, all applicable panels shall be called out. (See sheet 4.) The panel number shall always be entered with the first applicable step or substep on each page.



CodeDescription

⑥

## REMARKS Column

Rationale supporting adjacent procedures shall be provided in the REMARKS column. Performance data, operational parameters, and other useful information necessary to augment instructions in the procedure column shall be included in the REMARKS column. Each remark shall be as brief as is practical, and shall be placed opposite its relative instruction in the procedures column.

⑦

## Introductory Paragraph

Each subsection shall have an introductory paragraph describing, generally, the content of the subsection. General instructions and information common to all procedures within the subsection, shall be included. Information unique to a portion of the procedures may be included, but shall be identified with the procedures the information will influence. The introductory paragraph shall be written full page width with conventional margins as shown on sheet 2.

⑧

## Procedure Purpose

The purpose of each procedure (sheet 2) shall be placed in the remarks column opposite the procedure title. The description should be brief, but provide the reader with a knowledge of what is to be accomplished. If two or more purposes are listed, bullets (●) shall be used to identify these.

⑨

## Parameter Ranges

Whenever an indicator readout is not required to be an exact figure, but may fall within a given range, the limits of that range shall be called out rather than the nominal figure with a plus and minus tolerance. (See sheet 2.)

⑩

## References

References (sheet 2) are limited to procedures or data appearing elsewhere in the handbook. Material used more than once during a mission shall not be repeated. Instead, it shall appear once in its entirety and reference to that location be made thereafter. This applies whether it be to a partial or complete procedure, a table, or an illustration.



<u>Code</u>	<u>Description</u>
(11)	<p>G&amp;N Routines</p> <p>To identify routines within G&amp;N procedures, the routine number and title are placed in parentheses, as shown on sheet 4.</p>
(12)	<p>DSKY Callup</p> <p>The word "Key" has been established as the simple command to precede the callup of any computer program or routine. (See sheet 4. )</p>
(13)	<p>DSKY Registers</p> <p>The four examples (sheet 3) illustrating how DSKY register data shall be written include the following information: variations in the number of registers activated; the different types of parameters that can be displayed (including mixed parameters); the use of "B" for indicating blank register windows; the use of one entry where all register displays are alike; the placement of decimals; and the acceptance or rejection of the register display.</p>
(14)	<p>Crew Option</p> <p>Where there is more than one method of carrying out a step or procedure, only the desired result shall be called out. (See sheet 4. ) The optional methods of obtaining that result shall be left to the crew's discretion.</p>
(15)	<p>Optional Procedures</p> <p>When optional procedures exist (sheet 4), the options shall be identified by alphabetical lower case letters. The word "or" placed in the step column shall precede "b" and subsequent letters to show crew option.</p>
(16)	<p>Remarks—General</p> <p>The major portion of the notes appearing in the remarks column are of the general information type. (See sheets 3 and 4. ) They provide operational parameters and rationale relative to the entry in the procedures column. Bullets (●) shall be placed in front of two or more remarks that pertain to a particular step or procedure, but that are unrelated to each other.</p>



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Certain remarks that may be necessary to an operational procedure shall be placed in the procedure column. (See sheet 3.) This type remark shall be in parentheses and positioned immediately after the applicable step. Where there is carryover, or if space does not permit starting the remark on this line, the next line(s), which is indented, shall be used.

⑪

**Remarks—Supplemental Data**

Specific data on certain switches and on the positions of the talk-back indicators is placed in the remarks column. The requirement for this additional data is obtained from the asterisk (\*) and cross (†) items in SD 67-633, List of Standardized Apollo (CSM) Panel Nomenclature and Abbreviations. (See sheet 5.)

⑫

**Remarks—Performance Data**

Additional performance data relative to a procedural step shall be placed in the remarks column opposite that step, as shown on sheet 2.

⑬

**Cautions, Warnings and Notes**

Caution and warning statements shall be placed in the procedures column when it is imperative to direct the crew's attention to a potentially dangerous operational condition. These statements shall always precede the substep, step, or procedure to which they apply, to preclude the possibility of the wrong action being taken by the crew.

Warnings are used when the operational condition will result in injury to the crew, and/or damage to equipment that will lead to early mission termination, or be of a catastrophic nature. (See sheet 5.)

Cautions are inserted when the operational condition will cause equipment damage only, but not to the extent of becoming catastrophic. (See sheet 5.) This includes damage making is necessary to resort to backup or alternate equipment (or procedures), or that results in the loss of mission objectives or requirements.

When preparing cautions and warnings, the command or precautionary statement is always followed by the consequences resulting from non-compliance.



<u>Code</u>	<u>Description</u>
	The remarks column, explained in code 6, is specifically for the use of all supplemental data classified as notes. As such, the word "Note" above any remark in the AOH shall not be used.
(20)	Single Backup Procedures  A backup procedure (sheet 6) shall immediately follow the normal procedure to which it applies. For rapid identification as such, the backup procedure shall be placed between two horizontal rows of x's.
(21)	Successive Backup Procedures  Where individual backup procedures are required for two or more normal procedures in succession (sheet 6), the backup procedures shall be placed to the right of the normal procedures (omitting the panel numbers) and be separated by a vertical row of x's. If there are numerous backup procedures on one page, as in the abort section, the row of x's shall extend the length of the page.
(22)	Handbook Designation and Title  Each page of the AOH shall contain the handbook designation and title assigned by the NASA. (See sheet 5.) These should remain constant, except for changes to the spacecraft number to correspond to the applicable spacecraft.
(23)	Basic Date  The date of the basic AOH issue for each spacecraft (title page date) shall be placed in this block. (See sheet 5.) The date is to remain the same throughout subsequent changes to the AOH.
(24)	Change Date  All pages containing changed or added material shall have the change publication date inserted in the Change Date block (sheet 5). This requirement also applies to all added pages. Refer to paragraph 3-3 of this style guide for other details concerning changes.
(25)	Page Number  The number inserted in the Page block (sheet 5) shall consist of the handbook section number (4 or 5), a hyphen, and the number of the



CodeDescription

page within the section. The first page of each section shall be number one, and run consecutively as far as required. Where a blank left-hand page exists, the preceding page shall carry both page numbers with a slash between, i. e., 4-25/4-26. New pages shall be identified with the last preceding page number and consecutive capital letters, i. e., 4-72A, 4-72B, etc. New pages inserted at the end of a section shall pick up the consecutive numbering.

(26)

## Subsection Title

The applicable subsection title shall be placed at the bottom of each page, as shown on sheet 6. This will facilitate the locating of any procedure or referenced data within the handbook.

(27)

## Indexing Markers

An indexing marker (sheet 6) shall be placed on each right-hand page of sections 4 and 5. The markers shall consist of white letters on a black background, and be appropriately staggered along the unbound edge of the page according to category.

(28)

## Emergency Procedures

Emergency procedures shall be written in accordance with the style and format of the normal/backup procedures. However, to facilitate rapid location of the emergency procedures, all such pages shall be bordered with black and white diagonal stripes on all but the bound side of each page. (See sheet 7.)

## Procedure Pre-requisites

Conditions that have to be established, or procedures that have to be completed prior to beginning any given procedure, may be listed in the procedure column. Such pre-requisites, if any, should immediately follow the main heading, i. e., after 4.13.1 G&N ORBIT CHANGE PROGRAM (P40), figure 3-1, sheet 2.



## 3-3. HANDBOOK CHANGES.

Technical changes required in the handbook will include newly developed data, corrections or improvements generated by reviews, or the correction of significant errors. Non-technical changes in themselves are insufficient cause to change a page. After a technical change has been made on a page, however, non-technical changes on that page may also be incorporated. This updating procedure shall be accomplished on a scheduled frequency that is determined by vehicle launch dates.

Handbook changes shall be prepared in the same manner as the basic issue. Each change, whether it be a single word or several pages, shall be identified by a change symbol. This shall be in the form of a 1/16-in. vertical line extending the length of the material affected. On vertical pages the line shall be placed along the margin opposite the binding edge; on landscape pages it shall be along the left margin. An exception to the use of the change symbol will be for minor inaccuracies such as spelling, punctuation, or relocation of material, unless such a correction changes the meaning of the data or procedure. Previous change symbols on a page shall be deleted when that page is subsequently changed.

Changes affecting the numbering of steps, procedures, or paragraphs shall be handled in the following manner:

- a. Where a change deletes material and there is no replacement data, the formerly occupied space retains the same number with "Deleted" being inserted in the space. When a page is deleted and a blank page results, the statement "All data on page\_\_\_\_ deleted" is inserted in the bottom margin of the preceding page, or the top margin of the succeeding page. This also applies when two back-to-back pages are involved.
- b. Steps, procedures, or paragraphs added between existing ones shall be assigned the preceding number and a consecutive capital letter suffix. For example, 1A, 1B, 1C, or 4.8.1A, 4.8.1B, 4.8.1C. This same method applies to pages, except that such pages shall not be added between a right-hand (odd) and a left-hand (even) number page. If additional copy is added to a right-hand page, the over-run shall be carried to the next left-hand page and the over-run from that page placed on an added page. Therefore, added pages shall always be assigned even numbers, such as 2-4A, 2-4B, 2-4C.

Each page containing changed or added material shall have the change date placed in the appropriate space at the bottom of the page. This requirement is also applicable to all added pages.



## SECTION IV

### EDITORIAL STANDARDS

#### 4-1. GENERAL.

The editorial standards to be followed in AOH preparation are contained in S&ID Publication Style Guide, Section III Editorial Standards (PUB. 2541-A). Only the following subsections are applicable, however: Use of Abbreviations (rule 3 only), Acronyms, and Conventional Symbols; Number Terms; Capitalization; and Punctuation.

4-1.1. A deviation to the standard punctuation practice is required because the dash(—) is not included on the keyboard of the Selectric typewriter used in AOH production. As dashes are used repeatedly throughout the procedures, a hyphen with a space before and after will be substituted. The hyphen, as such, will be closed up. Example: ECS RAD-FLOW CONT-AUTO sw - AUTO.

#### 4-2. NOMENCLATURE—REGULAR AND SHORT-FORM.

It is essential in the preparation of the AOH that the nomenclature of all controls and displays be consistent throughout. This will be achieved by referring to the List of Standardized Apollo (CSM) Panel Nomenclature and Abbreviations, SD 67-633. Under certain conditions, many of these nomenclature items may be shortened. Examples of this short-form-type nomenclature is included in the referenced document.

#### 4-3. ABBREVIATIONS.

Extensive use of abbreviations in the handbook is encouraged, but each one must be in accordance with that tabulated in SD 67-633, List of Standardized Apollo (CSM) Panel Nomenclature and Abbreviations. This applies to individual words, short terms and phrases, or nomenclature for all the CSM controls and displays.

#### 4-4. SYMBOLS AND GREEK ALPHABET

A limited number of symbols and letters of the Greek alphabet have been approved for inclusion in the procedures. This tabulation appears in the List of Standardized Apollo (CSM) Panel Nomenclature and Abbreviations, SD 67-633.



## SECTION V

### ILLUSTRATIONS

#### 5-1. ILLUSTRATION POLICY.

Illustrations in this handbook (Volume 2) shall be kept to a minimum, and shall be line drawings.

#### 5-2. TYPES OF ILLUSTRATIONS.

##### 5-2.1. Line Drawings.

Line drawings shall be of high reproduction quality. Consistent high density tonal quality shall be maintained. Line weights shall be of a size that will reproduce clearly at the required reproduction size. Reproductions of final drawings will be acceptable provided artist aid patterns, etc., are sufficiently subdued to prevent excessive bleed in reproduction.

##### 5-2.2. Reduced Engineering Drawings.

Reduced engineering drawings may be used as illustrations provided that the reduction in size does not detract from the clarity of the data. Eliminate all references to other engineering drawings.

#### 5-3. ILLUSTRATION SIZE.

##### 5-3.1. Image Size.

Final image size will be such that the illustration adequately portrays the features and details intended to be conveyed. It shall reasonably fill the area selected without excessive blank marginal spaces.

##### 5-3.2. Foldouts.

Foldout illustrations shall fold out horizontally. Double foldout illustrations (vertical as well as horizontal) shall be avoided.

##### 5-3.3. Original Art.

Original art may be any size which can be reduced to produce a final reproduction size maintaining minimum standards of line weight, type size



and clarity. Final reproduction size will be 5-3/8 by 8 inches for full page illustrations, other than foldouts. This size can be further reduced to fit the abbreviated checklist.

5-3.4. Horizontal or landscape illustrations in the AOH which are also required for use in the checklist should be avoided where reduction to vertical checklist layout would cause loss of readability.

#### 5-4. ILLUSTRATION CALLOUTS.

##### 5-4.1. Nomenclature.

Nomenclature callouts shall be written all upper case (when possible) as briefly as is consistent with clarity. All nomenclature of two or more lines shall be written flush left.

#### 5-5. ILLUSTRATION REFERENCES.

References from text to illustrations are acceptable. References from illustrations to text and from one illustration to another are unacceptable.

#### 5-6. ILLUSTRATION FILE NUMBERS.

All illustrations must carry a distinguishable, identifying file number in the lower right corner. No two illustrations may carry the same file number. Provisions must be made to identify, by a change in the file number, any corresponding changes to illustrations.



## SECTION VI

## QUALITY ASSURANCE

The material contained in volume 2 of the AOH is maintained at an accurate and reliable level by a system of procedure development and review. This involves the customer, as well as the contractor, in order that all available sources of data may be incorporated and the material be thoroughly reviewed.

6-1. FLOW DIAGRAM—AOH-C/L PROCEDURE DEVELOPMENT & REVIEW CYCLE

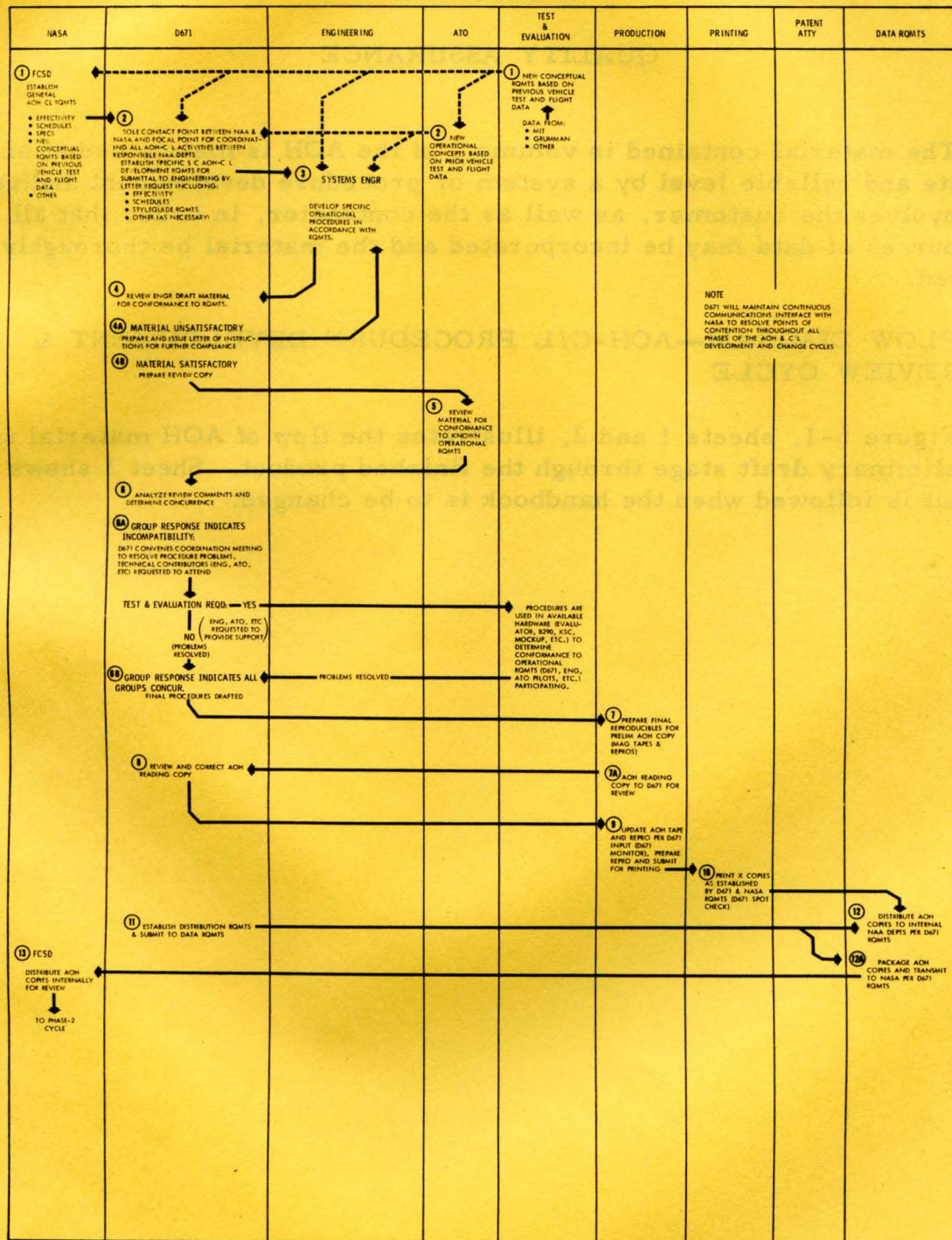
Figure 6-1, sheets 1 and 2, illustrates the flow of AOH material from the preliminary draft stage through the finished product. Sheet 3 shows the flow that is followed when the handbook is to be changed.



## FLOW DIAGRAM-AOH-C/L PROCEDURE DEVELOPMENT AND REVIEW CYCLE

## PHASE-1-PRELIMINARY AOH DRAFT

PHASE-1= PRELIMINARY AOH DRAFT DEVELOPMENT  
 PHASE-2= BASIC ISSUE AOH & C/L DEVELOPMENT  
 PHASE-3= AOH CHANGE CYCLE



DATE: 1 JUNE 1967 REV 1 SEPT 1967

SM-2A-1347A

Figure 6-1. (Sheet 1 of 3)

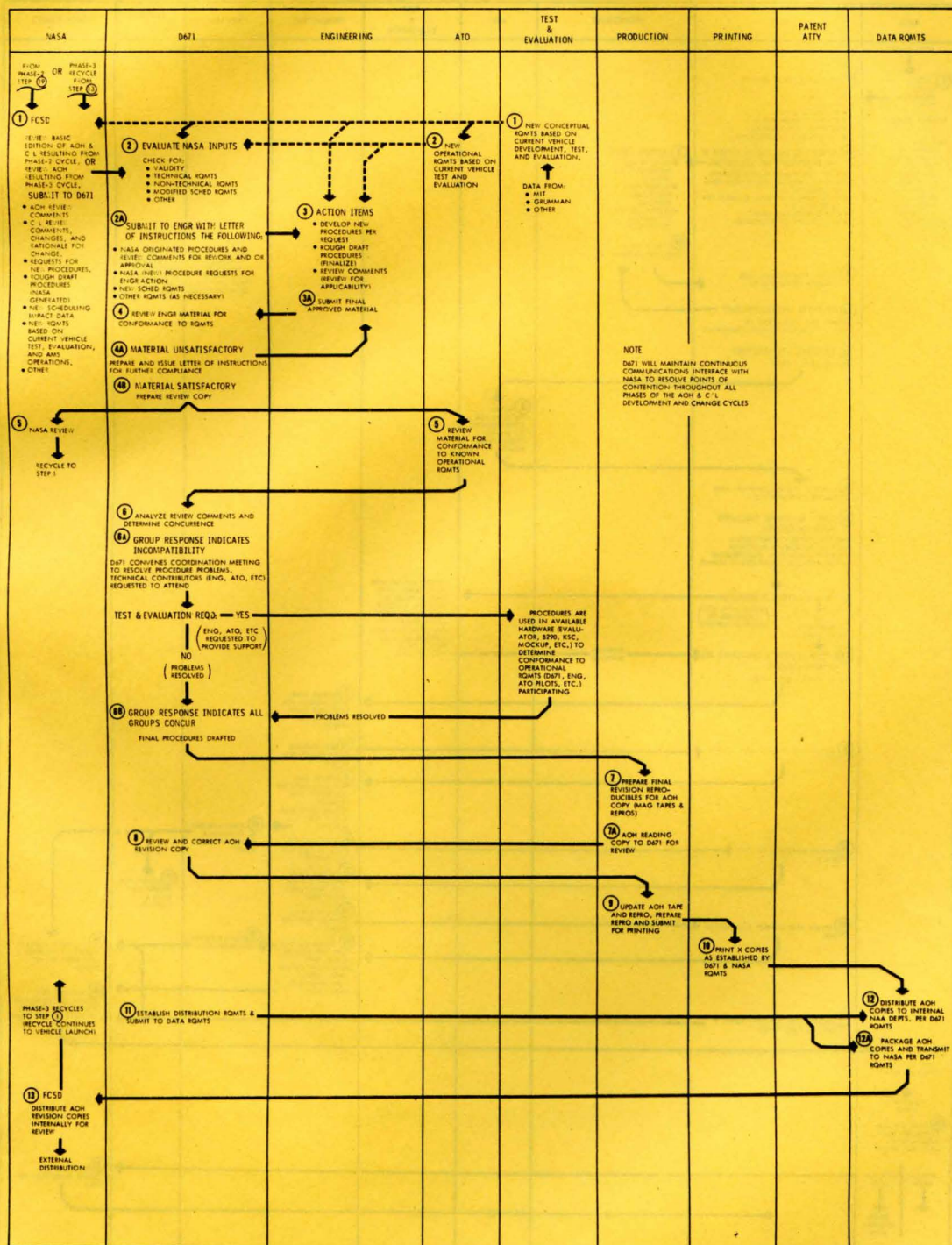






## FLOW DIAGRAM-AOH-C/L PROCEDURE DEVELOPMENT AND REVIEW CYCLE

## PHASE-3-AOH CHANGE CYCLE



DATE: 1 JUNE 1967 REV 1 SEPT 1967

SM-2A-1349A

Figure 6-1. (Sheet 3 of 3)



APPENDIX A

STYLE GUIDE  
FOR  
FLIGHT CREW  
ABBREVIATED CHECKLIST



## APPENDIX A

STYLE GUIDE FOR FLIGHT CREW  
ABBREVIATED CHECKLIST

## INTRODUCTION

The following information is presented as an effort to establish a consistent approach relative to preparation efforts concerning the Crew (Astronauts) Abbreviated Checklist. The Checklist presently is divided into sections similar to the AOH, Volume 2. Each section is, in turn, subdivided into main headings, each covering a main area of attention. For example, Section I, Backup Crew Prelaunch Checks, contains the following main headings: Backup Crew Status Checks, Backup Crew C&D Checks. Following each main heading are numbered steps requiring specific actions or attention relative to the accomplishment of an intended task.

Checklist Development

Information for the checklist is taken from the AOH, Volume 2, with minor changes which are delineated herein. The AOH is prepared using correct nomenclature and length of lines in order to permit direct transposition by magnetic tape typewriter of AOH procedures to the required checklist format. The following are general requirements for developing an abbreviated checklist from the AOH, Volume 2.

The checklist includes the information in the STA/T STEP, PROCEDURE, and PANEL columns of the AOH, Normal/Backup procedures. However, some procedures in the AOH (e. g., stowage lists) may be excluded from the checklist to conserve space. Decisions to exclude information shall be made by the astronauts. Information in the REMARKS column of the AOH is not included in the checklist, making single spacing possible with the exceptions indicated in the AOH-to-checklist conversion mark-up (figures A-4 and A-5). Procedural steps are retained, as well as charts and illustrations which are required to complete the procedures.

Section numbers of the checklist shall coincide as nearly as possible to the last digit of the two digit paragraph numbers in the AOH. Also, the paragraph headings of the two digit AOH paragraph numbers are used as the section headings. AOH paragraph headings with three digit numbers are retained in the checklist, but not the numbers. One digit step numbers and their headings are retained and should coincide with AOH step numbers and headings.



All references to AOH paragraph numbers shall be changed to page number references when used in the checklist.

WARNING notes will be retained, and also CAUTION notes which are considered necessary for proper operation of the systems.

Stations (CDR, CMP, and LMP) and panel numbers shall be carefully coordinated on each page, due to page length differences between the checklist and AOH.

When the procedures for a program are included on a page, the alpha-numerical designation (such as P61) shall be entered on the upper left-hand corner of left-hand pages, and the upper right-hand corner of right-hand pages.

Each section shall start on a right-hand page preceded by an indexer to allow quick access to the procedures. Subsections may start on a right-hand page preceded by an indexer as desired by the astronauts.

#### Format

The checklist is printed, for final use, on two sides of 90 pound white index, sized 8 x 5-1/2 inches. Emergency procedures are printed on pink index. The title page and each major section divider are printed on light green indexes (figure A-1). Abort modes, a part of section 4, are individually indexed with buff stock. Each indexer identifies the grouped material by section number and title. Four binding holes are drilled in the left-hand margin of the checklist.

#### Title Page

The front cover of the checklist serves as the title page (figure A-2). The title page contains the following information: title, applicable mission and spacecraft, document number, preparation directive, publication date, and any additional information considered necessary relative to checklist content.

#### "A" Page

The A page (figure A-3) is titled: LIST OF EFFECTIVE PAGES and directly follows the title page of the checklist. Information presented on the A page includes total number of pages, a tabulation of pages contained within each section and, in addition, establishes the latest change date of pages included in the current issue. Change date information applies only to pages changed since basic issuance of the checklist and subsequently released on a formal basis.



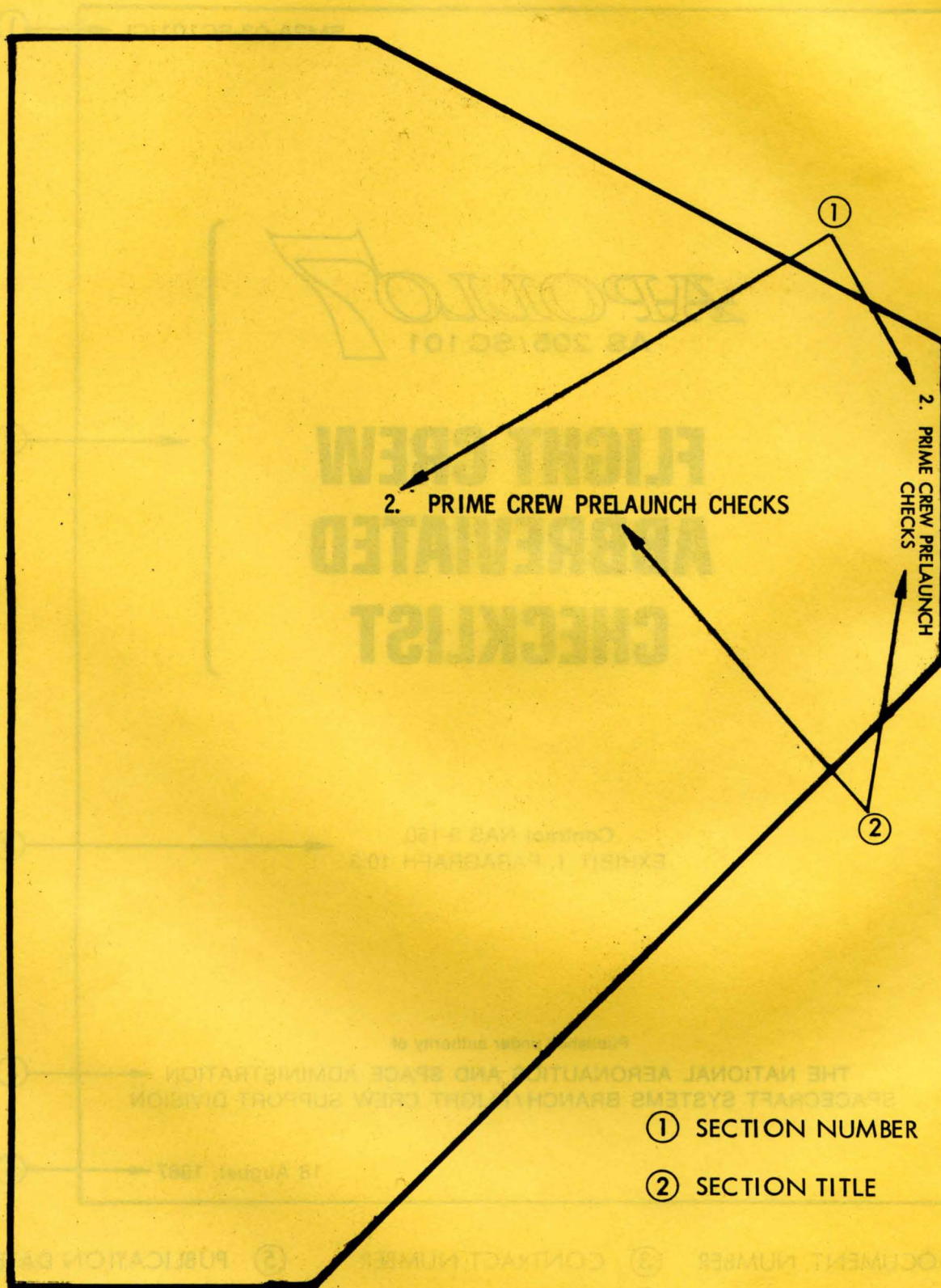



Figure A-1. Indexer



SM2A-03-SC101/CL ①



**FLIGHT CREW  
ABBREVIATED  
CHECKLIST**

Contract NAS 9-150  
EXHIBIT I, PARAGRAPH 10.3 ③

Published under authority of  
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION ④  
SPACECRAFT SYSTEMS BRANCH/FLIGHT CREW SUPPORT DIVISION

18 August, 1967 ⑤

- |                    |                         |                    |
|--------------------|-------------------------|--------------------|
| ① DOCUMENT NUMBER  | ③ CONTRACT NUMBER       | ⑤ PUBLICATION DATE |
| ② TITLE-MISSION-SC | ④ PREPARATION DIRECTIVE |                    |

Figure A-2. Title Page



A		①
LIST OF EFFECTIVE PAGES		②
Total number of pages in this publication is 184 consisting of the following:		③
Page	Issue	
Title	Basic	
A	Basic	
1-1 thru 1-9	Basic	
2-1 thru 2-6	Basic	
3-1 thru 3-8	Basic	
4-1 thru 4-14	Basic	
5-1 thru 5-14	Basic	
6-1 thru 6-11	Basic	④
7-1 thru 7-13	Basic	
8-1 thru 8-8	Basic	
9-1 thru 9-23	Basic	
10-1 thru 10-17	Basic	
11-1 thru 11-11	Basic	
12-1 thru 12-19	Basic	
13-1 thru 13-24	Basic	
14-1 thru 14-3	Basic	
15-1 thru 15-2	Basic	

① PAGE  
IDENTIFICATION

② TITLE

③ TOTAL PAGE  
STATEMENT

④ PAGE RELEASE  
DATE

Figure A-3. "A" Page



A-6  
SD 67-935

①  
②  
③

Basic Date \_\_\_\_\_  
Change Date \_\_\_\_\_  
Page 4-240

STA/T STEP	PROCEDURE	PANEL	REMARKS
<b>SECTION 13.</b>			
4.13.1	G&N ORBIT CHANGE <u>Center</u>		Provides detailed instructions for performing SPS thrusting for earth orbit changes.
4.13.1	G&N ORBIT CHANGE PREPARATION (DAP Data Load - R03)		
All CDR	1 G&C BASIC except FDAI POWER sel - BOTH SCS ELEC PWR sel - GDC/ECA BMAG-1 PWR sel - ON	7	
CMP	Load DAP (Fig. 4.5-2) (pg 10-3)	2,140	Figure 4.5-2, DAP Data Load Procedures, provides all data necessary for selecting deadband, maneuver rate, and RCS jets for ullage and RCS maneuvers.
CDR	CMC MODE sw - HOLD	1	
4.13.2	G&N ORBIT CHANGE EXTERNAL ΔV PRE-THRUSTING PROGRAM (P30)		Accept targeting parameters from source external to CMC and compute required velocity and other initial conditions required by CMC for execution of desired maneuver.
CMP	1 Key V37E 30E FL V06 N33 GETI OOXX. HRS OOXX. MIN OXX.XX SEC	2,140	Display: GETI (TIG) = stored time of ignition
4.13.3	G&N ORBIT CHANGE SPS THRUSTING PROGRAM (P40)		To compute preferred CSM attitude and IMU orientation for an SPS thrusting maneuver.
1	Key V37E 40E (Poss P05 or P51)		

ABORT NORMAL/BACKUP

SM2A-03-SC101-(2)  
APOLLO OPERATIONS HANDBOOK

Figure A-4. Typical AOH Page (Sheet 1 of 2)



SM2A-03-SC101-(2)  
APOLLO OPERATIONS HANDBOOK

STA/T STEP	PROCEDURE	PANEL	REMARKS
05:003-13.3.1	<u>Gimbal Drive and Trim Check</u>		Verifies trim control and manual (MTVC) control capability of the primary and secondary gimbal control systems.
LMP	1 Initialization	5	
CDR	MAIN BUS TIE (both) - ON	7	
	TVC SERVO PWR-1 sw - AC1/MNA		
	TVC SERVO PWR-2 sw - AC2/MNB		
	2 Primary TVC check	1	
	SPS GMBL TW (2) - Set to desired values		
	<u>CAUTION</u>		
	Start motors sequentially to avoid power surge		
	SPS-GMBL MOT-PITCH 1 sw - START-center		Momentary up
	SPS-GMBL MOT-YAW 1 sw - START-center		Momentary up

Basic Date \_\_\_\_\_ Change Date \_\_\_\_\_ Page 4-241

4

5

SD 67-935

A-7

ABO T

NO MAL BACKUP

Figure A-4. Typical AOH Page (Sheet 2 of 2)



(Trim front page on solid crop marks; back page on dash crop marks.)

13-1

P30/P40

SECTION 13. G&N ORBIT CHANGE

G&N ORBIT CHANGE PREPARATION  
(DAP Data Load - R03)

All	1	G&C BASIC except	
CDR		FDAI POWER sel - BOTH	7
		SCS ELEC PWR sel - GDC/ECA	
		BMAG-1 PWR sel - ON	
CMP		Load DAP pg 6-3	2,140
CDR		CMC MODE - HOLD	1

G&N ORBIT CHANGE EXTERNAL AV PRE-THRUSTING PROGRAM (P30)

CMP	1	Key V37E 30E	2,140
		FL V06 N33	
		GETI	
		OOXXX. HRS	
		OOOXX. MIN	
		OXX.XX SEC	

G&N ORBIT CHANGE SPS THRUSTING PROGRAM (P40)

1 Key V37E 40E  
(Poss P05 or P51)

05:00 Gimbal Drive and Trim Check

1 Initialization

LMP		MAIN BUS TIE (both) - ON	5
CDR		TVC SERVO PWR-1 sw - AC1/MNA	7
		TVC SERVO PWR-2 sw - AC2/MNB	

2 Primary TVC check

		SPS GMBL TW (2) - Set to desired values	1
--	--	---	---

CAUTION

Start motors sequentially to  
avoid power surge

SPS-GMBL MOT-PITCH 1 sw - START-center  
SPS-GMBL MOT-YAW 1 sw - START-center

Basic Date Changed

SC101

Figure A-5. Typical Checklist Page



Procedures

The format of material presented in the checklist conforms to guidelines established for developing AOH procedures with few exceptions. Typical AOH and checklist instructions (figures A-4 and A-5) depict the "before" and "after" manner of presentation. Characteristic differences between AOH and checklist instructions, and the method of markup required for conversion from AOH to checklist, are indicated by the codes in figure A-4 (AOH), figure A-5 (checklist), and are discussed in the following paragraphs.

<u>Code</u>	<u>Description</u>
①	Section number and title: Subsection number and title of AOH becomes section number and title for checklist. As shown, the decimal number is removed, and the section number and title is centered at the top of the page.
②	Main heading: The decimal number is removed. The main heading is shifted to the left even with the first digit location in the step column.
③	Basic and Changed dates: Basic and changed date entry locations are repositioned as shown.
④	Sub-procedure title: The decimal number is removed. The subprocedure title is shifted to the left and one space to the right of the second digit location in the step column.
⑤	Page number: The page number is changed from AOH subsection/page number designation to checklist section/page number designation and is placed at top center of the checklist page. Each section shall begin with page number one.
⑥	Program notation: This entry only applies to the checklist where computer programs are associated with the procedures. On any given page, where one or more computer programs apply, those programs shall be identified at the top right hand corner on right hand pages, and at the top left hand corner on left hand pages.
⑦	When marking up checklist copy for final typing, special effort must be taken to assure that each page has station and panel callouts properly located and when necessary, carried over from the preceding page.



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## INTRODUCTION

This document establishes the style and quality assurance requirements governing the preparation of the Apollo Operations Handbook, SM2A-03-SCXXX (2). It is not the intention of this document to prescribe the details of preparation, but to specify the results to be obtained.

The guidelines for obtaining the basic (only) edition of the Flight Crew Abbreviated Checklist, SM2A-03-SCXXX/CL are provided in Appendix A of this document. The basic checklist is a modified derivative of the Normal/Backup, Abort, and Emergency procedures contained in the Apollo Operations Handbook (AOH), Volume 2.

Changes will be made periodically to this style guide to incorporate revised and additional information. Any recommended changes to this document should be directed to Apollo Training and Support Documentation, Department 671, Apollo Site Activation and Logistics, Space Division of North American Aviation, Inc., Downey, California.