

G. L. Silver

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

APOLLO

GUIDANCE, NAVIGATION AND CONTROL

E-1087
REV. F

G. Silver
7-140

APOLLO GUIDANCE AND NAVIGATION
DOCUMENTATION HANDBOOK AND PLAN

August 1970

MIT

CAMBRIDGE MASSACHUSETTS 02139

**CHARLES STARK DRAPER
LABORATORY**

APOLLO

GUIDANCE, NAVIGATION AND CONTROL

Approved: L. E. Larson, Jr. Date: 9/17/70
L. E. LARSON, JR., MANAGEMENT DIRECTOR
APOLLO GUIDANCE AND NAVIGATION PROGRAM

Approved: David G. Hoag Date: 18 Sep 70
DAVID G. HOAG, DIRECTOR
APOLLO GUIDANCE AND NAVIGATION PROGRAM

Approved: Ralph R. Ragan Date: 18 Sep 70
RALPH R. RAGAN, DEPUTY DIRECTOR
CHARLES STARK DRAPER LABORATORY

E-1087
REV. F

G. Silver
7-140

APOLLO GUIDANCE AND NAVIGATION
DOCUMENTATION HANDBOOK AND PLAN

August 1970

MIT

CAMBRIDGE, MASSACHUSETTS, 02139

**CHARLES STARK DRAPER
LABORATORY**

ACKNOWLEDGEMENT

This report was prepared under DSR Project 55-23890, sponsored by the Manned Spacecraft Center of the National Aeronautics and Space Administration through Contract NAS 9-4065.

The publication of this report does not constitute approval by the National Aeronautics and Space Administration of the findings or the conclusions contained therein. It is published only for the exchange and stimulation of ideas.

PREFACE

This publication has been prepared to provide a single source reference for the configuration management plan and implementing procedures, including specific instructions and formats for document preparation. It is divided into the following eleven sections:

- Section 1 MIT Configuration Management Office (CMO) plan for the establishment of a configuration management system for the Apollo Guidance and Navigation Program.
- Section 2 MIT CMO procedures for the implementation and maintenance of the configuration management plan.
- Section 3,4,5, and 6 Requirements and specific format and content guides for the preparation of Procurement Specifications, (PSs), including NDs and SCDs, Final Test Methods (FTMs) and Assembly Test Procedures (ATPs).
- Section 7 Procedure and format for the preparation of Job Description Cards (JDCs) and their associated data sheets.
- Section 8 Specific format and content guide for Equipment History, which provides a complete history of system and subsystems.
- Section 9 A general format guide for preparation of documents not specifically described in other sections of this publication.
- Section 10 A format guide for preparation of illustrations.
- Section 11 Procedures for review, approval, and release of all types of Apollo Documentation (including drawings): MIT Report E-1186, Technical Data Release Procedures.

Note: Section 11 is bound separately, but is considered a part of this document.

It is intended that this handbook shall be a "living" document; as guidelines and specific formats for other types of documents are formulated, this publication will be revised and expanded to include such additional information.

Revision F of this handbook dated August 1970 comprises revisions to Section 1 thru 10. Section 4 thru 10 had been previously bound separately as Rev. C.

TABLE OF CONTENTS

Section		Page
1	CONFIGURATION MANAGEMENT PLAN	1-1
1.1	PURPOSE	1-1
1.2	RESPONSIBILITIES	1-2
1.2.1	MIT	1-2
1.2.2	Contractors	1-2
1.3	ORGANIZATION AND FUNCTION, CONFIGURATION MANAGEMENT OFFICE	1-3
1.3.1	Other Groups	1-3
1.4	APPLICABLE DOCUMENTS	1-6
1.4.1	NHB 8040.2	1-6
1.4.2	Technical Directive Procedures, MIT Report E-1161	1-6
1.4.3	MIT Apollo Drawing Standards, MIT Report 1167	1-6
1.4.4	Technical Data Release Procedures, MIT Report E-1186	1-6
1.4.5	System Identification Data List (SIDL)	1-10
1.4.6	NHB 5300.4 (1B)	1-10
1.4.7	NPC 200-3	1-10
1.4.8	NPC 250-1	1-10
1.4.9	ND 1002023	1-10
1.4.10	Acceptance Data List (ADL)	1-10
1.4.11	Software Configuration Management Plan, MIT Report E-2345	1-10
1.5	OTHER CONTROL DOCUMENTATION	1-11
1.5.1	Aperture Cards	1-11
1.5.2	Qualification Status List (QSL)	1-11
1.5.3	Specification Change Notices	1-11
1.5.4	Interface Control Drawings (ICDs)	1-12
1.5.5	Manuals	1-12
1.5.6	Master Files	1-12
1.5.7	Field Log Book	1-12
1.6	OTHER REQUIREMENTS	1-12
1.6.1	Documentation Requirements	1-12
1.6.2	Manual Format	1-13

Section	Page
1.6.3	Specification Format 1-13
2	PROCEDURE AND IMPLEMENTATION OF THE CONFIGURATION MANAGEMENT PLAN 2-1
2.1	SCOPE 2-1
2.2	ESTABLISHED PROCEDURES 2-1
2.2.1	Document Preparation 2-1
2.2.2	Document Release Procedures 2-4
2.2.2.1	DRB Procedure 2-4
2.2.2.2	Configuration Control Board Procedure 2-5
2.2.2.3	Engineering Change Procedure 2-9
2.2.3	Configuration Control Committee (CCC) 2-14
2.2.4	Mission Design Review Board 2-14
2.2.5	Familiarization and Training 2-15
2.3	EQUIPMENT CONFIGURATION IDENTIFICATION 2-15
2.4	FORMAL REVIEWS 2-17
2.5	RELATED INFORMATION 2-17
2.5.1	Acceptance Data Package Verification 2-17
3	SPECIFICATIONS 3-1
3.1	INTRODUCTION 3-1
3.2	BLOCK II PROCUREMENT SPECIFICATIONS 3-1
3.2.1	Usage 3-1
3.2.2	Determination of Need for a Block II PS 3-2
3.3	DESCRIPTION OF SPECIFICATION (BLOCK II) 3-2
3.3.1	Definition 3-2
3.3.2	Preparation 3-3
3.3.3	Format Description 3-3
3.3.3.1	Front Matter 3-3
3.3.3.2	Sections 3-4
3.3.3.2.1	Section 1: Scope 3-4
3.3.3.2.2	Section 2: Applicable Documents 3-4
3.3.3.2.3	Section 3: Requirements 3-4
3.3.3.2.4	Section 4: Quality assurance 4.1, 4.1.1, 4.1.2, 4.1.2.1 3-6
3.3.3.2.5	Section 5: Preparation for Delivery 3-8
3.3.3.2.6	Section 6: Notes 3-8
3.3.3.2.7	Section 7: Appendix 3-8
3.3.3.2.8	Index 3-8
3.3.4	Security Requirements 3-8
3.3.5	Revisions 3-8

Section		Page
3.4	RELATED INFORMATION	3-9
3.4.1	Job Description Cards (JDCs)	3-9
3.4.2	Classification	3-9
3.4.3	Revision	3-10
3.4.4	Reference on drawing	3-10
3.5	OTHER DOCUMENTS	3-10
3.5.1	Control Drawings	3-10
3.5.2	ND Documents	3-11
4	PROCUREMENT SPECIFICATION (PS) DOCUMENTATION (BLOCK I)	4-1
4.1	SCOPE	4-1
5	PREPARATION OF FINAL TEST METHOD (FTM) DOCUMENTATION (BLOCK I)	5-1
5.1	PURPOSE	5-1
6	PREPARATION OF ASSEMBLY TEST PROCEDURE (ATP) DOCUMENTATION	6-1
6.1	PURPOSE	6-1
6.2	DEFINITION	6-1
6.3	FORMAT	6-1
6.3.1	Front Matter	6-1
6.3.1.1	Title Page	6-1
6.3.1.2	Table of Contents	6-2
6.3.2	Sections	6-2
6.3.4	Concluding Material	6-3
6.3.4.1	Notice	6-3
6.3.4.2	Appendix	6-3
6.3.4.3	Index	6-3
6.3.5	Security Requirements	6-3
6.3.6	Revisions	6-3
6.3.6.1	Addenda and Types	6-4
6.4	CONTENTS	6-4
6.4.1	Test	6-4
6.4.1.1	Limitations	6-5
6.4.1.2	Style	6-5
6.4.1.3	Identifying Marks	6-5
6.4.1.4	Reference to Parts	6-5
6.4.1.5	Abbreviations	6-5
6.4.1.6	Reference Designations	6-5
6.4.1.7	Electrical and Electronic Symbols	6-6
6.4.2	Illustrations	6-6

Section	Page
6.4.2.1 Electrical and Electronic Symbols	6-6
6.4.2.2 Reference Designations	6-6
6.4.3 Sections	6-6
6.4.3.1 Introduction	6-6
6.4.3.1.1 Classification	6-6
6.4.3.2 Assembly Requirements	6-7
6.4.3.3 Test Requirements	6-7
6.4.3.3.1 List of Equipment	6-7
6.4.3.3.2 Test Conditions	6-7
6.4.3.4 Test Procedures	6-7
6.4.3.5 Notes	6-8
7 PREPARATION OF THE JOB DESCRIPTION CARD	7-1
7.1 PURPOSE	7-1
7.2 DEFINITION	7-1
7.3 FORMAT	7-2
7.3.1 Security Requirements	7-2
7.3.2 Standard Information	7-2
7.3.3 Procedure	7-3
7.3.4 Illustrations	7-3
7.3.5 Text	7-3
7.4 DATA SHEETS	7-4
7.4.1 Preparation	7-4
7.4.2 Standard Information	7-4
7.5 RELEASE	7-4
7.5.1 Initial	7-4
7.5.2 Revision	7-5
8 EQUIPMENT HISTORY	8-1
8.1 PURPOSE	8-1
8.2 DESCRIPTION	8-1
8.2.1 Acceptance Data Package (ADP)	8-1
8.2.1.1 Narrative End Item Report	8-1
8.2.1.2 Nonconformance	8-2
8.2.1.3 Limited-Life Items	8-2
8.2.1.4 Factory Acceptance Procedures and Data	8-2
8.2.2 Post-Acceptance Data Package (PADP)	8-2
8.2.2.1 Guidance and Control System Logbook	8-3
8.2.2.2 Subsystem History Record	8-3
8.2.2.3 Unit History Record	8-3
8.3 ORGANIZATION OF EQUIPMENT HISTORY	8-3

Section		Page
	8.3.1 Guidance and Control System Logbook	8-3
	8.3.2 Subsystem History Record	8-4
	8.3.3 Unit History Record (UHR)	8-4
	8.3.4 Test and Inspection Data Record	8-4
8.4	INSTRUCTIONS FOR EQUIPMENT HISTORY RECORDING	8-5
	8.4.1 Inventory Record	8-5
	8.4.2 Historical Event/Operation Record	8-5
	8.4.3 Unit History Record	8-7
	8.4.4 Specific Applications	8-8
	8.4.4.1 GSE	8-8
	8.4.4.2 Spares (Field Replaceable Modules)	8-8
	8.4.4.3 Data	8-9
	8.4.4.4 Data Center	8-9
9	GENERAL FORMAT GUIDE FOR APOLLO GUIDANCE AND CONTROL SYSTEM PUBLICATIONS	9-1
9.1	SCOPE	9-1
9.2	DRAFTS	9-1
	9.2.1 Working Copy	9-1
	9.2.2 Preliminary Copy	9-1
	9.2.3 Final Copy	9-1
9.3	RUNNING HEADS	9-1
9.4	MARGINS	9-4
	9.4.1 Top Margin	9-4
	9.4.2 Side Margins	9-4
	9.4.3 Bottom Margin	9-4
	9.4.4 First Page of Chapter	9-4
9.5	SECURITY REQUIREMENTS	9-4
9.6	INDENTATION	9-4
	9.6.1 Enumerations	9-4
	9.6.2 Cautions, Notes, and Warnings	9-5
9.7	VOLUME, PART, AND CHAPTER	9-5
9.8	NUMBERING SYSTEM	9-5
	9.8.1 Layout for Heads	9-6
	9.8.1.1 Primary Heads	9-6
	9.8.1.2 Secondary Heads	9-6
	9.8.1.3 Tertiary Heads	9-6
	9.8.1.4 Quaternary Heads	9-6
9.9	FIGURES	9-6
	9.91 Captions	9-6

Section	Page
9.9.2 Turn Pages	9-6
9.9.3 Foldouts	9-6
9.10 TABLES	9-7
9.10.1 Titles	9-7
9.10.2 Format	9-7
9.10.3 Turn Pages	9-7
9.11 FRONT MATTER	9-7
9.12 APPENDIXES	9-7
9.13 PAGINATION	9-8
9.13.1 Front Matter	9-8
9.13.2 Text	9-8
9.13.3 Foldout Page	9-8
9.13.4 Appendix	9-9
9.13.5 Index	9-9
9.14 ND-SERIES MANUALS	9-9
9.14.1 Front Matter	9-9
9.14.2 Page Identification	9-9
9.14.2.1 Front Matter	9-9
9.14.2.2 Text	9-10
9.14.3 Revisions	9-10
9.14.3.1 Numbering Changes	9-10
9.14.3.1.1 Additions	9-10
9.14.3.1.2 Deletions	9-10
9.14.3.2 Changes to the List of Effective Pages	9-11
9.14.4 JDCs	9-11
10 ILLUSTRATION GUIDE FOR APOLLO GUIDANCE AND CONTROL SYSTEM PUBLICATIONS	10-1
10.1 SCOPE	10-1
10.2 LINE ART	10-1
10.2.1 General Requirements	10-1
10.2.1.1 Illustration Size	10-1
10.2.1.2 Line Weight	10-2
10.2.1.3 Lettering Size	10-2
10.2.1.4 Illustration Identification	10-2
10.2.2 Specific	10-2
10.2.2.1 Block Diagrams	10-3
10.2.2.2 Charts and Graphs	10-3
10.2.2.3 Theory Drawings	10-3

Section	Page
10.2.2.4 Wiring Diagrams	10-3
10.2.2.5 Schematic Diagrams	10-3
10.2.2.6 Loop Diagrams	10-4
10.2.2.7 Orthographic Drawings	10-4
10.2.2.8 Three-Dimensional Drawings	10-4
10.2.2.9 Cross-Section Drawings	10-5
10.2.2.10 Composite Drawings	10-5
10.3 TONAL ART	10-5
10.3.1 General Requirements	10-5
10.3.1.1 Illustration Size	10-5
10.3.1.2 Lettering Size	10-6
10.3.1.3 Illustration Identification	10-6
10.3.2 Specific Requirements	10-6
10.3.2.1 Retouching	10-6
10.3.2.2 Screening	10-6

ABBREVIATIONS USED IN E-1087

ADL	Acceptance Data List
ADP	Acceptance Data Package
AFH	Air Force Industrial Account
AG	Apollo Guidance
AGC	Apollo Guidance Computer
ATP	Assembly Test Procedure
CCB	Configuration Control Board
CCC	Configuration Control Committee
CEI	Contract End Item
CMO	Configuration Management Office
DRB	Design Review Board
ECP	Engineering Change Proposal
ECPR	Engineering Change Proposal of Record
EDP	Electronic Data Processing
EMF	Engineering Master File
ERP	Engineering Revision Proposal
FACI	First Article Configuration Inspection
FTM	Final Test Method
GAC	Grumman Aerospace Corporation
GFP	Government Furnished Property
G&N	Guidance and Navigation
GSE	Ground Support Equipment
IBM	International Business Machine
ICD	Interface Control Document
ISS	Inertial Subsystem
JDC	Job Description Card

LM	Lunar Module
MDRB	Mission Design Review Board
MIT/DL	Massachusetts Institute of Technology Charles Stark Draper Laboratory
MSC	Manned Spacecraft Center
NAR	North American Rockwell
NASA	National Aeronautics and Space Administration
ND	NASA Document
PADP	Post Acceptance Data Package
PS	Procurement Specification
QSL	Qualification Status List
RASPO	Resident Apollo Spacecraft Project Office
RECP	Request for Engineering Change Proposal
SCD	Specification Control Drawings; Source Control Drawing
SCN	Specification Change Notice
SIDL	System Identification Data List
TD	Technical Directive
TDRR	Technical Data Release and Revision
UHR	Unit History Record

APOLLO GUIDANCE AND NAVIGATION DOCUMENTATION HANDBOOK AND PLAN

MARCH 1970

Section 1

CONFIGURATION MANAGEMENT PLAN

1.1 PURPOSE

This Documentation Handbook and Plan, MIT Report E-1087, presents the MIT plan for the establishment, implementation, and maintenance of a configuration management system for the Apollo Guidance and Navigation Program. Revision F includes the implementation of NHB 8040.2 "Apollo Configuration Management Manual" requirements for Block II and LM. The policies and procedures relevant to the Block I requirements have been edited and retained for continued use in applicable areas. Revision F includes changed document flow and authorization and review responsibility as directed by NASA/MSC.

On the basis of program phase requirements, specific item-by-item compliance with NHB 8040.2. The procedures are designed to provide the controls and organization necessary for full compliance with the intent of NHB 8040.2.

In providing an overall plan for the configuration management system, MIT Report E-1087 coordinates the various MIT publications which are issued as separate documents and which define and implement specific aspects of the system. Detailed descriptions of control procedures are referenced and presented in the applicable documents. Formats to be used for the preparation of various MIT publications have been included, as well as samples of the forms used in the accomplishment of the procedures.

This handbook is intended to provide an operating plan and the necessary procedures to provide a common base for configuration management throughout the

G&N program. Any conflict with contractual obligations should be brought to the attention of the MIT Configuration Management Office (CMO) and NASA/ MSC at MIT for resolution.

This handbook also includes specific requirements sections for areas not covered in separate publications.

1.2 RESPONSIBILITIES

The responsibilities pertinent to configuration management by MIT and the various Contractors are outlined in the following paragraphs.

1.2.1 MIT. As the Associate Contractor for the Apollo Guidance and Navigation Program, MIT has the responsibility for the direction and implementation of documentation, configuration management, and configuration control. MIT has established a Configuration Management Office (CMO), reporting to the Management Director, which is responsible for the management direction to implement configuration management for the G&N program.

All documentation and configuration requirements currently identified by NASA and imposed on the G&N program and any additional future requirements necessary to establish and maintain configuration management during the phases of development and operation of the G&N system shall be implemented by the MIT CMO.

1.2.2 CONTRACTORS. The Industrial Contractor and his directed subcontractors have the responsibility of actively supporting the configuration management requirements in accordance with their respective contracts. The Contractors shall:

1. Implement in-house procedures in accordance with this plan.
2. Provide a designated representative having full authority to the Configuration Control Board (CCB).
3. Provide designated representation on the Configuration Control Committee.
4. Maintain a Design Review Board (DRB) to accomplish design review obligations as enumerated in Paragraph 2.2.2.1 in accordance with the NASA contracts for design responsibility.

1.3 ORGANIZATION AND FUNCTION, CONFIGURATION MANAGEMENT OFFICE

The objective of this section is to outline the overall functional organization of the MIT Configuration Management Office and specify its responsibilities and basic authority. The MIT CMO operates in a management capacity to identify the requirements, establish the procedures, and assign responsibility for the establishment and maintenance of configuration control for the G&N system and its ground support equipment. The MIT CMO, with the Industrial Contractor and the directed subcontractors, provides the direction necessary to ensure compliance with the configuration requirements.

The CMO shall:

1. Develop, direct, and report the status of the G&N specification plan and provide review coordination to the Design Review Board (DRB) for Contract End Item (CEI) Specification changes.
2. Provide procedures for configuration identification, control, and accounting for all G&N equipment and documentation through all phases of the program.
3. Provide a means of coordinating the documentation and configuration management aspects of the program to all organizations.

The following formally organized boards provide the basic coordination and control points for configuration management:

1. Design Review Board (DRB). (Auth.: MIT R-383).
2. Mission Design Review Board (MDRB). (Auth.: MIT E-2345).
3. Configuration Control Board (CCB). (Auth.: MIT E-1186.)
4. Configuration Control Committee (CCC). (Auth.: MIT Letter AG-974-64.)

A G&N Documentation Flow Chart is shown in Figure 1-1. Figure 1-2 shows the Configuration Management Office interrelationships.

1.3.1 OTHER GROUPS. Various other groups within MIT may conduct meetings for the purpose of discussing documentation problems unique to the individual groups on an "as required" or periodic basis. However, any changes to the existing configuration management requirements and procedures shall be coordinated with the MIT Configuration Management Office for the consideration of overall compatibility with, and fulfillment of, the MIT configuration management program.

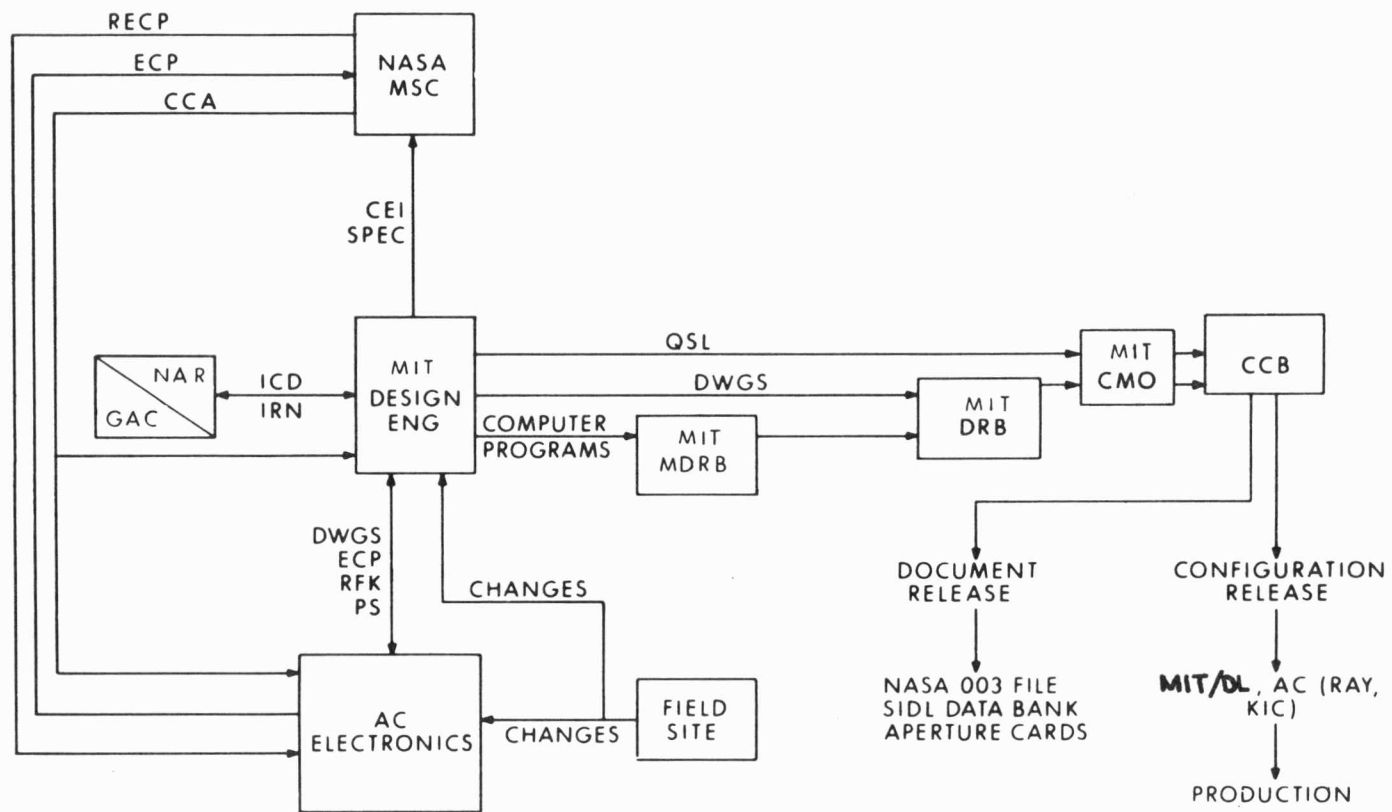


Figure 1-1 Documentation Flow Chart

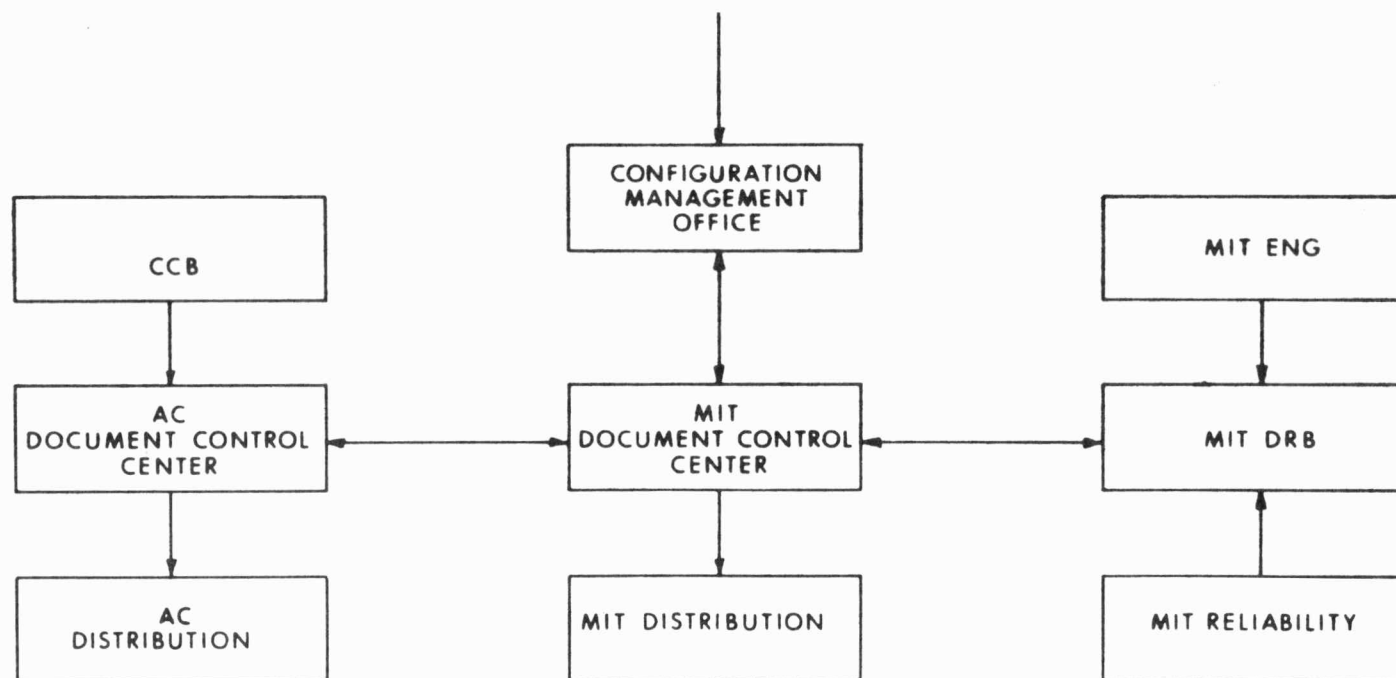


Figure 1-2 Configuration Management Organization

1.4 APPLICABLE DOCUMENTS

This publication and the documents referenced in this publication form the nucleus of the MIT documentation and configuration control system in compliance with the instructions of NHB 8040.2. The purpose of each of the referenced documents is indicated below; they are incorporated, by reference, as parts of MIT Report E-1087.

- 1.4.1 NHB 8040.2. "Apollo Program Configuration Management," provides direction for configuration identification, control, and accountability. This is the governing NASA direction to MIT for Block II documentation. The provisions of this handbook and referenced applicable documents are intended to implement NHB 8040.2 within the practical limits of the program phase and existing procedures. In view of separate agreements with NASA to waive specific parts of NHB 8040.2, it may appear that incompatibilities exist with MIT procedures. The MIT CMO is responsible for obtaining and disseminating resolution of any conflicting requirements and incompatibilities concerning configuration management. Any conflicting requirements must be defined and submitted to the MIT CMO for resolution.
- 1.4.2 TECHNICAL DIRECTIVE PROCEDURES, MIT REPORT E-1161. The Technical Directive (TD) is a work-authorizing procedure that provides formal documentation necessary to bridge the organizational structure involved in the G&N program. MIT Report E-1161 specifies the requirements for the generation of a Technical Directive (TD) and provides instructions for its initiation, preparation, authorization, and implementation.
- 1.4.3 MIT APOLLO DRAWING STANDARDS, MIT REPORT E-1167. The MIT Apollo Drawing Standards, MIT Report E-1167, provides a single source of instructions for preparing, revising, and maintaining all drawings, wire lists, and the like, generated by MIT or the Contractors. Any conflict between these standards and contractually imposed standards must be resolved by the MIT CMO with NASA.
- 1.4.4 TECHNICAL DATA RELEASE PROCEDURES, MIT REPORT E-1186. MIT Report E-1186 establishes the Configuration Control Board (CCB) and the procedures for control of all design and document releases. Through the CCB and the identification of all of its actions in a data bank, a complete configuration record is established for each system as designed, up to the time of delivery.

A corollary publication, MIT Report E-1293, "Field Operations Program Requirements", provides the procedures for field changes to equipment and documents by referencing the documentation requirements derived by the Industrial Contractors (AC Electronics) throughout the Apollo G&N Field Operations Program. The "Field Operations and Support Plan," Section VI, prepared by AC Electronics, outlines the procedures for changing technical data and Field Site Manuals. Figures 6-3, "Field Site Manual Change Procedure Flow Diagram," and 6-4, "Field Site Engineering Data Change Procedure Flow Diagram", are reproduced here as Figures 1-3 and 1-4.

The requirement for approved change packages to be processed through DRB and CCB according to established engineering change procedure as described in E-1186 for Class A documents is shown in these diagrams.

At field sites, a reporting system will be initiated and maintained to accumulate continuous information relative to location and configuration of all components affected by modifications or interchange of parts. This report, called the "Mod Status and Location Report", will be distributed on a monthly basis to facilitate kit allocations and the planning of retrofit work-loading. The site input to this report will be accomplished as follows:

A "Retrofit or repair compliance report - ACC Form 1 (Revised)" will be prepared for each repair addition or retrofit accomplished at any location. This documentation of re-configured, added or replaced items in G&N Systems in NASA inventory will be transmitted to the AC Electronics Logistics Apollo Material Control for updating the "Logistics Modification and Location Status" and simultaneously to the AC Electronics Program Office for incorporation on the Installation List Drawing. The AC Electronics "Configuration, Accountability and Traceability" magnetic tape file maintained for the Data Control Center at NASA/MSC, Houston, will incorporate information derived from these forms.

The following data will be listed in the report:

- (a) Retrofits accomplished on all components during the reporting period.
- (b) Inter "AFH" account changes in location of serialized assemblies.
- (c) The "Retrofit or Repair Compliance Report" Forms will be submitted as applicable.

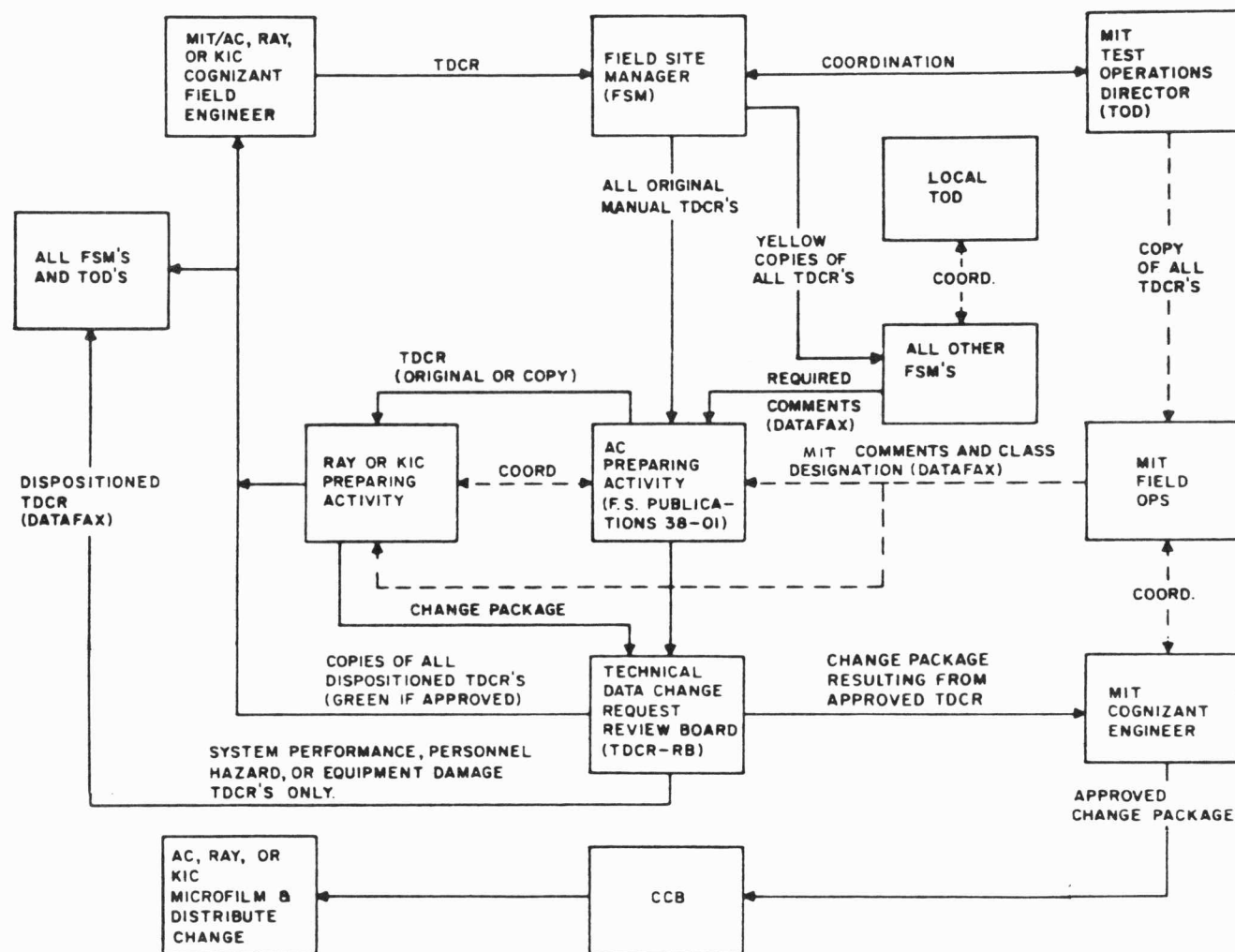


Figure 1-3 Field Site Manual Change Procedure Flow Diagram

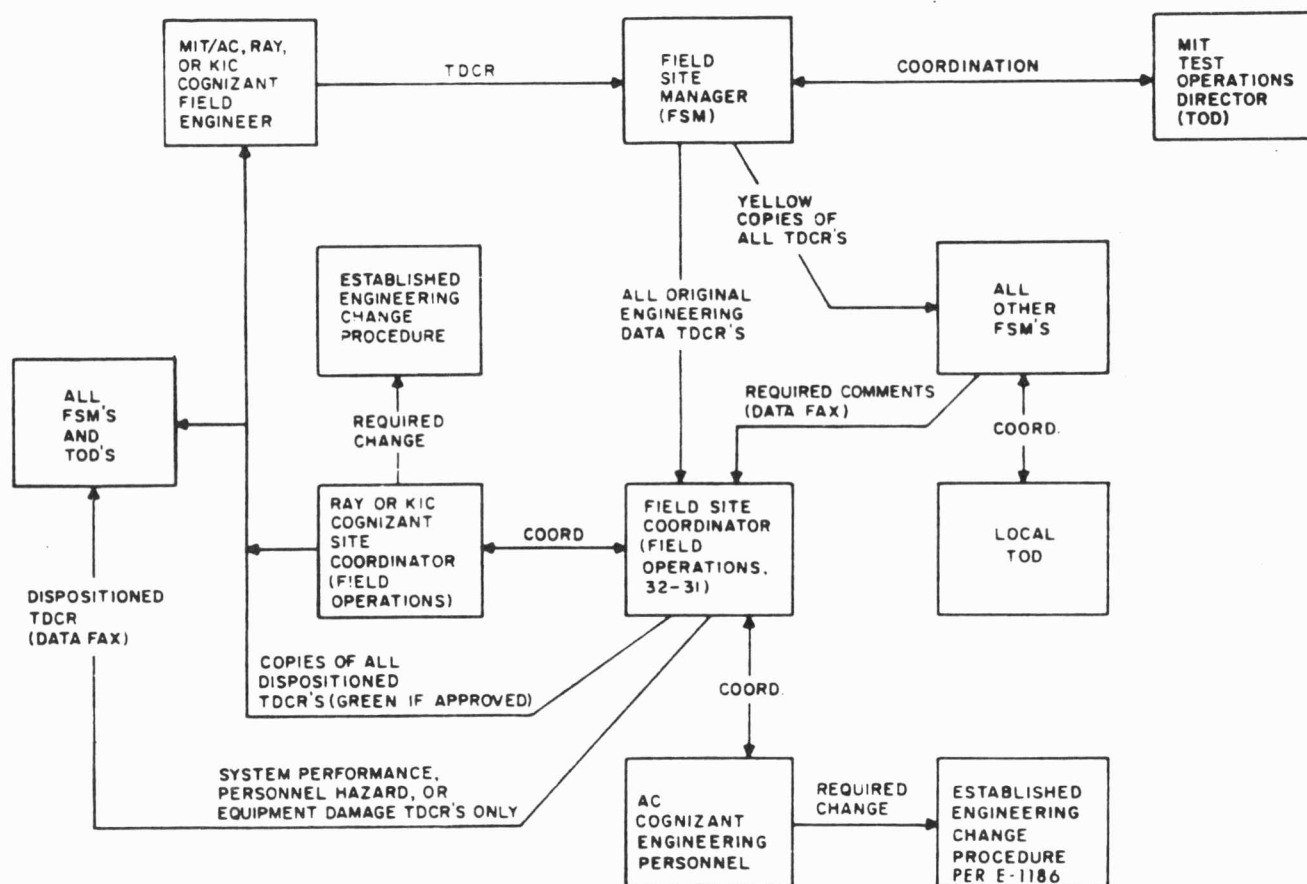


Figure 1-4 Field Site Engineering Data Change Procedure Flow Diagram

- 1.4.5 SYSTEM IDENTIFICATION DATA LIST (SIDL). SIDL is a print-out of documentation identification data collected from the actions of the CCB. SIDL provides an official record of all technical documentation issued via the Configuration Control Board for use in design, production, assembly, inspection, procurement, and use of Apollo Guidance and Navigation equipment, including ground support equipment. It identifies all drawings, procurement specifications, and other documentation released by CCB and provides the revision history of G&N documentation. "SIDL is a cumulative document".
- 1.4.6 NHB 5300.4 (1B). Quality Program Provisions for Space System Contractors, NHB 5300.4 (1B), is incorporated to provide common, general requirements for contractor quality control programs to insure the required quality of NASA space systems and their elements.
- 1.4.7 NPC 200-3. Inspection System Provisions for Suppliers of Space Materials, Parts, Components, and Services, NPC 200-3, is incorporated to provide common, general requirements for suppliers' inspection systems to insure the required quality of materials, parts, components, and services for end-use in NASA space systems.
- 1.4.8 NPC 250-1. Reliability Program Provisions for Space System Contractors, NPC 250-1, is incorporated to provide common, general guidelines for all NASA programs for the purpose of designing reliability into space systems and to prevent degradation of the design reliability through the steps from fabrication to end-use.
- 1.4.9 ND 1002023. Procedure for Serialization of Components, Subassemblies and Assemblies for Apollo Guidance and Navigation Equipment, ND 1002023, establishes the method to be used for the assignment and control of serial numbers and also identifies the specific assemblies, subassemblies, and components requiring serialization.
- 1.4.10 ACCEPTANCE DATA LIST (ADL). This list is submitted to the government inspector as a certification of the "as built" configuration.
- 1.4.11 Software Configuration Management Plan, MIT Report E-2345. MIT Report E-2345 is the MIT Software Configuration Management Plan. Its purpose is to provide the necessary controls with which effective software configuration management can be realized.

1.5 OTHER CONTROL DOCUMENTATION

In addition to the publications listed above, the documents listed below form an integral part of the documentation and design control plan:

1. Aperture Cards
2. Qualification Status List (QSL)
3. Interface Control Drawings (ICDs)
4. Manuals
5. NASA Master Files(002 Configuration and Traceability, 003 Engineering)
6. Field Log Book
7. Equipment History, including Unit History Record, (see paragraph 8.2.2.3)

1.5.1 APERTURE CARDS. Aperture cards are prepared for drawings, specifications, technical data release or revision forms (TDRRs), and manuals, and for every revision to these documents. They are IBM cards punched and printed to facilitate the storage and retrieval of design information. They include 35-mm microreproduction inserts of the document(s).

1.5.2 QUALIFICATION STATUS LIST (QSL). The QSL is the result of an integrated program for the qualification testing of parts, components, subassemblies, assemblies, and systems. Details of the program, requirements, responsibilities, and status are given in MIT Report R-389, Requirements of and Index to Design Evaluation, Qualification and Reliability Test Program for Apollo Guidance and Navigation System.

Details of quality assurance procedures, including the detailed quality plan, are contained in MIT Report R-396, Apollo Guidance and Navigation Quality Assurance Plan.

1.5.3 SPECIFICATION CHANGE NOTICES. Subsequent to final approval and acceptance by NASA/MSC of CEI specifications, all changes to those specifications shall be processed in accordance with the specification change notice (SCN) procedure as described in NHB 8040.2. Based on the responsibility to provide document and configuration control during the operational phase of the G&N system, every engineering change proposal (ECP) and its related SCN for G&N equipment including GSE, shall be processed through the MIT CMO for appropriate action.

For specifications below the CEI level, the MIT CMO shall notify the Contractor by an AG-letter of the individual specifications required. The effort for this work will be authorized by Technical Directive. The AG-letter serves as notice to commence preparation in accordance with established milestone. The MIT CMO shall maintain surveillance of the specification cycle and provide direction as required.

1.5.4 INTERFACE CONTROL DRAWINGS (ICDs). As the Apollo Guidance and Navigation Program develops, liaison is required to establish interface requirements and to verify compatibility with the other systems. The liaison with North American Rockwell (NAR) and Grumman Aerospace Corporation (GAC) is defined in the separate "Memorandum of Understanding" documents approved by NASA. Interface control drawings (ICDs) are one of the inputs to the MIT Design Review Board in processing changes to the guidance and control equipment, requirements, or procedures. ICDs are coordinated as described in the Memoranda of Understanding.

1.5.5 MANUALS. The requirements of the Statement of Work and NHB 8040.2 pertaining to technical manuals shall be implemented by the Industrial Contractor.

1.5.6 MASTER FILES. Under cognizance of the AC Electronics CMO, two master files in NASA format shall be generated and maintained for the accountability of technical data:

1. Engineering Master File (003),
2. Configuration and Traceability Master File (002).

1.5.7 FIELD LOG BOOK. Section 8 of this handbook provides the format and implementation of field log books to furnish a basis for configuration and operating control of delivered systems and changes made to them in the field. Also see MIT Report E-1293, "Field Operations Program Requirements".

1.6 OTHER REQUIREMENTS

1.6.1 DOCUMENTATION REQUIREMENTS. The documentation requirements and classifications for the G&N program are detailed and responsibilities are established in Exhibits C and D of the Statements of Work for MIT and the Industrial Contractor.

- 1.6.2 MANUAL FORMAT. The format for manuals and related documents is included in Section 9 of this handbook. When necessary, the format for other documents not specifically covered in other instructions will be outlined in Technical Directives or left to the discretion of the originator.
- 1.6.3 SPECIFICATION FORMAT. The format and procedures for specifications are included in this handbook as Sections 3 and 4. These sections specify the Block II G&N requirements (Section 3) and retain the Block I G&N procedures (Section 4) still being utilized on those equipments.

Section 2

PROCEDURE AND IMPLEMENTATION OF THE CONFIGURATION MANAGEMENT PLAN

2.1 SCOPE

Procedures required to implement the Configuration Management Plan outlined in the preceding section are listed and referenced or discussed below. All procedures described below have been placed in operation as of the date of publication of this revision of E-1087.

2.2 ESTABLISHED PROCEDURES

The procedures followed at MIT have been established to meet the requirements defined in NHB 8040.2, MIL-D-70327, NPC 200-1, NPC 200-3, and NPC 250-1, including referenced documents. MIT procedural control documents E-1087, E-1186, E-1167, and R-349 have been prepared to implement these requirements. Figure 2-1 shows the organizational structure of the MIT/Industrial Contractor Guidance and Navigation configuration control program. Figure 2-2 is a G&N Configuration Management Documentation Tree showing the relationships of these various documents and the relationship to the Industrial Contractor. It shows those documents establishing the requirements and those required to control configuration. Within the framework of the documents incorporated in their contracts, the Industrial Contractors have basic in-house policies and procedures which by revision or addendum have been oriented to meet the Apollo NASA/MSC requirements. The Industrial Contractor's Reliability and Quality Assurance Plan (bearing a contract requirement for NASA approval) provides the details of in-house control with governmental and MIT audit as a follow-up.

2.2.1 DOCUMENT PREPARATION. Document preparation shall be initiated in accordance with the following plan:

1. All documents submitted to meet contractual requirements are distributed in accordance with current NASA/MSC distribution lists.

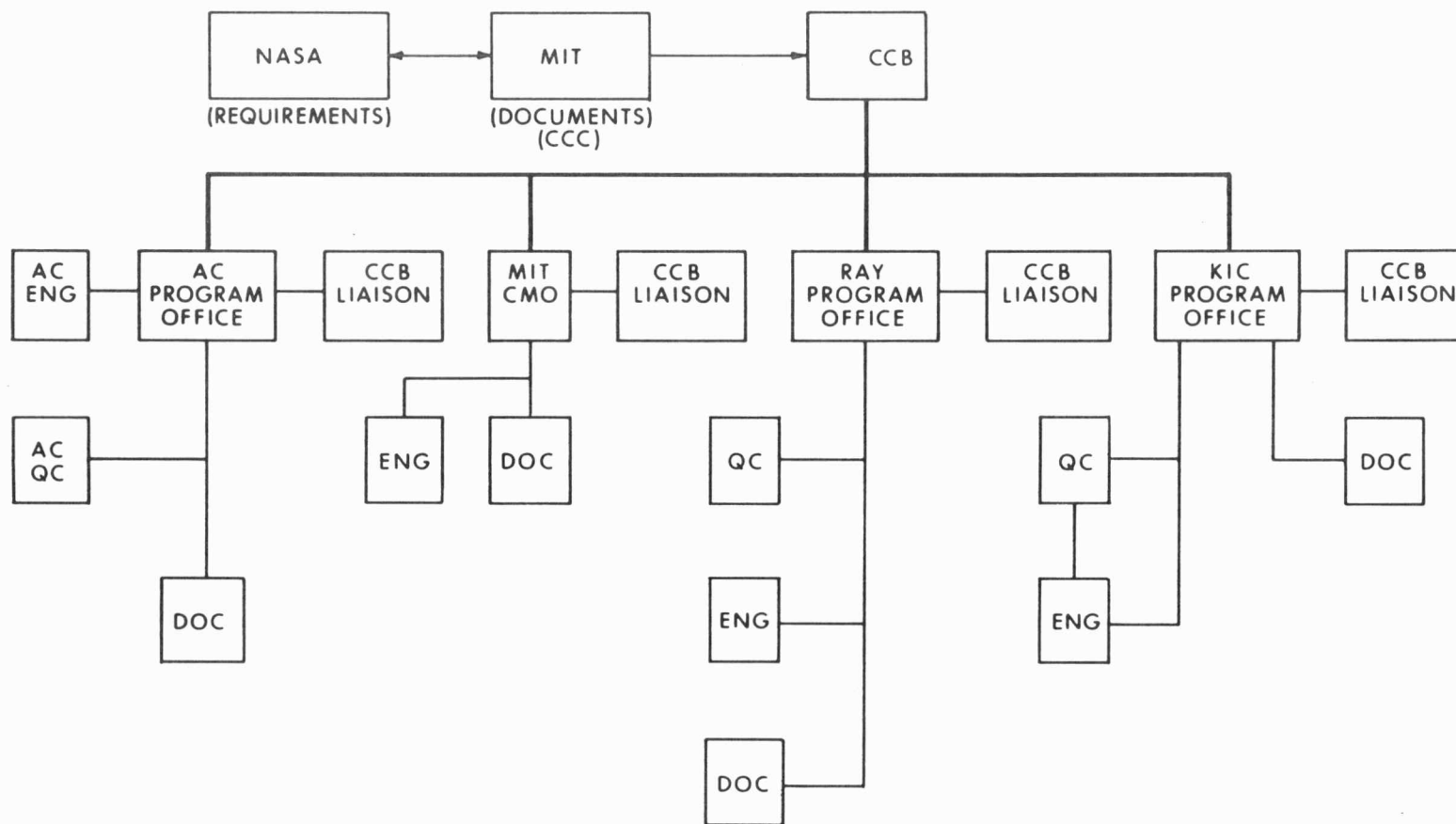


Figure 2-1 G&N Configuration Control Organization

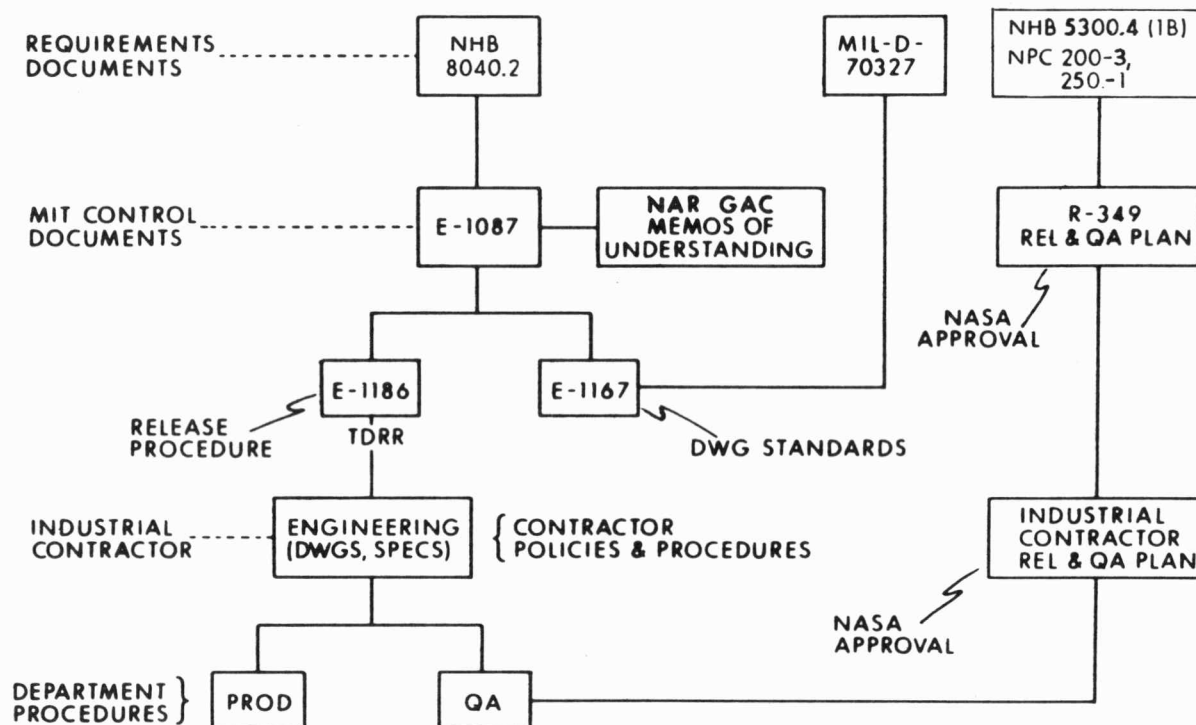


Figure 2-2 Configuration Management Documentation Tree

2. ND Specifications and Specification Control Drawings that Participating Contractors intend to issue through CCB require a "Request for Apollo G&N Documentation" form to be filled out and sent to MIT CMO prior to the preparation of the document. If the decision is made to issue the document, a document number is issued to the Contractor by MIT.
3. MIT conducts technical review at MIT, determines schedules for design release, and determines schedules for required use of documents.
4. The preparing activity (MIT or Contractor) designates a responsible person for each document. This designee coordinates preparation, content, format, schedules, review, and release.
5. When required, MIT prepares a Technical Directive authorizing the Contractor to prepare the document(s). The TD summarizes the requirements of (3) and (4) above.

2.2.2 DOCUMENT RELEASE PROCEDURES. Procedures followed by the MIT CMO for the implementation of configuration management are described in the following sections.

2.2.2.1 DRB Procedure. The DRB consists of the Technical Director and such of the design group heads as he designates. Each design group head in turn calls upon design engineers and Contractor personnel in his area of responsibility to cover the design being reviewed. The membership of the Board is designed to provide personnel capable of determining the total impact of the data on the guidance and navigation segment of the Apollo program. An MIT Reliability Group representative and a Systems Group liaison representative are always present at DRB. Meetings are held in each design group to review all Class A releases and all Class I changes to Apollo G&N documents. In addition to the technical aspects of the function of the design, other items considered are interface problems, logistics of procurement, and suitability for fabrication, assembly, test, or use. In general, this review is intended to provide early consideration of system interfaces and integration, compatibility, and reliability factors. DRB approval is required before any Class A Release and Class I Changes to Apollo G&N documents may be presented to CCB. Complete details of DRB procedures are contained in MIT Report R-383, Design Review Procedures.

In compliance with NHB 5300.4 (1B), the Industrial Contractor and the directed subcontractors have established individual design review boards for evaluation prior to submittal to the MIT DRB or NASA CCB.

When a proposed change of any kind causes a possible interface problem with the spacecraft, it is the responsibility of the engineering group proposing the change to coordinate any change to Interface Control Documents (ICDs) with the affected contractor (NAR or GAC). Since the ICDs and IRNs are prepared by the spacecraft contractors, the coordination results in their preparation of an IRN to be approved by themselves and MIT. See Figures 1-1 and 2-2.

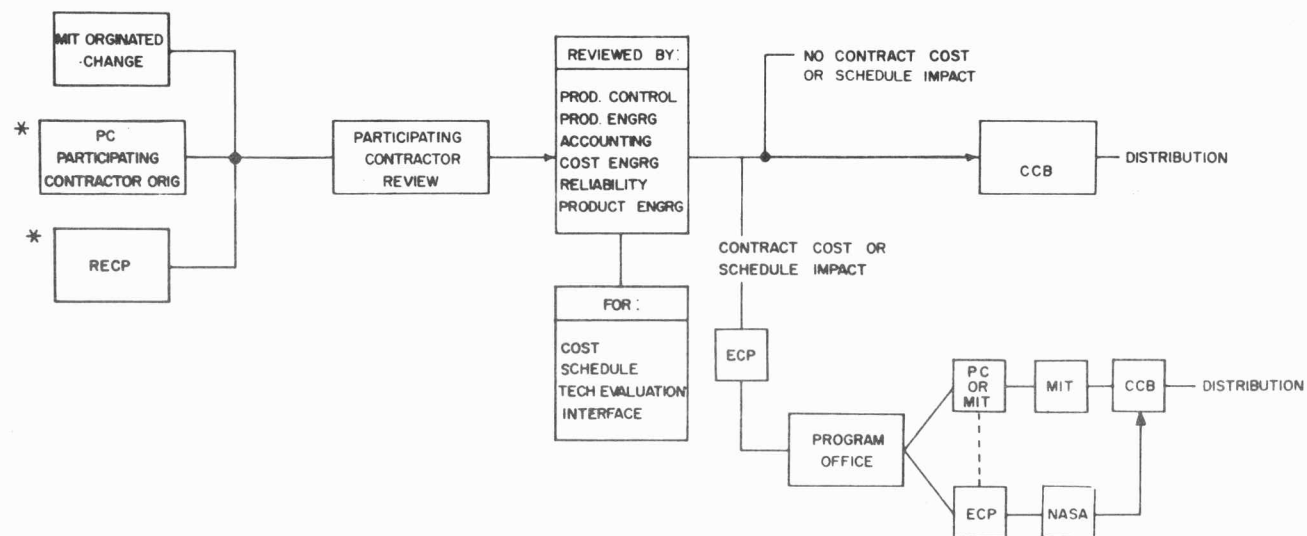
It is the responsibility of MIT DRB to insure that such changes have been properly coordinated. DRB signature on the TDRR signifies this coordination. The Industrial Contractor processes the change through the regular ECP channels for that portion of the change which is required on the G&N side of the interface. The spacecraft contractor uses his own procedures to handle his part of the interface which is being changed.

A typical Industrial Contractor change review procedure is shown in Figure 2-3. This chart is included to show the flow and organizational elements involved in changes at the Industrial Contractor's facility. Liaison effort between the Contractor and MIT is similar to that between design, engineering, and production groups and its extent depends upon the nature of the change.

A flow diagram of engineering document release and revision showing the interaction of the various groups is included in MIT Report E-1186. The diagram is reproduced here as Figure 2-4. In addition, Figure 2-5 displays a typical flow of the released documentation in a Contractor's plant. The exact sequence varies from Contractor to Contractor, but full compliance with configuration control requirements exists at AC Electronics, Raytheon Company, and Kollsman Instrument Corporation. The procedural steps in the diagrammed flow are described in detail in the individual Contractor's Reliability and Quality Assurance Plan, supported by detailed in-house procedures. The preceding sequence of charts indicates the flow and control of documentation from the inception of design through delivery of hardware to the customer.

2.2.2.2 Configuration Control Board Procedure. The mechanics of the CCB procedures are described in detail in MIT Report E-1186.

The MIT Authorizing Member of the CCB shall be the official representative of the MIT CMO and shall ascertain compliance with the CMO policies and procedures.



* IN THE CASE OF A CONTRACTOR PROPOSED CHANGE OR AN ECP CONCERNING DESIGN, THE MIT DESIGN GROUPS WOULD CONDUCT A PARALLEL REVIEW.

Figure 2-3 Typical Industrial Contractor Change Review Procedure

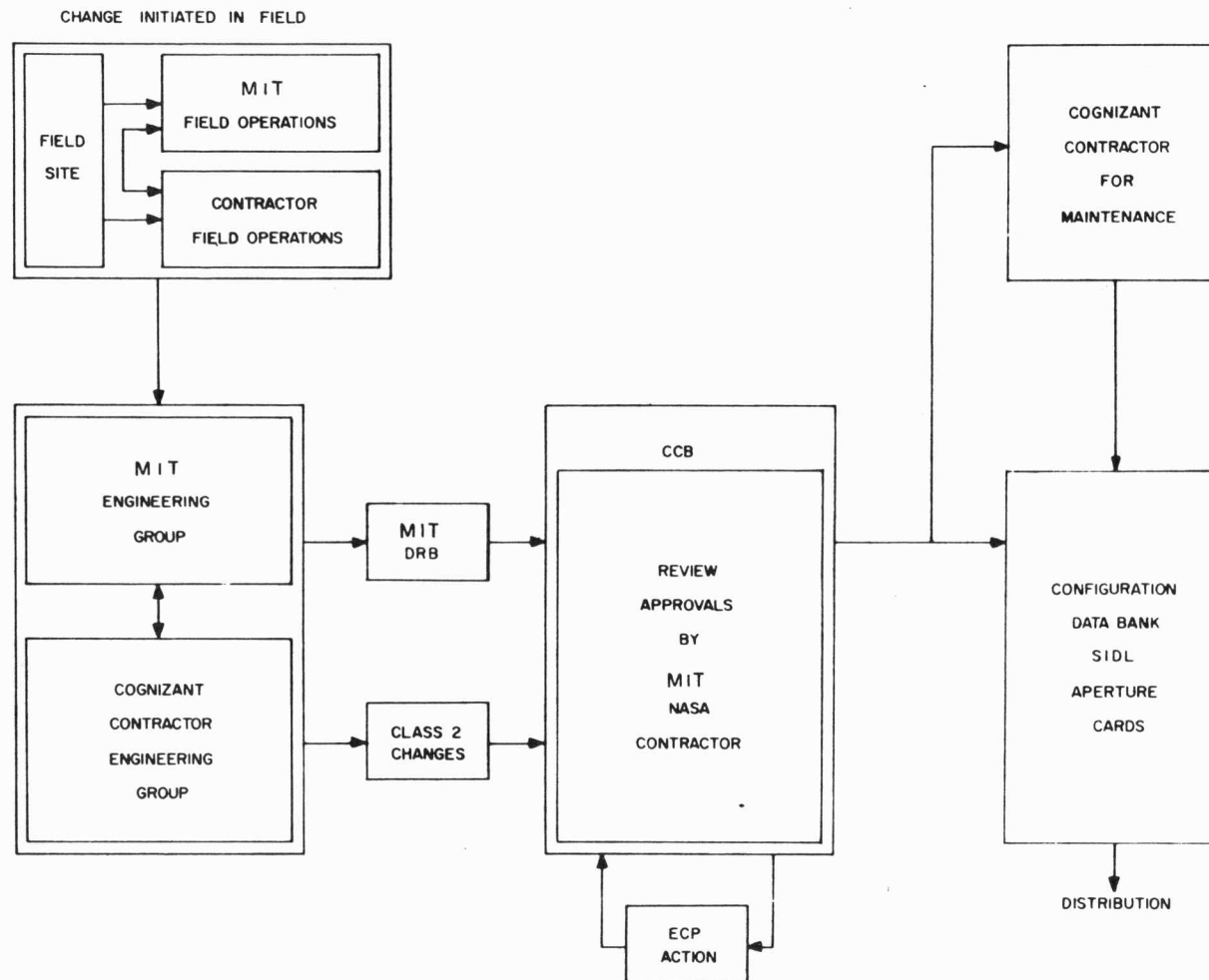


Figure 2-4 Document Flow

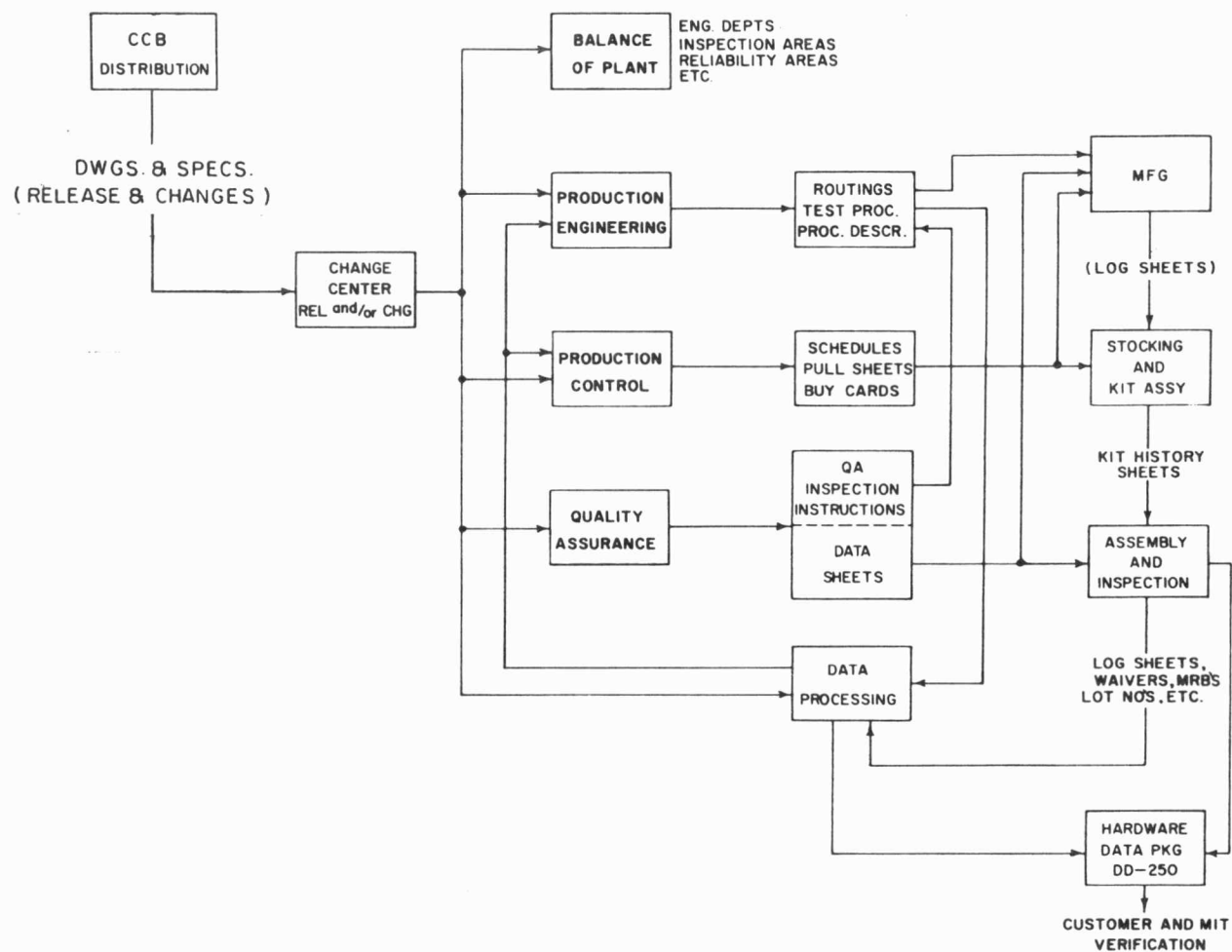


Figure 2-5 AC Electronics Data Flow

The function of the CCB includes specifying additional action required by NASA, MIT, and/or the Contractor as a result of the approval or disapproval of the data submitted.

2.2.2.3 Engineering Change Procedure. The procedures of MIL-STD-480 are in effect for Class I Engineering Changes, modified to fit the various contractors as described below. NASA signature is not required on K-Start Tape TDRRs and Spacecraft Installation List Drawing TDRRs. All other changes must be approved by CCB. See NASA TWX EG44-136-JC43-69-2095, dated 6 June 1969.

Engineering Change Proposals (ECPs) are submitted to NASA for all Class I engineering changes. Normally, the ECP is prepared by AC Electronics. ECPs may also be prepared and submitted by MIT, in which case the ECP is coordinated with AC Electronics before submission and may result in the preparation of parallel alternate ECPs submitted to NASA for evaluation. ECPs may be requested by NASA on a Request for Engineering Change Proposal (RECP). They may also be requested by MIT, Raytheon, Kollsman, or AC Electronics. When an ECP is required for a change that affects the contracts of Raytheon or Kollsman, the affected Contractor initiates preparation by submitting an Engineering Revision Proposal (ERP) to AC Electronics as the basis for the AC-Electronics-prepared ECP.

The following rules have been established by NASA for processing ECPs and "ECPs for Record", (ECPRs).

ECP & ECPR GROUND RULES

1. ECPs will be categorized into two groups.
 - A. Added Scope to the contract - Engineering Change Proposal (ECP)
 - B. Within Scope of the contract - Engineering Change Proposal for Record (ECPR)

The attached flow diagram (Figure 2-6) represents the procedures to be followed for ECPs and ECPRs. ECPs and ECPRs will be submitted to the NASA MSC Configuration Control Board. The NASA MSC Configuration Control Board will review the aspects of the change and, if approved, will issue a CCA approving the ECP as added scope to the contract or ECPR as within scope of the contract. ECPRs shall be prepared for recommended in-line break-ins as well as recommended retrofit.

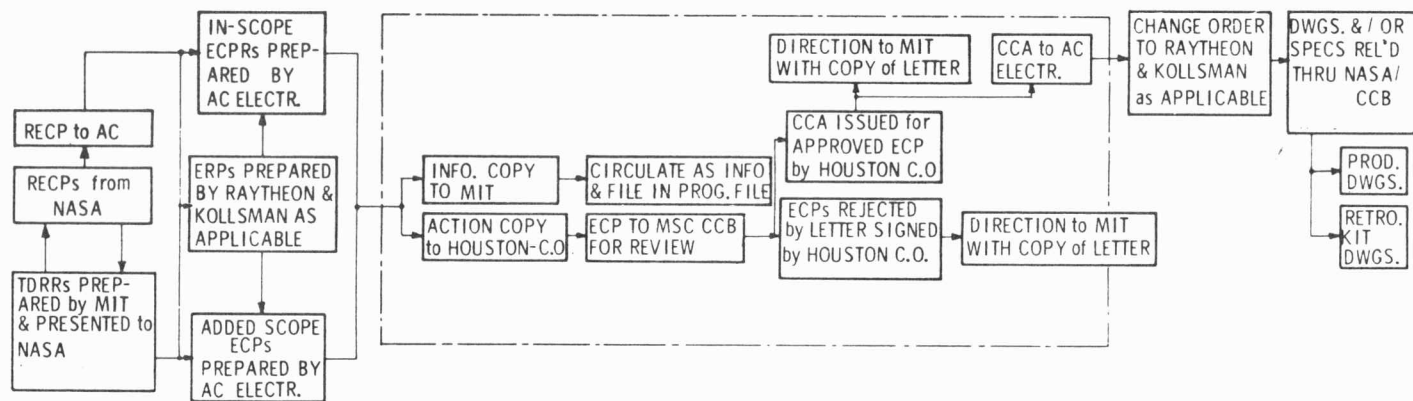


Figure 2-6 ECP Flow Diagram

2. All Class I changes occurring after baseline require ECPs or ECPRs for implementation. Baseline is defined as the original release of drawings including changes made affecting the first unit without cost or schedule impact. ECPs or ECPRs shall be prepared in accordance with NHB 8040.2 and MIL-STD-480. All ECPRs and ECPs require a CCA as authorization. After FACI all ECPs require a SCN to recognize specification changes.
3. All hardware changes, either forward production or retrofit, shall require preparation of a full set of production drawings reflecting the configuration. In addition, all retrofit shall be accomplished by having a retrofit kit and retrofit instruction bulletin (RIB), for field location retrofit, processed through the CCB. (See Figure 2-7).

Figure 2-6 indicates the typical ECP and ECPR flow.

The following implementation and format ground rules are established for ECPs and ECPRs:

1. When an ECP includes retrofit, there shall be a separate "Retrofit Kit" drawing for the GSE portion of the proposed change, and a separate "Retrofit Kit" drawing for the flight hardware portion of the proposed change for each individually numbered ECP. These drawings are the "top drawings" of the package and may consist of a list of kits or be single kits, as required to describe the entire change to all systems covered by a given ECP.
 - A. Definition. (From Para. 3.18.1 of MIL-STD-7A) A kit drawing indicates or depicts a package unit, item, or a group of items, instructions, photographs, or drawings such as are used in modification, installation or survival. The items in a kit normally do not in themselves constitute a complete functional assembly. A kit drawing may be a listing of part numbers, a pictorial representation of parts, or a combination of both.
 - B. The format of a retrofit kit shall be such as to include:
 - (a) All piece-parts and/or assemblies to be supplied by the Contractor in order to accomplish the retrofit. This may also include special tooling, if required for field retrofit.
 - (b) Retrofit Instruction Bulletin (RIB).
 - (c) Any special instruction drawings required that are not a part of the RIB.
 - (d) All GFP items required to accomplish the retrofit to be supplied from government inventory.

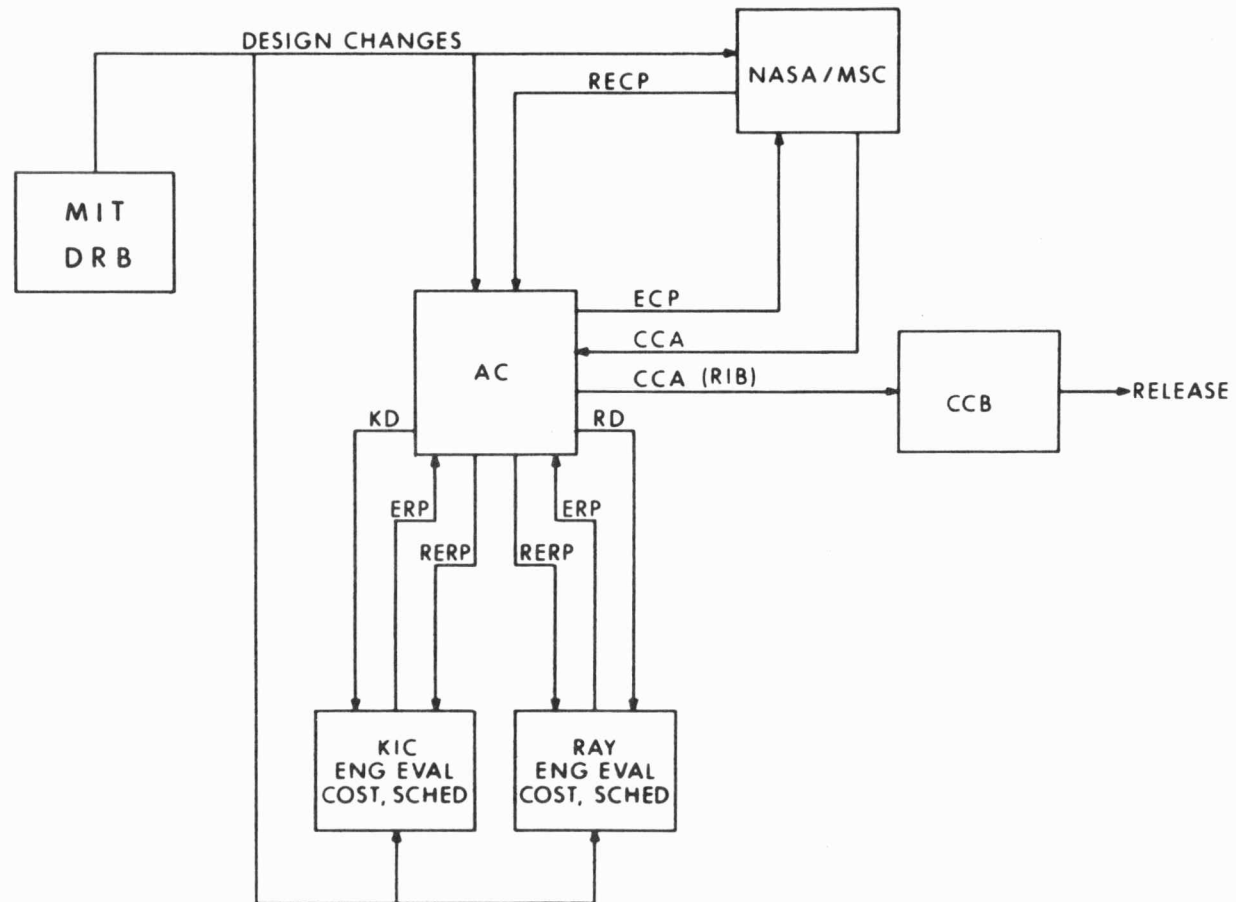


Figure 2-7 ECP Flow Diagram at MIT

2. The "Retrofit Instruction Bulletin" (RIB) shall be called out as a part of the Retrofit Kit bill of materials.
3. When a retrofit is required and there is no cost or schedule impact because the retrofit is within the scope of the contract, an "ECP of Record" (ECPR) shall be prepared. The ECPR shall be numbered in the regular ECP numbering sequence for the contractor involved, and shall be prepared in the same detail required for all ECPs. Authorization for the incorporation of an ECPR will be granted by NASA/MSC.
4. Occasionally an ECP will attempt to bring two or more different base-line systems into the same final configuration. In this case, the kits should be prepared such as to call out every item that is required to perform the retrofit, regardless of the initial configuration, with instructions for the disposition of unused new hardware included for each of the hardware configurations being retrofitted.

Where un-used new hardware in a kit may be a costly item, it is permissible to divide the kit for the ECP into two or more sub-kits for different base-line configurations. However, to keep documentation to a minimum, only one RIB should be written to encompass all sub-kits associated with a single ECP.

5. A Retrofit Instruction Bulletin shall be called out as an integral part of each retrofit kit when field location retrofit may be accomplished. This RIB shall be prepared in such a way that it, as a single document, is applicable to every equipment proposed in the parent ECP and authorized by CCA. In a few cases it may be necessary to divide the RIB into a family of sub-structured instructions wherein the description of work to be performed on each different initial base-line of equipment being retrofitted is tailored as a specific description for each unit.

When it is planned to re-work a system or systems to incorporate more than one ECP as a single operation, an ECPR may be prepared to collect the ECPs into a single package, or an original ECP may be prepared to cover the total re-work.

6. ECPs presented to DRB at MIT and CCB at MSC shall be presented as complete packages (dwgs, PS, JDCs, etc.). Whenever possible the package should contain a copy of the ECP and a copy of the CCA, but since in the general case these are not available, copies should be forwarded to MIT as soon as possible for verification and validation that the changes fulfill the intent of the CCA. The package must contain a separate retrofit kit list for each ECP. The structure of the retrofit kit list shall call

out all required drawings, retrofit instructions, and hardware. The necessary drawings and retrofit instruction bulletin form a part of the package. The title block of the kit and of the RIB shall reference or include the ECP number. A TDRR to update the contractor's top retrofit kit list shall be included. Effectivity of the kit shall be included. Effectivity of the kit shall be specified on the TDRR against the serialized items being retrofitted, by part number.

7. AC Electronics shall be responsible for assuring that ECPs applicable to items produced by Raytheon Co. and Kollsman Instrument Corp. are initiated.
8. The input to AC Electronics which shall cause AC Electronics to initiate an ECP may be a Request for ECP (RECP) from NASA or an ERP from Raytheon or KIC, or the ECP may be self-generated by AC Electronics.
9. The production drawings must be updated to reflect the retrofitted configuration. The changes to the production drawings may be made as part of the package referenced in 7. above, or these changes may be made separately. The TDRR reflecting the changes must reference the ECP.

ECP priorities of "compatibility", "emergency", "urgent", and "routine" shall apply as defined in MIL-STD-480. Expedited action for "emergency", "urgent," or "compatibility" priority is coordinated through the MIT CMO and the AC Electronics program office using the most expedient means for coordination and reporting to NASA/MSC.

2.2.3 CONFIGURATION CONTROL COMMITTEE (CCC). The CCC provides the opportunity for the Contractors and MIT to identify, discuss, and resolve all problems related to configuration management requirements and procedures. This committee is chaired by a representative of the MIT CMO. Specific Contractor and additional MIT participants are chosen according to the agenda for each meeting in order to provide a thorough evaluation and to determine the most beneficial and expeditious course of action.

2.2.4 MISSION DESIGN REVIEW BOARD. The Mission Design Review Board established at MIT for the control, integration, authentication, and approval of computer programs and their associated specifications have the following general responsibilities:

1. Definition of Programming requirements: The Board defines and maintains control of planned computer program features.

2. Creation of a well-integrated program for the AGC: The Board reviews program characteristics, features, interfaces, and schedules to achieve efficient overall system use.
3. Approval and authentication: The Board is the MIT authenticator of AGC programs and specifications. The Board Chairman's approval is required before release of software programs by the CCB.

The CCB shall release a computer program only after approval has been granted by the Chairman of the Mission Design Review Board and the MIT DRB.

2.2.5 FAMILIARIZATION AND TRAINING. The major training effort occurs during the meetings of the Configuration Control Committee when experienced configuration management personnel from all sources are called upon for discussion of anticipated or existing problems. This provides a cross-fertilization with the training programs conducted by the Industrial Contractors. The Industrial Contractors provide formal training through their quality assurance departments to implement and assure compliance with the detailed configuration management requirements of the Apollo program.

2.3 EQUIPMENT CONFIGURATION IDENTIFICATION

The intent of NHB 8040.2 is satisfied by the present MIT numbering system as outlined below. The G&N systems are grouped into blocks and series, and serialized (Reference: ND-1002023) as contract end items within these groupings as shown in Table 2-I.

Table 2-I
G&N Serial Numbers

Block	Series	G&N Serial Number
I	0	5,6,7,8,20
I	50	17,12
I	100	110-124
II	N/A	201 on
LM	N/A	601 on

The sequence of Block I G&N systems which is used for specifying effectivity of changes is the same as defined early in the contract. Information inserted on TDRRs stating a G&N serial number "and on" is to be interpreted according to this sequence. No changes will be made to this sequence, as shown below:

G&N Serial Numbers: 6,7,8,20,17,12,110,111,109,121,122,123,124.

AC Serial Numbers: 6,7,8,20,17,12,110,111,109,121,122,123,124.

Raytheon Serial Numbers (AGC and DSKY): 6,7,8,20,10,9,120,117,112,
110,109,111,119,121,122,123,124.

Kollsman Serial Numbers (Optics): 6,7,8,20,17,12,110,121,111,
109,122,123,124,125.

The Block II/ LM effectivity sequence, as required by NHB 8040.2, will be in strict numerical sequence.

Effectivity control during fabrication and assembly at Contractor establishments is accomplished by the introduction of changes into serialized assemblies, as specified on TDRRs. Cut-in and cut-out effectivities are according to the sequence shown for Block I, and are in numerical sequence for Block II and LM. If it is necessary to modify the planned effectivity, the modification shall be processed in accordance with MIT Report E-1186.

GSE is serialized, but since the eventual capability of each GSE is to include universal coverage for all G&N systems, the block-series grouping is not utilized. Instead a system of controls on the effectivity of retrofit kits is used. Equipment for both G&N and GSE that is designed to provide variable or additional capability is included in the top drawing structure and is designated as an end item as applicable.

Numbers are assigned by AC Electronics as CEI part numbers. Part numbers are also assigned to all components and assemblies at the time of initiation of the drawing and are derived from blocks of drawing numbers assigned by the AC Electronics CMO.

Drawing numbers are seven-digit numbers used to identify the drawing. An additional three digits added as a dash-number is required to identify the part number. All released drawings of components or assemblies with a seven-digit drawing number and no recorded dash-number are assumed to have a three-digit "zero" dash-number (XXXXXXX-000) and are so recorded. The first revision to a drawing is updated to record this zero dash-number and record the next required dash-number change.

2.4 FORMAL REVIEWS

The requirements of NHB 8040.2 on reviews govern. The following is amplification within certain areas.

The requirements for formal design reviews imposes certain responsibilities which must be recognized in the MIT-Industrial Contractor relationship. The following is intended to establish areas of responsibility, while recognizing that the type of review and specific requirements may vary. In general, the reviews will require close liaison between MIT and the Industrial Contractor, and the presentation will be a joint effort.

MIT, as the design agency, will negotiate with NASA to establish the types of reviews to be held and the designation of system configuration to be reviewed. With the Industrial Contractor, MIT will: recommend a specific date and location for the review; develop the documentation package for submittal to NASA; develop an agenda for submittal to NASA; and prepare the material required for the meeting.

When the location of a review is approved by NASA, the host activity will provide the necessary facilities for the meetings and displays, if any, and will be responsible for the recording and reproduction of the minutes of the meeting.

When a review is scheduled, MIT will coordinate a meeting with the Industrial Contractor(s) to assign responsibilities for the specific requirements necessary to fulfill the documentation needs and agenda items for the particular type of review.

2.5 RELATED INFORMATION

2.5.1 ACCEPTANCE DATA PACKAGE VERIFICATION. Concurrent with the acceptance of a serialized item of hardware, the manufacturer prepares an "as-built" listing, bracketing the revision letter of documents used for that serial number. Acceptance Data Package verification is accomplished by comparison of the "as-built" with "as-designed" list.

Section 3

SPECIFICATIONS

3.1 INTRODUCTION

This section provides the specification plan for the Apollo Guidance and Navigation Program. It provides direction for the preparation, processing, format, and content of NASA Contract End Item (CEI) and related specifications and Block II procurement specifications (PSs). Section 4 restates the practice for the existing Block I documentation.

3.2 BLOCK II PROCUREMENT SPECIFICATIONS

3.2.1 USAGE. The procurement specifications (PSs 2015000 and 6015000) for the Block II G&N requirements fulfill the NHB 8040.2 requirements for Part II Specifications and serve as the lowest level of directly controlled documents in verifying design. At FACI, these PS documents will be converted to become Part II of the CEI Specification.

For Block II and LM, the PSs shall be prepared as complete documents with expanded Sections 3 and 4 to include all requirements and tests with values and tolerances. At subsystem and system levels where a commonality of tests is required between factory and field for correlation of data, JDCs may be utilized where deemed necessary by MIT Engineering. When it is determined by MIT Engineering that it is practical to group assembly test procedures into a separate document (ATP) at the system level, such ATPs will be referenced in Section 3 and become part of the procurement specification.

The level of equipment to which procurement specifications will be written includes the lowest level of spares anticipated and/or the subassembly level where significant testing is to be accomplished. This does not preclude the incorporation of an assembly procedure or test as an intermediate step below the PS assembly level within the sections of the PS. Thus, the step-by-step procedures are permitted to be Contractor in-house documents. The design is controlled by detail drawings and by compliance with PS requirements.

The exception to this approach is at "system" level where other requirements exist. By "system" is meant the testing and assembly of a grouping of major subsystems, such as the ISS, where detailed procedures are necessary and a direct correlation of data is applicable to field use or analysis of the system after delivery. In these cases the volume and detail of procedures warrants the use of ATPs and JDCs. (See Section 4 for further explanation of these documents.) These documents must finally be correlated to the CEI specification of the G&N system.

- 3.2.2 DETERMINATION OF NEED FOR A BLOCK II PS. The requirement to generate a particular specification shall be decided by the MIT Apollo Configuration Management Office after a detailed evaluation of the managerial and technical requirements for both MIT and the Contractors. This evaluation shall include a determination that the item for which a specification is planned is a contract end item which will be produced in the Contractor's plant and which will be complete, delivered, and formally accepted by the procuring agency.

Contract end items include spares, factory replacements, field spares, or any items, be they subassembly or piece-part, which are ordered by NASA as separate items. The designation of location for these items, whether it be a bonded room in a subcontractor's plant, a field site, or a government storage facility, does not alter the requirement for a procurement specification.

Subsequent to the indication that an item is to be provisioned as a spare, a PS is generated only when the item provisioned is a subassembly of a CEI and has demonstrable characteristics which must be verified and which cannot be assumed as a natural consequence of drawing compliance. A procurement specification shall be originated to specify the design requirements and the tests necessary to verify compliance with the requirements specified in section 3 of the PS.

Procurement specifications shall not be written for piece-parts or mechanical subassemblies which are completely defined on engineering drawings. Such items shall be procured from the engineering drawing without further documentation.

3.3 DESCRIPTION OF SPECIFICATION (BLOCK II)

- 3.3.1 DEFINITION. A procurement specification is a description of the technical requirements for a material, a product, or a service, including the methods and/or procedures which shall be used to determine that the requirements

have been met. The specification shall establish a standard for the technical and physical characteristics or performance requirements of the materials, products, or services. The procedures for packaging, packing, and marking shall also be stated in the specification. The test and inspection procedures necessary to ensure that the requirements of the specification are met by the supplier shall be established in the specification.

3.3.2 PREPARATION. PSs shall be prepared on 8-1/2-inch by 11-inch 198H DIETZGEN vellum or an equivalent heavy, fine surface, tracing vellum. The format to be followed in the preparation of a procurement specification is shown in Exhibit 3-1 which is based on Exhibit II of NHB 8040.2, sample format C.

3.3.3 FORMAT DESCRIPTION. This section describes the format requirements for procurement specifications, as defined in NHB 8040.2, for both G&N and GSE, Block II.

3.3.3.1 Front Matter. The procurement specification shall contain one page of front matter which shall be the title page. The title page shall follow the format and shall contain the information presented in the sample title page shown in Exhibit 3-1, which appears at the end of this section. The name of the item being specified will be the same name that appears on the drawing of the item when such a drawing exists. When a specification is written for an item for which no drawing exists or is planned, the title shall be concise and descriptive.

Initially, the specification number shall be the same as the drawing number of the item for which the specification is written. When no drawing exists or is planned, the specification shall be assigned a number from among those released by NASA for use on the Apollo project.

The TDRR number in the upper right-hand corner shall be the number of the TDRR on which the PS was initially released. This number shall remain on the specification regardless of the number of times the specification is revised.

The total number of pages included in the specification shall be indicated in the lower left-hand corner of the title page under the Record of Revisions block. Pages will be numbered consecutively, including the title page.

3.3.3.2 Sections. The specification shall have seven numbered sections, which retain the same title regardless of the content of the specification. The subject matter shall conform to the scope of the section in which it appears. This is to ensure that specific types of information shall always appear in the same section of each specification. If the specification does not contain any information which fits within the scope of a particular section, the section shall be retained in the specification but shall contain a statement to the effect that: "There are no applicable requirements." The seven sections are:

- Section 1: Scope
- Section 2: Applicable Documents
- Section 3: Requirements
- Section 4: Quality Assurance Provisions
- Section 5: Preparation for Delivery
- Section 6: Notes
- Section 7: Appendix

A brief statement of the prescribed content of each of these sections appears in the following paragraphs, and simple "boiler-plate" statements applicable to each section can be found in the sample specification, Exhibit 3-1.

3.3.3.2.1 Section 1: Scope. The statements under this section shall be similar to those shown in the sample format, Exhibit 3-1.

3.3.3.2.2 Section 2: Applicable Documents. This section shall contain a listing of all currently available approved documents which are to form a part of the specification. It shall also establish which document or documents shall prevail in the event of a conflict of statements in any of the named documents and shall be as shown in the sample format, Exhibit 3-1.

All documents referenced in the body of the specification, and only those documents, shall be listed in Section 2.

3.3.3.2.3 Section 3: Requirements. This section, Section 3, forms the major portion of the specification and shall specify performance, product configuration and standards of manufacture and manufacturing processes which must be verified at time of delivery to establish the quality of the item as manufactured. Each requirement to be specified herein must satisfy the following criteria:

- 1 There shall be a direct means of testing or verifying that the requirement has been satisfied, as specified in Section 4.
- 2 The test/verification which formally demonstrates that the requirement has been satisfied shall be accomplished at the place of manufacture of the item.
- 3 The requirement must be verified at time of acceptance to assure that manufacturing control has been maintained and that the item as fabricated will function to satisfy the requirements of its use.
- 4 The requirement shall be specified in terms of the item itself, in terms of physically measureable properties, with tolerances.

Introductory material may be included in the first paragraph directly under the main heading for Section 3. All requirements shall be specified within subparagraphs. Standard content for paragraphs 3.1 and 3.2 is indicated below. Other subparagraphs to follow 3.2.1 may include such information as "Finish", "Nameplate or Product Marking", "Maximum Weight", etc.

Paragraph 3.1, Performance: This paragraph shall specify performance requirements for the items that conform to the criteria stated in Items 1 through 4. Performance features included herein shall be specified at environmental conditions normal to the manufacturing process and/or the place of acceptance, and no attempt shall be made to simulate the environment in which the item will be used. This paragraph shall specify those performance features which cannot be assumed as the natural consequence of drawing compliance. Performance requirements specified herein may include features which must be verified by preassembly, station, or manufacturing tests/verifications. Requirements for test/verifications which shall be accomplished prior to final assembly shall be specified directly. Requirements included in this paragraph shall be specified to the level of detail necessary to establish limits for the test/verification method to be specified in paragraph 4.2 to follow. This paragraph shall include subparagraphs as necessary to specify each individual requirement in a separate and distinct subparagraph.

Paragraph 3.2, Product Configuration: This paragraph shall specify the product configuration requirements for the CEI. Basic paragraph 3.2 may include description material or material included for purposes of continuity. All requirements shall be specified within the subparagraphs included herein.

Subparagraph 3.2.1, Drawings: The requirements of this paragraph may be satisfied by the statement as shown in the sample format, Exhibit 3-1.

3.3.3.2.4 Section 4 Quality assurance 4.1, 4.1.1, 4.1.2, 4.1.2.1. This section shall begin with the paragraph contained in the sample format, Exhibit 3-1, and shall specify only the specific tests/verifications which must be accomplished to satisfy all requirements specified in Section 3. Tests/verifications to assure control of quality during the manufacturing process not specifically included herein shall be accomplished by routine manufacturing level surveillance as required by the local representative of the procuring agency (NASA Plant Representative, or equivalent). Each test/verification specified herein shall be witnessed, or the contractor record of the test/verification reviewed, at time of acceptance of each unit of the item; hence, all tests/verifications included herein are identified as acceptance tests/verifications. Tests/verifications included herein shall be accomplished during the manufacturing process, or at time of delivery, to establish the quality of the item as fabricated and assembled. Each test/verification requirement shall be specified to the level of detail necessary to:

1. Identify each test/verification specified herein with the requirement in Section 3.
2. Establish the method for each test/verification specified herein. Methods of test/verification include inspection, demonstration, test, or combinations thereof.
3. Establish for each method related to each test/verification, specific limits which shall represent a clear basis for decision as to the quality, hence, the acceptability of the item.
4. Establish the accuracy of each test/verification specified herein. Introductory material may be included in the basic paragraph of Section 4. All requirements shall be specified within subparagraphs included herein.

Paragraph 4.1, General. The boiler-plate statements shown in the sample of Exhibit 3-1 for this paragraph and its associated subparagraphs indicate the typical content of this paragraph. More subparagraphs may be used if needed.

Paragraph 4.2, Tests/Verifications: This paragraph shall contain, in subparagraphs as appropriate, the tests/verifications required to satisfy each requirement specified in Section 3. The tests/verifications shall be included in the subparagraphs as appropriate. Individual quality verifications may be grouped into test/verification tasks to make effective use of test equipment and test personnel. Each inspection, demonstration, and test shall be specified to a level of detail which clearly establishes the validity and accuracy of the test/verification. The test/verification shall be so specified as to permit a clear, nonsubjective determination of the quality of the item. The tests/verifications to be specified in the subparagraphs to be included herein shall be specified to a level of detail which satisfies the following criteria:

1. Inspections and/or demonstrations shall be stated to quantitatively specify and define the limits for the acceptable condition. In general, verification of quality by inspection and/or demonstration in support of acceptance testing shall be limited to verification of construction features of the item, e.g., inspection for proper wire coding, determination of specific physical dimensions, inspection of production records to verify installation of Government-furnished property, and the like.
2. Tests shall be specified in quantitative terms, with tolerances, to the level of detail necessary to clearly establish the test method, the credibility of the test method, the validity of the test data, and the actual measurement values.
3. Where records generated during the manufacturing process are to be used as part of the acceptance test/verification, the method of establishing the validity of the record, as well as record content, shall be specified.

Subparagraph 4.2.1, Drawing Compliance: This paragraph shall specify the method for verifying that the item as fabricated and assembled is configured to conform to the drawing specified in paragraph 3.2.1. To the extent practical, this shall be accomplished by inspection at the time and place of acceptance of the item. The "as manufactured" configuration of items which cannot be inspected in the fully assembled condition to the level of detail necessary to fully establish configuration conformance to the drawing (complex items, hermetically sealed units, electronics equipment assembled into cabinets, and the like) shall be verified by reference to manufacturing records.

3.3.3.2.5 Section 5: Preparation for Delivery. This section shall define preservation and packaging, and the packing and marking methods to be used for shipment and storage of Apollo G&N major assemblies, subassemblies, parts, and associated ground support equipment. These requirements may be covered by reference to ND 1002214. For shipment and storage of items to Apollo G&N Contractors by their vendors and suppliers, the requirements are covered by ND 1002215.

3.3.3.2.6 Section 6: Notes. This section shall include any pertinent information of value to the purchaser or the manufacturer that is not covered elsewhere in this specification.

3.3.3.2.7 Section 7: Appendix. The specification may contain a supplemental section of requirements if it is deemed necessary. This section will be bound to the specification and shall be designated as Section 7. (Ref: M-200 A, para. 6-317, p. 614.)

3.3.3.2.8 Index. If the specification is lengthy, an alphabetical index may be added to facilitate location of information.

3.3.4 SECURITY REQUIREMENTS. All documents containing classified information shall be classified according to the highest classification of security information they contain. The appropriate classification shall be in accordance with DD 254 accompanying the contract and with the Industrial Security Manual.

3.3.5 REVISIONS. Revisions to a PS shall be presented in accordance with the instructions contained in MIT Report E-1186, Technical Data Release Procedures.

When a PS is revised, the revision letter, date of revision, and TDRR number shall be placed in the Record of Revision Block along with the page number(s) of the revised page(s). The appropriate revision letter shall be placed after the PS number on all revised pages.

On the title page, the TDRR number and date shown in the upper right-hand corner are the TDRR number and date associated with initial release of the document and should not be changed or erased throughout the life of the document, regardless of the number of revisions.

If more space is needed in the Record of Revisions block, one or more additional sheets, having the same identifying information and Record of Revisions format as shown on the title page may be added. In such an event, the notation "(cont)" shall be added below the block on the cover page and above the block on succeeding pages. The additional pages shall be numbered 1a, and so on.

The initials of the Authorizing Member of CCB and of the NASA/MSR representative shall be placed in the appropriate spaces of the Approval block.

A description of the changes need not be attached to the PS because this information is contained on the TDRR.

3.4 RELATED INFORMATION

- 3.4.1 JOB DESCRIPTION CARDS (JDCs). The initial release of a JDC must be referenced to a parent document: PS, ATP, or Manual. Subsequent to release, the JDC shall be revised as an independent document and acquire a revision history of its own.

The addition of a JDC to a document requires that the parent document be revised to reflect the addition. The deletion of a JDC requirements also demands that the parent document be revised.

For Block II/LM procurement specifications, either the basic PS or an addendum may be the parent document.

If the new revision is unconditionally interchangeable with all the applications of the former revision, JDCs used for Block II/LM may be revised by revision letter advancement alone. If a change to a JDC limits the application of the JDC, a new JDC shall be issued which carries a new JDC number.

- 3.4.2 CLASSIFICATION. The addendum system as outlined in NHB 8040.2 may be used to specify the differences imposed by two or more dash-numbered configurations of an equipment in Block II/LM. The basic PS shall define the requirements for the first equipment configuration (part number XXXXXXXX-011 or XXXXXXXX-000) and will be identified as PS XXXXXXXX. When a new dash-number configuration is introduced for the equipment, an addendum will be prepared to define only the deviations from a specific revision of the basic specification. If the requirements for the new equipment configuration (new part number) are completely identical to those specified in the basic specification, any one of the following three alternatives is acceptable:

1. An addendum specification may be prepared containing statements to identify the complete identity of requirements.
2. The basic specification may be revised to include the new configuration (new part number) in Section 1 "Scope".
3. A complete new procurement specification with new PS number may be prepared to apply to the new configuration.

The choice of alternatives to be used is a matter of judgement by the preparing agency. Evaluation and comparison of the relative merits of the alternatives need not always result in the same choice.

The procedure established by alternative number 1 above results in the following:

1. The basic configuration to the specification (PS XXXXXXXX) stands alone when used for the first equipment configuration (part number XXXXXXXX-011 or XXXXXXXX-000).
2. The use of any addendum requires direct support by the basic specification at a specified revision.
3. Every dash-number configuration of an equipment has a corresponding basic specification or addendum.

Example: P/N XXXXXXXX-011 PS XXXXXXXX (Basic Specification)
P/N XXXXXXXX-021 PS YYYYYYYY (Addendum Spec for
P/N XXXXXXXX-021)

3.4.3 REVISION. The basic PS and each addendum are maintained as separate and unique documents with independent revision accountability. Any addendum may be revised without revising the basic PS or other addenda.

3.4.4 REFERENCE ON DRAWING. The Engineering Drawing shall call out the PS or addendum in the note structure (or bill of material) applicable to each dash-numbered configuration.

3.5 OTHER DOCUMENTS

3.5.1 CONTROL DRAWINGS. A specification control drawing or source control drawing (SCD) is also a procurement document and is prepared for commercial or vendor items in accordance with the requirements of MIL-STD-7A.

3.5.2 ND DOCUMENTS. The designation of "ND Document" is used for such items as process control specifications that are not covered by Military or Federal documents, for manuals, handbooks, and other documentation that is required to be controlled by the MIT CMO.

EXHIBIT 3.1 (11 PAGES)

SPECIFIC FORMAT GUIDE

FOR

BLOCK II/ LM SPECIFICATIONS

SECURITY CLASSIFICATION
(When Applicable)

Exhibit 3-1

WARNING NOTE
PER TITLE 18, Sec. 793 & 794
(When Applicable)

APOLLO G&C Specification
PS0000000

Rev
Original Issue Date:
Release Authority: TDRR
Class Release

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

(INSERT TITLE THAT APPEARS ON TOP ASSEMBLY DRAWING)

DRAWING NO. 0000000

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of Pages 1 to inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACE
-----------	----------	--------	-----

Page 1 of Addendum Specification

SECURITY CLASSIFICATION
(When Applicable)

SECURITY CLASSIFICATION
(When Applicable)

Exhibit 3-1

APOLLO G&C Specification
PS0000000
Rev
Original Issue Date
Release Authority: TDRR
Class Release

ADDENDUM NOTICE

This Specification has been prepared as an Addendum to:

Specification No. _____ (of Basic Spec)

Revision _____ (of Basic Spec)

Release Date _____ (of Revision to Basic Spec)

FOR

(Approved Nomenclature)

Used With

(Project or System Name)	(Project or System)
APOLLO	G&C SYSTEM

The exact content of specification (insert same number as above) used as the basic document for this addendum is the revision referenced above plus the following specification change notices to specification (insert same number as above).

1 SCOPE

This specification establishes the detail requirements for complete identification and acceptance of the (Name on Assembly Drawing), Part No. 0000000-011.

1.1 PRODUCT CONFIGURATION BASE LINE ACCEPTANCES. The product configuration base line shall be established by FACI of the end item Serial No.

. This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

- 2.1 EFFECTIVE ISSUES. Unless otherwise specified herein, Military and Government standards and specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

Specifications

APOLLO G&N

Standards

Military

Drawings

APOLLO G&N

Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.

- 2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this specification, and the documents listed in this section, the following order of precedence shall apply and the Contractor shall notify MIT/IL APOLLO Configuration Management Office of the conflict as soon as it is determined.

The contract

This specification

Documents listed in this section

3 REQUIREMENTS

3.1 PERFORMANCE

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 0000000-000 and all drawings and engineering data referenced thereon.

3.2.2 Add Government Furnished Property List (If Applicable)

4 QUALITY ASSURANCE

- 4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Nonconformance. The failure of an end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the Contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance or, when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the Contractor to the cognizant NASA representative.

4.1.2 Test Conditions.

- 4.1.2.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

Temperature: $25 \pm 10^{\circ}\text{C}$

Relative Humidity: 90 maximum

Barometric Pressure: 28 to 32 inches of Hg

4.2 TESTS/VERIFICATIONS.

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 0000000. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.2 Tests. (List tests to verify each and every requirement specified in section 3.)

4.2.3 Workmanship, Vibration. (Where applicable). Energize the Module. Subject the Module to vibration along the axis shown in Fig. . The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch constant displacement from 10 cps to the crossover frequency. (Specify parameter to be monitored and allowable tolerance.)

5 PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with Specification ND 1002214.

6 NOTES

7 APPENDIX (if needed)

8 INDEX (if needed)

Section 4

PROCUREMENT SPECIFICATION (PS) DOCUMENTATION (BLOCK I)

4.1 SCOPE

The implementation of a specification program for the Block I phase of the Apollo Guidance and Control program required the utilization of six basic documents. This section identifies these basic documents and establishes the requirements for format and content of the procurement specification documentation generated for Block I.

NOTE: Because of the inactivity of usage of Block I documents this section has not been reproduced in this revision. The reader should refer to revision "C" of E-1087 for an explanation of Block I documentation.

Section 5

PREPARATION OF FINAL TEST METHOD (FTM) DOCUMENTATION (BLOCK I)

5.1 PURPOSE

This section provides a standard for the preparation of Final Test Methods (FTM's) applicable to each specific complex equipment design undertaken by the contractors participating in the design and fabrication of the Apollo G&C system. This section defines the objectives and use of the Final Test Method. The format, style, and content of the FTM are presented as well as the methods and considerations involved in its preparation.

NOTE: Because of the inactivity of usage of Block I documents this section has not been reproduced in this revision. The reader should refer to revision "C" of E-1087 for an explanation of Block I documentation.

Section 6

PREPARATION OF ASSEMBLY TEST PROCEDURE (ATP) DOCUMENTATION

6.1 PURPOSE

The purpose of this section is to establish the requirements for the content and format of Assembly Test Procedure (ATP) documentation for equipment contained in, or a part of, the Apollo Guidance and Control system.

6.2 DEFINITION

An Assembly Test Procedure is a clear, concise description of the procedures required to test components, subassemblies, or assemblies for the Apollo guidance equipment at any level of testing prior to its procurement as an end item. ATPs are to be prepared when it is determined by MIT engineering that it is practical to group assembly test procedures into a separate document (ATP). Such ATPs will be referenced in Section 3 of the PS and become a part of the PS.

6.3 FORMAT

The ATP shall be prepared on 8-1/2-inch by 11-inch 198H DIETZGEN vellum or an equivalent heavy, fine surface, tracing vellum. The first page of the specification, the title page, shall be page 1, and the remaining pages shall be numbered consecutively. (See Exhibit 6-1.)

6.3.1 FRONT MATTER. The front matter includes the following:

Title Page

Table of Contents (when required).

6.3.1.1 Title Page. The title page shall follow the format and contain the information shown on the sample title page in Exhibit 6-1. The name of the end item shall be the same name that appears on the drawing of the item.

Initially, the ATP number shall be the same as the assembly drawing number of the item for which the ATP is written. When no drawing exists or is planned, the ATP shall be assigned a number from among those released by NASA for use on the Apollo project. This number shall not be used on a drawing, unless the drawing is of the item described in the ATP.

The TDRR number and date in the upper right-hand corner shall be the TDRR number and date by which the ATP is initially released. This number and date shall remain on the title page regardless of the number of times the ATP is revised.

The total number of pages included in the ATP shall be indicated in the lower left-hand corner of the title page under the Record of Revisions block. The title page shall be page 1.

6.3.1.2 Table of Contents. A table of contents shall be required only when the ATP is long enough or complex enough to make a table of contents desirable in terms of convenience in locating information. As a general rule, an ATP longer than ten pages should have a table of contents. This ten-page figure should be used as a guide and not as a rule.

When required, the table of contents shall follow the format established by the sample table of contents in Exhibit 6-1. The full title of the ATP, the paragraph number, title, and page number of each section shall be centered on the page.

6.3.2 SECTIONS. The ATP shall be divided into the following main sections:

Section 1: Introduction

Section 2: Assembly Requirements

Section 3: Test Requirements

Section 4: Test Procedures

Section 5: Notes

If the ATP does not include a requirement or information coming within the scope of a particular section or sections, the section heading shall be retained, and a statement shall be added to the effect that: "There are no applicable requirements."

Sections 1 and 2, "Introduction" and "Assembly Requirements," shall be narrative in form and shall conform to the format illustrated in Exhibit 6-1. Section 3, "Test Requirements," shall also be narrative in form; the content of this section is explained in paragraph 6.4.3.3. Section 4, "Test Procedures," shall be prepared according to the Job Description Card (JDC) format described in Section 7 of this documentation handbook.

6.3.4 CONCLUDING MATERIAL. The ATP may contain the following concluding material: Notice, Appendix, and Index.

6.3.4.1 Notice. The following notice shall appear in all unclassified ATP's, immediately after Section 5, "Notes," except where specific authorization has been obtained to omit the notice or to substitute a special notice.

Notice: When Apollo G&C drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Apollo G&C procurement operation, the National Aeronautics and Space Administration thereby incurs no responsibility nor any obligation whatsoever; and the fact that Apollo G&C may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

6.3.4.2 Appendix. The ATP may contain a supplemental section of requirements if it is deemed necessary. This section shall be bound to the ATP.

6.3.4.3 Index. If the ATP is lengthy, an alphabetical index may be added to facilitate location of information.

6.3.5 SECURITY REQUIREMENTS. All documents containing classified information shall be classified according to the highest classification of security information contained therein, in accordance with DD-254 accompanying the contract and with the Industrial Security Manual.

6.3.6 REVISIONS. Revisions to an ATP shall be presented in accordance with the instructions contained in MIT Report E-1186, Technical Data Release Procedures.

When an ATP is revised, the revision letter, date of revision, and TDRR number shall be placed in the Record of Revisions block along with the page numbers of the revised pages. The appropriate revision letter shall be placed after the ATP number on all pages included in a particular revision. On page 1, the TDRR number shown in the upper right-hand corner is the TDRR number associated with the initial release of the document and should never be changed or erased throughout the life of the document, regardless of the number of revisions.

If more space is needed than is provided in the Record of Revisions block, one or more additional sheets, carrying exactly the same identifying information and Record of Revisions format as shown on page 1, may be added. In such an event, the notation "(cont)" shall be added below the block on page 1 and above the block on succeeding pages. The additional page(s) shall be numbered 1a, and so on.

The initials of the CCB chairman and the NASA/MSC representative shall be placed in the Approval block on the title page of the ATP.

A record of changes need not be attached to the ATP because this information is contained on the TDRR.

6.3.6.1 Addenda and Types. ATPs using addenda or type classifications, as applicable, shall be revised in accordance with the procedures specified in Sections 3 and 4, respectively, of this documentation handbook.

6.4 CONTENTS

The ATP shall cover only one item. The item may be a module, subassembly, or assembly. The format for individual pages is shown in Exhibit 6-1, a sample ATP.

6.4.1 TEST. The ATP shall provide precise instructions on testing procedures that form an integral part of the assembly procedure and, when required, shall state clearly and consisely the assembly requirements applicable to the item for which it is written. These test procedures include any alignment, adjustment, balancing, or calibrating which is conducted during the assembly process, and any tests or checks necessary to ensure the proper operation of the end item after the completion of the assembly process or to provide test information required for final acceptance of the item.

6.4.1.1 Limitations. Unless specifically required for an understanding of the testing of the end product, the ATP shall not cover the testing of components or accessories belonging to the same system as the end product involved but not actually necessary for the operation of the end product. The ATP shall contain instructions for the testing of cabling only when such cables form an integral part of the end product. Interconnection cabling between units shall be covered in a separate ATP when necessary. The tests performed on the end item shall not be considered as final acceptance or inspection tests but as production inspections to ensure that assembly operations have been performed satisfactorily and that the end item will meet operational requirements.

6.4.1.2 Style. The test shall be factual, specific, concise, and clearly worded and illustrated so as to be readily understood by the average level of assembly and test personnel. Specialized engineering or scientific knowledge either shall be omitted or, if absolutely necessary for the assembly test procedure, shall be converted into terminology readily understood at the production level. Text material shall make reference to appropriate diagrams, tables, charts, and illustrations. Repetitious material shall be avoided except in those cases where a repetition of the information is desirable for the sake of clarity. Emphasis shall be placed on unusual, extremely difficult, or very precise steps in the assembly test procedures.

6.4.1.3 Identifying Marks. All identifying marks shall appear in the test exactly as they appear on the end item, production machinery, or test equipment.

6.4.1.4 Reference to Parts. Reference to the end item or its components, to the production machinery or its parts, or to the test equipment or its parts shall be by standard drawing nomenclature, drawing number, type designation, reference designation, or figure and index numbers as applicable. The rule shall apply the first time an item is mentioned. In addition to all of the above information, the short name may also be given; the part or item may be referred to by its short name thereafter.

6.4.1.5 Abbreviations. Abbreviations shall conform to MIL-STD-12 when applicable. Any abbreviations used which are not contained in MIL-STD-12 shall be explained in a paragraph entitled "Definition of Terms" under Section 5, "Notes."

6.4.1.6 Reference Designations. Reference designations shall be in accordance with the latest revision of MIL-STD-16. Reference to color coding of chassis

wiring shall be in accordance with MIL-STD-687. Wiring color codes which do not conform to the provisions of MIL-STD-687 shall be explained in a special paragraph under Section 5, "Notes."

6.4.1.7 Electrical and Electronic Symbols. The electrical and electronic symbols used in the test shall conform to the provisions of MIL-STD-15.

6.4.2 ILLUSTRATIONS. Illustrations shall be used to convey essential information or to clarify the instructions in the test. Illustrations shall be used to show arrangements or equipment setups which are difficult to explain in the text. Schematics and/or physical drawings shall show the test points on electronic assemblies. Illustrations shall include, but not necessarily be limited to, photographs, line drawings, schematics, tables, charts, or diagrams. Illustrations shall conform to the requirements of M-200, Military Outline of Form and Instructions for the Preparation of Specifications, and Section 10 of this publication.

6.4.2.1 Electrical and Electronic Symbols. Electrical and electronic symbols used on drawings and illustrations shall conform to the provisions of MIL-STD-15.

6.4.2.2 Reference Designations. Reference designations shall be in accordance with the latest revisions of MIL-STD-16. Reference to color coding of chassis wiring shall be in accordance with MIL-STD-687 or the special paragraph under Section 5, "Notes."

6.4.3 SECTIONS. The ATP shall contain these main sections: Introduction, Assembly Requirements, Test Requirements, Test Procedures, and Notes.

6.4.3.1 Introduction. The introduction of the ATP shall contain a statement of the scope and purpose of the ATP and a statement of the purpose of the item. Any special precautions concerning the production process or the safety of personnel or equipment shall be noted in the introduction.

6.4.3.1.1 Classification. Changes in an equipment configuration may require comparable differentiation in the associated ATP. ATPs prepared for Block I application shall use the type classification prescribed by Section 4; however, ATPs prepared for Block II shall utilize the addenda prescribed by Section 3.

All specifications, standards, publications, and drawings which are referenced in and form a part of the ATP shall be listed in a paragraph of the introduction. The list shall contain the number or symbol and title of the referenced documents. The paragraph shall begin with the following statement: "The following documents of the issue in effect on the date of issue of the Assembly Test Procedure form a part of this Assembly Test Procedure." Information necessary for obtaining copies of the document referenced in this paragraph may be added as a parenthetical statement when applicable.

6.4.3.2 Assembly Requirements. This section shall define the requirements for the assembly of the end item when these requirements are necessary to perform the tests described in the ATP. Special, unusual, or extremely precise operations shall be noted in this section. A list of the tools required in the performance of the assembly operation shall be included in this section.

The list of tools shall consist of all specially designed tools, jigs, templates, punches, dies, molds, fixtures, production gages, patterns, and production inspection equipment needed in the assembly of one complete end item. The list shall include the name, drawing number, and/or applicable specifications of the item listed. The figure number of the item may also be listed if the tool is shown in a figure. Standard government furnished gages and catalog tools shall be included.

6.4.3.3 Test Requirements. This section shall indicate the tests, alignments, adjustments, calibrations, and production level inspections arranged in the logical order of performance throughout the assembly process.

6.4.3.3.1 List of Equipment. A tabular listing of the test equipment, gages, jigs, fixtures, and specialized test equipment necessary to perform the required tests shall be provided. This listing shall include the equipment nomenclature, the AN type or manufacturer's designation or drawing number when applicable, performance characteristics, intended use, and alternate equipment when applicable.

6.4.3.3.2 Test Conditions. This paragraph shall describe and define any special environmental conditions required for the performance of the required tests, including those test power requirements and input signals that may be needed and that are not self-defining.

6.4.3.4 Test Procedures. Instructions shall be given or JDC referenced for any tests, alignments, adjustments, or calibrations which are to be performed

on the end item or its constituent parts to verify their operational status. The tests shall be listed in the sequence in which they are to occur, either during the assembly process or after it. If test procedures require careful adherence to assembly procedures, such assembly procedures may be included in the ATP. The requirements for the level of testing are stated in paragraph 6.4.1.2. Separate data sheets, keyed to the JDCs, shall be utilized for recording the results of individual tests.

6.4.3.5 Notes. This section shall contain ordering data, definition of terms, explanations of wire coding, and any other information required in the assembly or test procedures which is not included in the prescribed content for any other sections of the ATP.

EXHIBIT 6-1 (6 PAGES)
SPECIFIC FORMAT GUIDE
FOR
ASSEMBLY TEST PROCEDURE

SECURITY CLASSIFICATION
(When Applicable)

Exhibit 6-1

APOLLO G&C Specification
ATP 0000000
Rev. _____
Original Issue Date:
Release Authority: TDRR
Class Release

ASSEMBLY TEST PROCEDURE

FOR

(Drawing Nomenclature of Item)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of Pages 1 to 6 inclusive.

APPROVALS

NASA/MSC

MIT/IL

ACE

APOLLO G&C Specification
ATP 0000000
Rev. _____

ASSEMBLY TEST PROCEDURE

FOR

(Nomenclature of Item)

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	Introduction	
2	Assembly Requirements	
3	Test Requirements	
4	Test Procedures	
5	Notes	

APOLLO G&C Specification
ATP 0000000
Rev. _____

ASSEMBLY TEST PROCEDURE

FOR

(End Item Nomenclature)

1 INTRODUCTION

1-1 SCOPE. This specification describes the requirements and procedures for the assembly test of (Item Nomenclature). The (Item Nomenclature) will be used on (Next Higher Assembly Nomenclature).

1-2 PRECAUTIONS. The following is a list of special precautions to be observed during the assembly test procedure.

Example: Prepare the solutions in section 4 in a well ventilated area only; toxic fumes may be released during the process.

1-3 APPLICABLE DOCUMENTS. The following documents of the issue in effect on the date of issue of this ATP form a part of this ATP.

Military Specifications
Federal Specifications
Military Standards
Commercial Standards
Drawings
NASA APOLLO G&C Specifications
Other Publications

1-4 CLASSIFICATION. (Normally this paragraph shall specify the type classification necessary to distinguish the differences in requirements and tests for a Block I equipment with more than one configuration. For exceptional cases in Block II/LEM when the MIT/IL Configuration Management Office sanctions and authorizes the preparation of a separate ATP, the addendum method shall be used to account for every configuration of an equipment.)

APOLLO G&C Specification
ATP 0000000
Rev. _____

2 ASSEMBLY REQUIREMENTS

2-1 LIST OF TOOLS. The following tools are required to perform the assembly test procedure.

Nomenclature	Dwg. No.	Spec. No.	Figure No.

3 TEST REQUIREMENTS

3-1 GENERAL REQUIREMENTS. The (Name of Item) must be capable of meeting the following requirements (broad definition of the test requirements of the item):

3-2 TEST EQUIPMENT. All items of test equipment utilized must be of sufficient accuracy and precision to permit valid performance of the required tests. Calibration checks and adjustments shall be regularly scheduled, and the results of all such calibrations shall be subject to cognizant NASA Inspector approval. All items of test equipment below marked (*) shall be calibrated in the presence of the cognizant NASA Inspector at intervals frequent enough to assure that their specifications of accuracy are maintained.

<u>Item</u>	<u>Identification</u>	<u>Currency of Calibration</u>
(List Equipment)	(List Identification)	

APOLLO G&S Specification
ATP 0000000

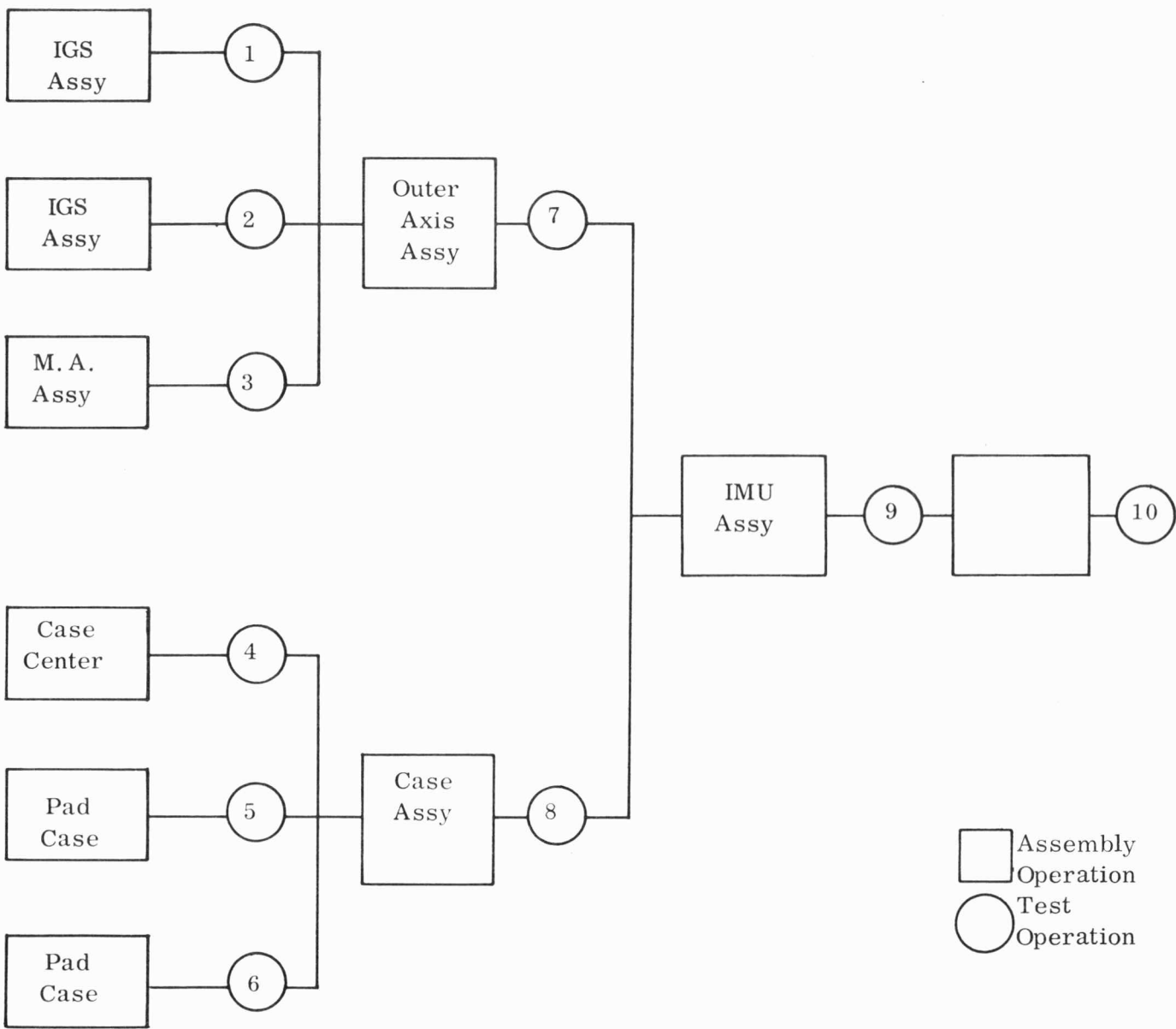


Exhibit Figure 3-1 Inspection and Test Flowgram

APOLLO G&C Specification
ATP 0000000
Rev. _____

3-3 TEST CONDITIONS. The (Name of Item) shall be capable of meeting the test requirements established above under the following test and environmental conditions.

(List temperature, humidity, etc., applicable to the item under test.)

4 TEST PROCEDURES

4-1 GENERAL. The examinations and tests contained in this section are intended for execution on the specific entity identified by the referenced drawing.

4-2 TEST FAILURE. The failure of a subassembly to pass any examination or test of this section will automatically classify the unit as nonconforming. All instances of nonconformance shall be corrected by the contractor.

4-3 JDC'S AND DATA SHEETS. The following JDC's form a part of this procedure (the applicable data sheet will be found with the appropriate JDC).

(List JDC numbers, and attach copy of each JDC and its respective data sheet.)

5 NOTES

(This section shall contain any explanatory notes, such as definitions, transportation data, or any other topic material contained in chapter V, section 6, of DOD handbook M-200.)

Section 7

PREPARATION OF THE JOB DESCRIPTION CARD

7.1 PURPOSE

The purpose of this section is to establish the requirements for the content and format of the Job Description Card (JDC) documentation for Apollo Guidance and Control equipment and its associated ground support equipment.

7.2 DEFINITION

The JDC shall describe in specific and unambiguous terms a particular task (test, inspect, clean, calibrate, lubricate, or repair) to be performed on equipment. The JDC shall:

1. Describe minimum procedures for control purposes.
2. Contain all the information necessary to perform the task.
3. State specific tasks in language and illustrations understandable by the personnel required to perform the task.
4. Provide adequate definition of the man-machine interface actions at all levels and sites.

The JDC specifies a unit task to be performed within the normal working capacity of the facility and personnel.

Combinations of JDCs constitute the test requirements in PSs, ATPs, FTMs and manuals which, with certain amplifying data, specify the procedures for accomplishing an overall task.

JDCs are released and revised per MIT Report E-1186, Technical Data Release Procedures.

7.3 FORMAT

The JDC and its associated data sheet, if required, shall be submitted on 8-1/2-inch by 11-inch 198H DIETZGEN vellum or an equivalent heavy, fine surface, tracing vellum. (See Figures 7-1, 7-2, 7-3, and 7-4.)

7.3.1 SECURITY REQUIREMENTS. JDCs containing classified matter shall be classified according to the highest classification of security information contained therein, in accordance with the DD-254 accompanying the contract and with the Industrial Security Manual.

JDC data sheets shall be similarly marked if classified. If the classification should change upon entry of data, the classification shall be modified with the statement "when filled in".

7.3.2 STANDARD INFORMATION. The following guide shall be used in filling in the standard information in the top section of the initial page of the JDC. For each designation in the block, do the following:

1. JOB: Enter a short description of the task to be performed. This description shall include an action verb, such as test, inspect, calibrate, clean, lubricate, replace, followed by a descriptive object, e.g., Test PIGA Shaper Outputs.
2. SUBSYSTEM: State the title of the highest system or subsystem at which this task is to be accomplished, e.g., G&N, IMU, OSS, AGC, GSE.
3. DESCRIPTION: Give a brief description of the results desired, e.g., Test To Calculate Drift.
4. JDC: Enter the appropriate CCB-controlled, five-digit code number, e.g., 99999.
5. REV: If the JDC has been revised, enter the appropriate revision letter. Otherwise, enter a dash to show no revision to the original release.
6. PAGE__OF__: Enter the page of pages data, e.g., 1 of 3, 2 of 3, etc.
7. ASSEMBLY: Enter the name of the assembly which is primarily affected by the JDC if different than the Subsystem.
8. INTERVAL: Enter the test, inspect, clean, calibrate, lubricate, or repair (TICCLUR) time interval, e.g., as required.

9. TOOLS AND MATERIAL: Describe any special tools and/or materials required to perform the task described above.
10. REFERENCES: List reference documents required to perform the task.
11. IMPORTANT: State any requirements, limitations, or parameters not listed elsewhere that must be taken into account in performing the task.
12. INITIAL TDRR: Enter the original TDRR releasing number.
13. D.S. pp___: Enter the total number of data sheet pages associated with that JDC.

On succeeding pages, items 1, 2, 4, 5, 6, and 7 shall be filled in.

7.3.3 PROCEDURE. The procedure for performing the task shall be outlined under four main headings as follows:

- A. PREPARATION: If none is required, write NA (not applicable); if required, describe the preparation procedure; i.e., hook-up instructions, test-equipment alignment, etc.
- B. OPERATION: Describe the step-by-step functions to be performed to accomplish the job.
- C. CALCULATION: If none is required, write NA (not applicable); if required, detail the calculation and formula necessary.
- D. RECORD: Give items to be recorded on the data sheet.

Each step of the job shall be numbered sequentially and shall correspond to the number identified on the associated data sheet.

7.3.4 ILLUSTRATIONS. Illustrations shall be incorporated on the JDC where required for clarity and completeness. They can also serve the purpose of reducing the writing of test requirements.

7.3.5 TEXT. The text shall be written in clear, concise terminology appropriate for the engineer or technician who will be required to perform the task.

The use of standard abbreviations (MIL-STD-12) is permissible. If a term is used many times in a JDC, the term is spelled out the first time it is used, followed by the abbreviation in parentheses. The abbreviation may then be used throughout that JDC.

7.4 DATA SHEETS

Data sheets shall accompany each JDC when it is necessary to record the results of operations performed. When completed, these data sheets are a part of the history for the assembly being tested and shall be handled in accordance with the requirements of Section 8, "Equipment History."

7.4.1 PREPARATION. Each JDC data sheet shall have the following information preprinted: JDC number, revision letter, job title, page number, and the step-by-step requirements of the JDC as detailed in paragraph 7.3.

7.4.2 STANDARD INFORMATION. The following guide shall be used in filling in the information in the top section of the initial page of the data sheet. For each designation, do the following:

1. ASSEMBLY UNDER TEST: Enter the assembly title, serial number, part number, and drawing revision letter of the assembly under test.
2. TEST HISTORY: Enter the start and end time of the task, the elapsed time in hours, and the site and location where the task is performed.
3. MAJOR GROUND SUPPORT EQUIPMENT: Enter the name, serial number, and calibration date of the equipment used to perform the task.
4. OTHER: Enter the name and affiliation of the person performing the task, the person approving the results, and the date of completion of the JDC.
5. INITIAL TDRR: Enter the original TDRR releasing number.

7.5 RELEASE

JDC's and their associated data sheets shall be presented for release in accordance with the instructions contained in MIT Report E-1186, Technical Data Release Procedures.

7.5.1 INITIAL. The Initial release of JDCs and their data sheets may be through their parent document. The TDRR releasing number and date shall be entered in the space provided on the first page of the JDC and the first page of the data sheet.

7.5.2 REVISION. Revisions of a JDC or its data sheet shall be handled as specified in MIT Report E-1186 for a drawing revision. All information regarding the change shall be entered on the TDRR. The TDRR number, the revision letter, the page number(s) of revised page(s) and the date shall be entered in the Record of Revisions block provided on page 1 of the JDC.

The JDC and its associated data sheet(s) shall be considered an entity for the purposes of release and revision, and all pages shall carry the revision letter of a change affecting any one of the pages of either the JDC or the data sheet. The pages making up the data sheet shall be numbered independently of the JDC; i.e., the first page of the data sheet shall be page 1. Revisions to pages shall be recorded in the Record of Revisions block by entering the appropriate page number(s) under either the "JDC" heading or "D.S." heading, whichever is applicable.

The JDC and its data sheet shall be revised without going through the parent document and/or other documents. Information regarding the JDC change as well as the effects of the change on the parent document and/or other documents shall be noted on the TDRR.

JDC.⁴ 99999 REV.⁵ — PAGE⁶ 1 OF 2
INITIAL TDRR.¹² 01234 DS. PGS.¹³ 1

SUBSYSTEM: 2 IMU

ASSY: 7 35 A01A04

DESCRIPTION: 3

The accelerometer input axis is placed up and the accelerometer shaper channel A and B outputs are checked for: (1) symmetry, (2) phase relationship, (3) missing pulses, and (4) pulses short of amplitude.

[illegible]

PREPARATION

1. Position rotary table axis (RR) horizontal and porro prism west: command Aig to 270° , Amg to 0° , and Aog to 90° .

OPERATION

2. Rotate faceplate -45° (counterclockwise) about RR so that sr unit input axis is up (see figure 1).
3. Display both encoder output channels A and B on a dual-channel oscilloscope. Set sweep to give a 1-cycle display (see figure 2).

RECORD

4. Record displayed lengths of X, Y, and Z.

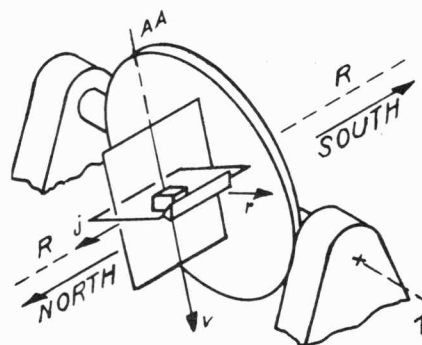


Figure 1. Sr Inputs in Up Position

(continued on other side)

DATE 30 DEC 63

Figure 7-1. Sample Completed JDC

JOB: TEST PIGA SHAPER OUTPUTS

JDC:99999 REV: — PAGE 2 OF 2

SUBSYSTEM: IMU

ASSY: 35 A01A04

CALCULATE

5. Encoder symmetry and phasing between channels
(see data sheet for formulas).

OPERATION

6. If symmetry is not within tolerance, adjust channel A with potentiometer R2 and channel B with potentiometer R4. Both potentiometers are located on the encoder bias AGC module.

NOTE: When properly adjusted, the encoder symmetry potentiometers shall be within 25 percent of the total turns from center position.

RECORD

7. Encoder symmetry.
8. Phasing between channels.
9. Missing pulses in either channel.
10. Pulses short of amplitude (more than 10 percent variation) in either channel.

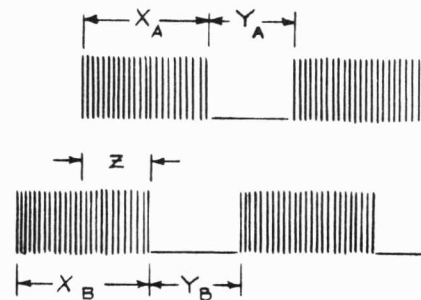


Figure 2. Shaper Outputs

DATE 30 DEC 63

Figure 7-2. Sample Subsequent Page(s) for JDC

APOLLO G&N
EQUIPMENT TEST
DATA SHEET 1 OF 1

JDC	
NO. 99999	
REV. _____	
INITIAL TDRR	01234

JOB TEST ACCELEROMETER SHAPER OUTPUTS

ASSEMBLY UNDER TEST		TEST HISTORY	
TITLE <u>Accelerometer</u>		DATE <u>2/14/64</u>	<u>2/14/64</u> AMR/VAB
SER. NO. <u>203</u>	DWG. <u>1000000</u> REV. <u>D</u>	START	END SITE / LOCATION
		TIME <u>1203</u>	<u>1315</u> <u>1.2</u>
		START	END TOTAL ELAPSED
MAJOR GROUND SUPPORT EQUIPMENT			
NAME <u>Rotary Table</u>	SER. NO. <u>22</u>	<u>11/6/63</u>	
		CAL DATE	
NAME <u>Optics Inertial Analyzer</u>	SER. NO. <u>23</u>	<u>12/9/63</u>	
		CAL DATE	
CONDUCTED BY <u>J. Doe / ACSP</u>		APPROVED BY <u>J. Roe / MIT</u>	
NAME / AFFILIATION		NAME / AFFILIATION	

4. X, Y, and Z lengths: X _____ Y _____ Z _____

7. Encoder symmetry (%):

$$\text{Channel A} = 100 \left(1 - \frac{X_A - Y_A}{X_A} \right) = 100 \left[1 - \frac{(\quad) - (\quad)}{(\quad)} \right]$$

$$= \frac{\quad}{\quad} \%$$

$$\text{Channel B} = 100 \left(1 - \frac{X_B - Y_B}{X_B} \right) = 100 \left[1 - \frac{(\quad) - (\quad)}{(\quad)} \right]$$

$$= \frac{\quad}{\quad} \%$$

8. Phasing between channels:

$$\text{Phasing} = \frac{Z}{X_A + Y_A} \times 360^\circ = \frac{\quad}{\quad}^\circ$$

Does Channel B lead Channel A? _____

9. Are there any missing pulses?

Channel A _____ Channel B _____

10. Are any pulses short of amplitude (more than 10% variation)?

Channel A _____ Channel B _____

DATE 30 DEC 63

Figure 7-3. Sample JDC Data Sheet

APOLLO G & N
EQUIPMENT TEST
DATA SHEET ____ OF ____

JDC
NO. _____
REV. _____

JOB: _____

(To be used if needed)

DATE _____

Figure 7-4. Sample Subsequent Page(s) for Data Sheet

Section 8

EQUIPMENT HISTORY

8.1 PURPOSE

An equipment history must be maintained for all guidance and control and ground support equipment in order to provide inventory and configuration identification as well as an operating history for reliability and design usage. The equipment history fulfills the requirements of NHB 5300.4 (1B) and NPC 250-1.

8.2 DESCRIPTION

The equipment history begins at some designated point in time when operating time, replacements, or other historical events worthy of note must be recorded to provide useful data. For some items, this starting point occurs during manufacture; for others, it occurs at acceptance. After government acceptance, maintaining a history of all equipment becomes the responsibility of field operations personnel. In order to make the transition of recording the equipment history before acceptance and after acceptance as smooth as possible and to avoid duplication of effort, the forms contained herein are intended to be used before as well as after acceptance. The requirements for the equipment history before acceptance are contained in the Acceptance Data Package (ADP); the requirements for the equipment history after acceptance are contained herein.

8.2.1 ACCEPTANCE DATA PACKAGE (ADP). NHB 5300.4 (1B) specifies the content of the ADP, which is delivered with each end item. Only the ADP requirements dealing specifically with equipment history are considered in this section. Other ADP requirements, although of importance, do not relate to equipment history and are, therefore, not discussed here.

8.2.1.1 Narrative End Item Report. The Narrative End Item Report contains the following:

1. Actual hardware configuration at acceptance
2. Replacements made during installation, test, and final checkout
3. Description of troubles, malfunctions, and the like
4. Corrective action taken as a result of item 2 in this list
5. Required tests not accomplished
6. Operating time on the item

8.2.1.2 Nonconformance. The nonconformance requirement of the ADP specifies inclusion of the following:

1. Waivers: copies of all approved waivers covering the item
2. Deviations: copies of all approved deviations covering the item.

8.2.1.3 Limited-Life Items. The ADP contains the following requirements for limited-life items:

1. Shelf life and replacement schedule
2. Operating time log and remaining operating time record of those items that have a limited lifetime.

8.2.1.4 Factory Acceptance Procedures and Data. This section of the ADP has one applicable requirement, which is Test and Inspection Data. Copies of data sheets showing all test and inspection variables and data shall be included.

8.2.2 POST-ACCEPTANCE DATA PACKAGE (PADP). The Post-Acceptance Data Package is used to record the history of the guidance and control equipment, its major components, and associated ground support equipment during the service life of the equipment. It also provides a primary source of performance information. The information contained in the PADP provides each receiving facility with the previous history of the equipment from the date of acceptance. This includes total operating time, test results, parts replacement, changes, waivers and deviations, and other data pertinent to performance. The information provided gives a valuable insight into the expected performance of the equipment and records data that will enable the contractor to evaluate equipment behavior to determine its reliability, failure trends, and areas for design improvement. The Post-Acceptance Data Package contains the following basic elements.

8.2.2.1 Guidance and Control System Logbook. The Guidance and Control system is provided with a G&C Logbook, which must accompany the system at all times. The system logbook contains only that information pertaining to the operation of the system as a whole. In order to maintain a complete package of operating data for reliability and performance verification, the balance of the Post-Acceptance Data Package must also be maintained. The system log commences at government acceptance, at which time entry of data into the equipment history portion of the ADP ceases.

No system should be shipped by any facility if the logbook is missing or fails to contain any of the prescribed forms. The serial number on the logbook must agree with that of the system it accompanies. The entries in the system logbook are the responsibility of the site manager or his designated representative.

8.2.2.2 Subsystem History Record. Each subsystem grouping definable by the manufacturer at the time of delivery for acceptance is accompanied by a historical record similar to the G&C System Logbook. This record accompanies the subsystem at all times. Although entries into this record may be made by various engineers, the responsibility for maintaining currency and accuracy lies with the site manager through his quality control personnel.

8.2.2.3 Unit History Record. Each item not identified as a grouping, as defined by paragraphs 8.2.2.1 and 8.2.2.2, is accompanied by a Unit History Record. This accompanies the item at all times and covers all items identified as field replaceable modules or parts, or any other items identified by the manufacturer as requiring a historical record.

8.3 ORGANIZATION OF EQUIPMENT HISTORY

The total package of historical data for the equipment is maintained at each field site. A certain amount of flexibility in the organization of the data is allowed so that the responsible engineer at the various sites can effectively deal with the contingencies of his particular situation. Certain guidelines, however, are required so that the transition of equipment and history from one site to another will be accomplished with a minimum of confusion.

8.3.1 GUIDANCE AND CONTROL SYSTEM LOGBOOK. The G&C System Logbook will be maintained separately and will contain the following historical data:

1. Inventory: This is an inventory of the major components making up the system by part number designation, serial number, and date of installation. This information is recorded at the time of government acceptance of the system. Preprinted forms are used for recording the information.
2. Historical Event/Operation Record: This record provides a continuous operating and event history of the equipment. It also serves to record changes, movements, or functions that may not involve operating time. These events are all recorded and briefly described.

Although this system historical event/operation record starts with time zero for the system at government acceptance, total time or events are obtained from this record and the historical event/operation record in the ADP. (See paragraph 8.2.1.1, item 6.)

8.3.2 SUBSYSTEM HISTORY RECORD. The Subsystem History Record is maintained for individual subsystems defined in paragraph 8.2.2.2. The record will contain the following data.

1. Inventory: This is an inventory of all items in the subsystem down to the lowest field replaceable module or part, as identified in paragraph 8.2.2.3.
2. Unit History Record: This is used to record all times and events for the subsystem when it is operated as a subsystem outside a complete system. These forms are maintained prior to government acceptance and are included in this section. All changes must be recorded on this record. These records are stored with the equipment to which they pertain, in inventory order, for ease of information retrieval.

8.3.3 UNIT HISTORY RECORD (UHR). This record is used to note operating times and historical events for any part or item (including spares) not definable as a system or subsystem as defined above. The record is stored in the data file under the subsystem in which it appears on the inventory, or separately if not installed in any higher assembly or subsystem. Prior to acceptance, data are recorded on this form in fulfillment of the ADP requirements. All changes must be recorded on this record.

8.3.4 TEST AND INSPECTION DATA RECORD. This record is used to store data other than specific operating history, events, and inventories. It contains such records as test data sheets, test results, inspection data, etc., and commences with the record for equipment contained in the ADP (paragraph

8.2.1.4). Standard forms are not designated herein because of the variations of usage, cognizant agencies, etc. In general, these sheets are supplied for the test to be performed. Where practicable, data of this type shall be filed, in chronological sequence, with the highest definable assembly to which the data pertain.

8.4 INSTRUCTIONS FOR EQUIPMENT HISTORY RECORDING

Recording of historical information begins in the manufacturer's plant; the information is usually on standard government forms or on in-house forms to be retained for manufacturer's records as well as to be delivered with the end item to the customer, in this case, NASA. For ease of information retrieval and uniformity of recording, the forms indicated herein are used before as well as after acceptance whenever practicable. The record sheets shall be 8-1/2-inch by 11-inch vellums.

8.4.1 INVENTORY RECORD. This record (Figure 8-1) is used to record the items making up assemblies, subsystems, and systems and will be included in the Guidance and Control System Logbook (paragraph 8.3.1) and in the Subsystem History Record (paragraph 8.3.2). The form is preprinted and shall be filled out to record all installed components down to the lowest field replaceable module. Spaces are provided to record the following:

- Item 1 S/N - serial number of the unit; if there is none, leave blank
- Item 2 REV - latest revision or dash number of the unit
- Item 3 IN - calendar date when unit was installed in the system (acceptance date when log begins)
- Item 4 OUT - calendar date that unit was removed from the system regardless of reason.

8.4.2 HISTORICAL EVENT/OPERATION RECORD. The Historical Event/Operation Record (Figure 8-2) provides a continuous record of the operating history of a guidance and control system. The dual title of the form results from the fact that, at times in its existence, the system may undergo a change, function, movement, or other similar event that does not involve operating time. These events must be recorded and briefly described. Begin a new sheet whenever items 2, 3, or 4 are changed. To maintain the record, enter the following information.

- Item 1 Enter G&C system number.
- Item 2 State site, e.g., NAR, KSC, etc.

- Item 3 State location at site, e.g., Lab, Vab, etc.
- Item 4 Enter test station number used during testing, including PACE or STU equipment, if applicable.
- Item 5 Enter identification (TDRR) number of change, modification, or waiver or deviation.
- Item 7 Record number of each JDC, Failure Report (FR), ATP, PS or other event identification number. If PS or ATP number is used, record in Item 8 any deviations from the complete list of JDC's. If there is any other reason for operating the system (not related to JDC, FR, etc.), it is noted here; any data are recorded on a data sheet. Make brief explanation in Item 8.
- Item 8 Entries under "remarks" should record observations of the following type:
- a. Describe any peculiar system behavior, such as gimbal oscillations, intermittent operation, gimbal runaway, or other abnormal conditions. Do not use colloquial terms, but try to provide a clear concise physical description of the observed condition.
 - b. Record any measurements that are out of tolerance when a test is not successfully completed. Describe fully why the test failed. It is important to log all such occurrences to establish trends that may be defined by intermittent failures.
 - c. Record all temperature irregularities. Since inertial component temperature is critical, all alarms should be logged.
 - d. If repairs are made to a guidance system, record what was repaired and how the repair was accomplished.

NOTE: List any component replaced or installed by making entry in inventory section of the log. In addition, enter failure report number (item 7) for later correlation. Record all adjustments and weight changes made to a system.

- e. Indicate dates when a guidance system is in storage, in transit from one facility to another, or is moved within a site.
- f. Record all questionable performance whether or not actual malfunction occurs. Although trouble may not be pinpointed

immediately, a few entries of similar questionable performance may lead to exposure of a problem area.

- g. Record all deviations from standard tests and the reasons for such deviations.
- h. Briefly describe the waiver, change, or deviation; indicate major subsystem or assembly affected, e.g., PSA, IMU, etc.

Item 9 Enter the name of the engineer responsible for the operation of the system for the time interval involved.

Item 10 Enter operating time reading for each ETI at end of test or function performed after initial entry is recorded.

Item 11 Compute total operating times as indicated.

Item 12 Compute duty cycles as indicated.

8.4.3 UNIT HISTORY RECORD. This record (Figure 8-3) contains the operating and event history of any subsystem, assembly, or module at any time other than when operating within an identifiable guidance and navigation system. At any time, the unit history of any module, plus copies of the unit history record of each successively higher assembly, subsystem, and system in which the module has operated, constitutes the total history record of the module. Because system operating logs are transmitted monthly to the data collection center, only that portion of the month not represented in the data sent to the collection center need accompany any module for shipment. The Unit History Record is required whenever a subsystem, assembly, or field replaceable module is removed from a full system or is delivered "outside" a system, e.g., spares. The initiation of a UHR in the field will be the responsibility of quality control personnel at the site. No item will be accepted for shipment unless its full and complete history accompanies it. This history includes system history for the current month only, plus higher assembly unit history records. The Unit History Record is completed as follows:

Item 1 Enter standard nomenclature of the unit as it appears on the inventory sheet.

Item 2 Enter serial number of the unit.

Item 3 Enter drawing number of the unit.

Item 4 Check this box if the unit is a limited-life item.

Item 4a Enter replacement date if the item is time-critical.

- Item 4b Enter total allowable operating hours of the unit before replacement if it is time-critical.
- Item 5 Enter date of event.
- Item 6 Enter area and location, e.g., NAR/LAB, KSC/VAB.
- Item 7 Enter the JDC number, TDRR number, or other identification number pertaining to the test, event, operation, or change.
- Item 8 Indicate hours of operation from chronometer, ETI, or watch. Leave blank if no operating time is accrued.
- Item 9 Indicate time remaining on items which have a limited operating life. Entries shall be total remaining time on entry date, and shall take account of operating time within a subsystem or system.
- Item 10 Give brief description of test, operation, change, waiver, deviation, irregularities, discrepancies, repairs, adjustments, storage or transit dates, and pertinent parameter measurements. Include designation of next higher assembly in which item is either installed or removed. Include instrument calibration data.
- Item 11 Enter last name of engineer responsible for the event or operation.
- Item 12 Record summation of all operating hours for this page.
- Item 13 Record allowable remaining time on the unit if it is a limited operating time unit.
- Item 14 Bring forward totals from previous page.
- Item 15 Record totals to date.

8.4.4 SPECIFIC APPLICATIONS.

8.4.4.1 GSE. In general, the forms and instructions contained in the previous paragraph pertain directly to GSE. Each console is delivered with a subsystem history record which follows the same pattern as described in paragraph 8.3.2, except that operating hours need not be recorded unless specifically indicated. Here again, a unit history record is not required for each component unless it is operated separately or undergoes a unique event or change. Calibration data must be indicated in the UHR whenever appropriate.

8.4.4.2 Spares (Field Replaceable Modules). Spare items are delivered with a UHR by the manufacturer. Records will be filed separately from any system or subsystem. Upon installation of the spare in a subsystem or system, the

UHR is filed with the appropriate subsystem record and the proper inventory entry is adjusted.

8.4.4.3 Data. The UHR and the historical event/operation record are an index to all events and tests performed at any level. This index is used for data retrieval. Although it is not mandatory, the manufacturer records inventories, historical events, and operating times on the forms described herein to facilitate retrieval and to provide continuity of recording. These forms are maintained in-house and delivered with the equipment at the time of government acceptance as part of the ADP. Subsequently, they are maintained by field personnel.

Test data are delivered as part of the ADP, as well. Tests performed in the field will be recorded and filed in the data package for the equipment affected. Copies of these test data are available for transmittal whenever the occasion demands, but ordinarily they will be retained with the equipment. Important or unusual results will be summarized in the "remarks" column of the appropriate history record.

8.4.4.4 Data Center. The reliability data center (Ref: E-1322) is responsible for the collection of failure reports and historical event time logs. Additionally, the data center is responsible for retrieving and summarizing these data and providing for a periodic reporting system. The G&C System Historical/Event Operation Record (Figure 8-2) is transmitted to the data center at the end of each month. Unit history records (Figure 8-3) are transmitted only when requested or with the equipment they support. Other records and data, such as test results, parameters measured, and the like, are transmitted as requested.

APOLLO G&C EQUIPMENT INVENTORY RECORD

	S/N ¹ REV ² IN ³ OUT ⁴	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT
	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT	S/N REV. IN OUT

12/2/63

PAGE ____

Figure 8-1. Sample Inventory Record Form

8-11

12/2/63

Figure 8-2. Sample Historical Event/Operation Record Form

8-12

12/2/63

Figure 8-3. Sample Unit History Record Form

Section 9

GENERAL FORMAT GUIDE FOR APOLLO GUIDANCE AND CONTROL SYSTEM PUBLICATIONS

9.1 SCOPE

This section is to be used in the preparation of manuals and other related documents in the Apollo Guidance and Control program. Existing publications, publications already under preparation as of the date of this issue, and revisions to existing publications need not be changed to comply with this format.

This material herein is intended to be a general guide only. Specific format and style questions should be resolved by use of the Government Printing Office Style Manual; a Manual of Style - University of Chicago Press; or contractor-furnished style manuals.

9.2 DRAFTS

9.2.1 WORKING COPY. Working copy (Figure 9-1) shall be defined to mean a preliminary draft on which changes and revisions are anticipated.

9.2.2 PRELIMINARY COPY. Preliminary copy shall be defined to mean copy submitted in its final form but prior to approval. Only few and minor changes should be anticipated for this draft.

9.2.3 FINAL COPY. Final copy (Figure 9-2) shall be defined to mean reproducible copy in its final form. Final reproducible copy shall be typewritten, single-spaced, justified or unjustified, on repro paper. All front matter shall be included and all pages shall be numbered. Illustrations, either repro or reduced-to-size negatives, shall accompany the text and be placed in proper sequence.

9.3 RUNNING HEADS

Running heads shall not be used in nonlooseleaf publications. All Apollo G&C manuals shall be considered looseleaf publications, and running heads shall be permitted in these manuals.



Figure 9-1. Sample Page Layout for Working Copy

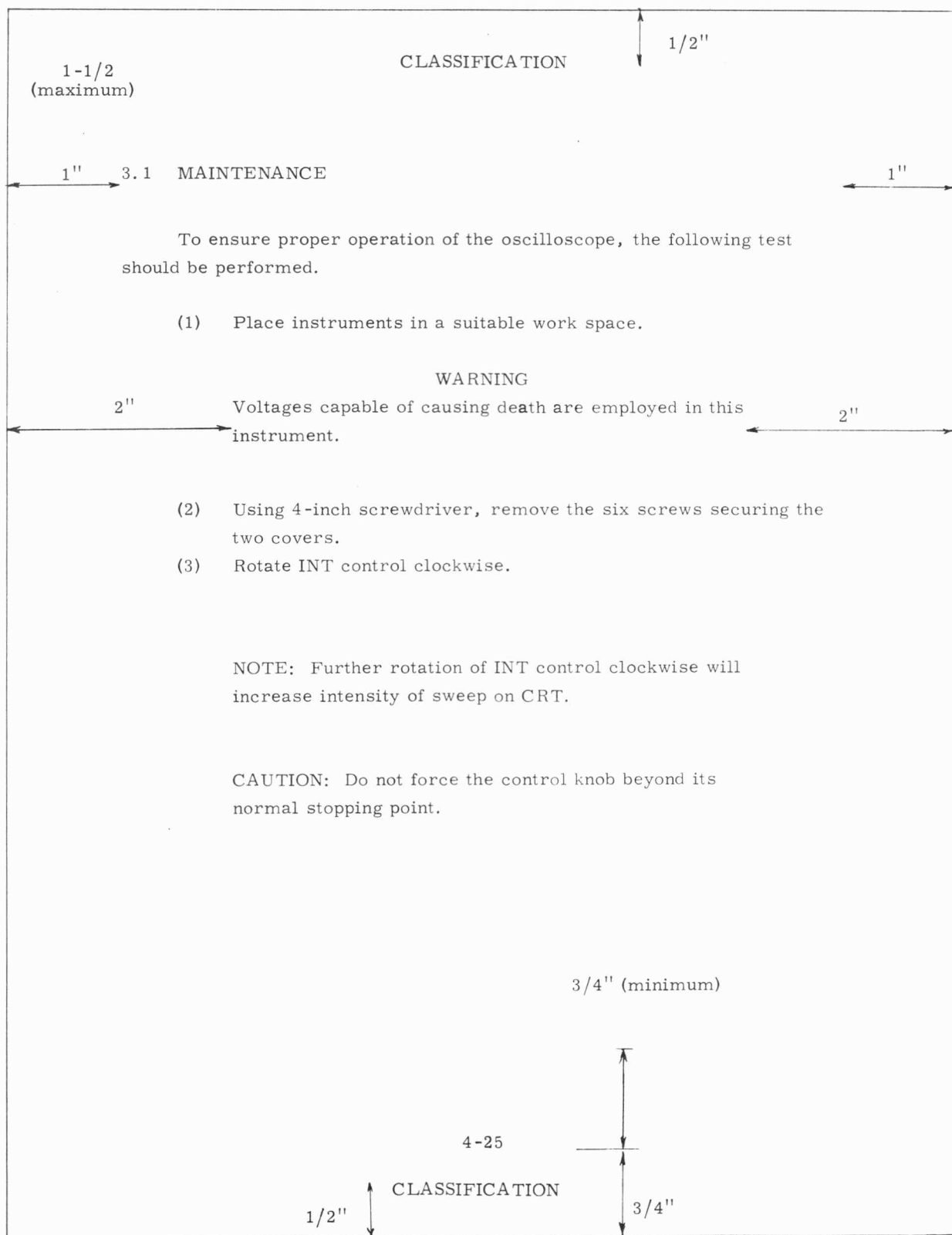


Figure 9-2. Sample Page of Final Copy for Classified Publication

The identifying number and title of the publication shall appear in the corner of the upper outside edge of the page, i.e., the upper right-hand corner for right-hand pages and the upper left-hand corner for left-hand pages. The running-head line shall appear directly under the title and shall be 6-1/2 inches long, leaving 1-inch side margins. The running-head line shall be placed 1 inch from the top of the page. There shall be no running head on the first page of each chapter or on the first pages of the front matter.

9.4 MARGINS

Paragraph 9.4 shall apply to all drafts with or without running heads.

9.4.1 TOP MARGIN. For the first page of a chapter or section, the word "Chapter" or "Section" and the section number shall be centered 2 inches from the top of the page. On all other pages in the body of the text, the first line of text shall appear no more than 1-1/2 inches from the top of the page.

9.4.2 SIDE MARGINS. The side margins shall be 1 inch, leaving a typing area of 6-1/2 inches.

9.4.3 BOTTOM MARGIN. The last line of text shall appear at least 1-1/2 inches above the bottom of the paper. The page number shall appear at least 1/2-inch above the bottom of the paper.

9.4.4 FIRST PAGE OF CHAPTER. Each chapter or section shall begin on a right-hand page. The word "Chapter" or "Section," whichever is used, and its number shall appear 2 inches from the top of the page. The chapter title or section title shall be centered 1/2-inch below the word "Chapter" or "Section" and its associated number. The title shall be all caps.

9.5 SECURITY REQUIREMENTS

All documents containing classified information shall be classified according to the highest classification of security information contained therein. The appropriate classification shall be in accordance with DD-254 accompanying the contract and with the Industrial Security Manual.

9.6 INDENTATION

Numbered paragraphs shall be flush with the left margin. The first line of unnumbered paragraphs shall be indented 16 units (or eight spaces).

9.6.1 ENUMERATIONS. Enumerations shall be indented 16 units. Ordinarily, subsequent lines will line up with the first; however, subsequent lines may be

brought to the left margin if the complexity of the material so demands. The enumeration shall be denoted by Arabic numbers followed by a period.

9.6.2 CAUTIONS, NOTES, AND WARNINGS. Cautions and notes shall be in block form, centered, leaving 2-inch side margins; the words "Caution" and "Note" shall be part of the block form. Warnings shall be in block form, centered, leaving 2-inch side margins; the word "WARNING" shall be centered on a line above this block form and separated from it by one line space (see Figure 9-2).

9.7 VOLUME, PART, AND CHAPTER

Each volume shall be numbered consecutively with upper-case Roman numerals, e.g., I, II, III, IV. In the case of a volume that is divided into parts, the parts shall be identified with consecutive Arabic numbers, e.g., Vol. I, Part 3.

Chapters or sections, whichever nomenclature is used, shall be numbered consecutively with Arabic numerals.

9.8. NUMBERING SYSTEM

The following decimal system shall be used to number paragraphs, subparagraphs, and sub-subparagraphs. (This format guide conforms to this system.) Only paragraphs with titles should be numbered.

1.1 Primary (first titled paragraph in Section 1)

1.1.1 Secondary

1.1.2

1.1.2.1 Tertiary

1.1.2.2

1.1.2.2.1 Quaternary (when necessary)

1.1.2.2.2

1.2 Primary (second titled paragraph in Section 1)

1.2.1 Secondary

1.2.2

1.2.2.1 Tertiary

1.2.2.2

1.2.2.2.1 Quaternary (when necessary)

1.2.2.2.2

9.8.1 LAYOUT FOR HEADS. The following format shall be used in designating numbered paragraphs. Margin indentations are optional.

9.8.1.1 Primary Heads. These shall be all caps, no period, on a line alone, separated from the text by a line space.

9.8.1.2 Secondary Heads. These shall be all caps, followed by a period, and run in with the text.

9.8.1.3 Tertiary Heads. These shall be initial letter cap for each principal word, followed by a period, underlined, and run in with text. (This paragraph is an example of the format for this type of head.)

9.8.1.4 Quaternary Heads. These shall be initial letter cap for each principal word, followed by a period, and run in with text.

9.9 FIGURES

The figure caption shall be centered below the figure to which it applies; the length of the caption line shall not exceed the width of the figure. If a figure caption runs longer than one line, the first line shall be the longer, with the second line centered below it. A natural break in the words should be utilized if possible.

9.9.1 CAPTIONS. The figure number shall consist of two Arabic numerals separated by a hyphen. The number or numbers preceding the hyphen designates the subsection of the document in which the figure occurs; the number following the hyphen designates the number of the figure within the subsection. The figure number shall be separated from the caption by a period; there shall be no period at the end of the caption. The figure caption shall have the first letter of each principal word in caps. The figure caption shall be separated from the lowest part of the figure by at least 1/4 inch of white space, regardless of the number of lines in the caption.

9.9.2 TURN PAGES. If a figure appears on a turn page, the standard margins are still retained (see paragraph 9.4). The figure caption shall be turned with the figure and shall appear a minimum of 1 inch above the edge of the paper. The caption shall be on the right-hand side of the page when the book is held in the usual reading position. (The page number is never turned.)

9.9.3 FOLDOUTS. If a figure appears on a foldout page, the classification shall be positioned so that it is immediately visible to the reader on the uppermost section of the foldout. It is preferable for the figure number, title, and page number also to appear on the uppermost section; however, if such placement is not practical, they may be put elsewhere.

9.10 TABLES

A table title shall be centered above the table to which it applies. If a table title runs two lines, the first line shall be the longer, with the second line centered below it.

9.10.1 TITLES. The table number shall consist of numerals separated by a hyphen. The number or numbers preceding the hyphen shall be Arabic and will designate the subsection in which the table occurs; the number following the hyphen shall be Roman and will designate the number of the table within the subsection. The initial letters of each principal word in the title shall be capitalized. The table number shall be separated from the title by a period; there shall be no period at the end of a table title.

9.10.2 FORMAT. Tables shall have vertical side lines and horizontal top and bottom lines, whether or not they run to more than one page (exceptions may be made where clarity will not suffer by the elimination of lines separating the elements of the table). When the table runs more than one page, the notation "(cont)" shall be placed at the bottom of the table below the box line. On succeeding pages the title shall be repeated above the table, and "(cont)" shall be added on the title line.

9.10.3 TURN PAGES. If a table is too wide to fit vertically on a page and still maintain the proper side margins, it can be turned on the page. The table title must be turned with the table so that the title is on the left-hand side of the page when the book is held in the usual reading position. (The page number is never turned.)

9.11 FRONT MATTER

The front matter shall consist of title page and acknowledgment page required for NASA disclaimer and contract acknowledgment. Where applicable, the following categories of front matter may be utilized; safety summary, table of contents, list of illustrations, list of tables, a frontispiece, list of effective pages and their classification, signature page, revisions page, and abstract.

The title page shall be designed in accordance with the established format for any particular program.

9.12 APPENDIXES

Appendixes shall be identified by a capital letter. Examples: Appendix A, Appendix B.

Whenever possible, an appendix should have a descriptive title. Tables, figures, and pages within an appendix shall reflect the appendix letter.

Examples: Table A-III indicates the third table in Appendix A.
 Figure A-3 indicates the third figure in Appendix A.
 A-3 is the page number for the third page of Appendix A.

Each appendix shall begin on a right-hand page. The word "Appendix" and the letter shall be centered 2 inches below the top edge of the page. The appendix title shall be capitalized, centered below the first line, and separated from it by a line space.

9.13 PAGINATION

The following paragraphs specify the manner in which the pages shall be numbered.

9.13.1 FRONT MATTER. The front matter pages shall be numbered with lower-case Roman numerals. The title page shall be page i, although it will not appear on the page.

When a publication is printed with left- and right-hand pages, the back of the title page is unnumbered if it is blank. If used as the acknowledgment page, it is numbered page ii. When a publication is printed with right-hand pages only, page ii is numbered and used in sequence for the front matter. If a letter of promulgation is required, it shall appear after the title page and shall be unnumbered. If a preface, foreword, or abstract is included, it shall appear as page iii immediately after the acknowledgement page.

The sequence of front matter shall be: title page, acknowledgment page, abstract, revisions page, signature page, list of effective pages, safety summary, contents, illustrations, tables, frontispiece.

9.13.2 TEXT. Page numbers shall consist of two Arabic numerals separated by a hyphen. The number preceding the hyphen designates the chapter or section; the number following the hyphen designates the page within the chapter or section.

Examples: 4-9 indicates the ninth page in Section 4.
 1-1 indicates the first page in Section 1.

9.13.3 FOLDOUT PAGE. A foldout page shall be identified by two page numbers, the odd number separated from the even number by a slash. The odd number

always precedes the even number in this combination. (Single page numbers are used for foldouts, when the entire publication is printed on one side only. If the foldouts are backed up, the even page numbers will be repeated in its proper location.)

Examples: 2-11/2-12, 3-5/3-6.

9.13.4 APPENDIX. Pages in an appendix shall reflect the appendix letter.

Examples: A-4 is page 4 in Appendix A.

D-9 is page 9 in Appendix D.

9.13.5 INDEX. Pages of an index shall be numbered I-1, I-2, I-3, and so on.

9.14 ND-SERIES MANUALS

Apollo G&C Manuals that are issued under ND numbers shall be written in accordance with the provisions of Section 9, "General Format Guide," of the Documentation Handbook, except as specified in the following paragraphs.

9.14.1 FRONT MATTER. The front matter shall consist of at least the following pages in the order given: Title Page, acknowledgment page (if required), abstract page (if included), Revisions Page, Signature Page, List of Effective Pages, Table of Contents, Illustrations, Tables, and List of Related Manuals. A frontispiece is optional; if it is included, it becomes the last page of the front matter.

9.14.2 PAGE IDENTIFICATION.

9.14.2.1 Front Matter. Each page of the front matter except the Title Page and Revisions Page, shall contain the ND number and running head (if used) in the same format as the text pages.

The Title Page and Revisions Page shall contain the following information which shall be placed in the upper outside corner:

Type of manual, e.g., Apollo Checkout, Maintenance and Repair Manual

ND number

Date

TDRR number

Class of release (A or B)

9.14.2.2 Text. The text pages shall carry the ND number in the upper outside corner of the page. A running head is optional, but whether or not a running head is used, the ND number shall appear.

9.14.3 REVISIONS. The first entry on the Revisions Page shall be the date of initial release and the number of the releasing TDRR. When an ND manual is revised, the revision letter, date of revision, and the TDRR number shall be placed in the Record of Revisions block on the Revisions Page. When a page is revised, whether in the text or the front matter, the appropriate revision letter shall appear on the revised page. On all pages except the Title Page and Revisions Page, the revision letter shall appear in the lower inside corner of the page.

On the Title Page and Revisions Page, the revision letter shall be placed after the ND number. In addition, the TDRR number for the latest revision made to the manual shall appear, and the date associated with the latest TDRR number shall appear immediately beneath the old date.

9.14.3.1 Numbering Changes.

9.14.3.1.1 Additions. Pages, paragraphs, illustrations, and tables added between existing pages, paragraphs, illustrations, and tables shall be assigned the preceding number plus consecutive capital-letter suffixes.

Example: 6-4A, 6-4B, and 6-4C are the numbers of three pages that are added between pages 6-4 and 6-5.

9.14.3.1.2 Deletions. Removed paragraphs, illustrations, and tables shall be accounted for by the notation "deleted" beside the number of the removed material.

If the numbering continuity is broken by the deletion of pages, a statement indicating the deletion shall be placed on the bottom margin of the preceding page.

Example: "All data on pages 6-14 and 6-15 deleted."

If a change deletes a paragraph, illustration, or table without substituting another, the space formerly occupied can be used for other material, but sufficient space should be provided for the deletion notation.

Example: "Figure 5-4 deleted."

9.14.3.2 Changes to the List of Effective Pages. As changes are made to the manual, the list of effective pages shall be changed as follows:

1. The word "deleted" or "added," whichever is applicable, shall be placed alongside the pages affected.
2. The applicable revision letter shall be placed beside the number of each changed, added, or deleted page.

Example:

<u>Page No.</u>	<u>Rev.</u>
6-1	- -
6-1 A added	-B
6-2	-A
6-3	-A
6-4 deleted	-B

9.14.4 JDCs. JDCs and their associated data sheets contained in ND manuals shall be written in the format specified in Section 7 of this Documentation Handbook.

Section 10

ILLUSTRATION GUIDE FOR APOLLO GUIDANCE AND CONTROL SYSTEM PUBLICATIONS

10.1 SCOPE

This section is intended for use as a guide by the various Participating Contractors in the preparation of manuals and other related documents in the Apollo Guidance and Control program. Existing publications, or publications already under preparation as of this date of issue, need not be revised to comply with this format.

10.2 LINE ART

The preparation and execution of all line artwork for Apollo publications shall conform to the commonly accepted standards of good technical illustrating techniques and professional workmanship.

10.2.1 GENERAL REQUIREMENTS. The objective of the general requirements outlined in this section is to establish the basic ground rules for achieving uniformity of presentation in illustration size, line weight, lettering size, and illustration identification.

Engineering drawings (which will not conform to the requirements for line art) will be used wherever possible in lieu of preparing original artwork.

10.2.1.1 Illustration Size. Original line art shall be drawn at either same size (1 to 1) or twice size (2 to 1) with respect to final printed size. The preferred original art size is 2 to 1.

Illustrations shall not have borders but shall have crop marks indicated on all four corners of the estimated border. The crop marks shall be placed 1/4-inch outside the image area at 1 to 1 size. The crop marks shall be placed 1/2-inch outside the image area at 2 to 1 size. In addition, a reduction size will be shown by either a horizontal or vertical arrow which will indicate the reduction size (in inches) and the percentage of reduction.

NOTE: The printed-size width of foldout illustrations shall not exceed a live-art area of 14 inches, if possible.

10.2.1.2 Line Weight. Line weight for 1 to 1 illustrations shall be a No. 0 Leroy pen (or equivalent). Line weight for 2 to 1 illustrations shall be a No. 1 Leroy pen (or equivalent).

10.2.1.3 Lettering Size. Lettering size for 1 to 1 illustrations shall be a No. 60 Leroy guide and made with a No. 0000 Leroy pen. Lettering size for 2 to 1 illustrations shall be a No. 120 Leroy guide and made with a No. 0 Leroy pen.

10.2.1.4 Illustration Identification. Blocks of illustration control numbers shall be assigned to each Contractor for use in integrated manuals. Each illustration prepared by a Contractor shall bear a next-in-sequence control number in the lower right-hand corner of the live-art area. The control number will be lettered with a No. 60 Leroy guide at 1 to 1 size and placed 1/8-inch up and 1/8-inch in from the lower right-hand corner of the illustration as defined by the crop marks. Artwork at 2 to 1 shall have the control number placed 1/4-inch up and in from the lower right-hand corner.

Additional identification such as publication title or number, figure number (if known), and final reduction size (in inches) shall appear in the lower right-hand corner and outside the live-art area as defined by the crop marks.

Classified illustrations shall be marked with the appropriate classification at the top and bottom and front and back of the illustration.

The top of the illustration when viewed in normal reading position shall be marked "TOP."

10.2.2 SPECIFIC Requirements. The specific requirements for the various types of line artwork anticipated for usage in Apollo publications are defined in succeeding subparagraphs.

The types of line drawings are:

Block diagrams	Loop diagrams
Charts and graphs	Orthographic drawings
Theory drawings	Three-dimensional drawings
Wiring diagrams	Cross-section drawings
Schematic diagrams	Composite drawings

Callout arrows used on any of the various types of line drawings shall be Artype No. 2000 BW at 1 to 1 or Artype No. 2001 BW at 2 to 1.

Unless otherwise specified, line weight, lettering size, and illustration identification for all specific types of line artwork shall conform to the requirements defined in paragraph 10.2.1.

10.2.2.1 Block Diagrams. Insofar as practical, all block diagrams shall be drawn 2 to 1 with outline blocks that measure 1-3/4-inches wide by 1-inch high, with 1/2-inch multiples for blocks greater than 1-inch high.

Shading techniques shall not be used in block diagrams.

All lettering of more than one line shall be set flush left. Lettering within blocks that consist of one line only shall be centered.

The use of tape in block diagrams is permissible provided the requirements of paragraph 10.4.2.1.2 are not exceeded.

Flow arrows in block diagrams shall be the non-equilateral arrow from the No. 10 and No. 20 Leroy electrical templates for sizes 1 to 1 and 2 to 1 diagrams, respectively.

Flow connecting points in block diagrams shall be the smallest of the four concentric circles from the No. 10 and No. 20 Leroy electrical template for sizes 1 to 1 and 2 to 1 diagrams, respectively.

10.2.2.2 Charts and Graphs. The use of Artype or Zipatone shading sheets for defining areas in charts and graphs is permissible provided the shading will reproduce clearly when printed.

10.2.2.3 Theory Drawings. Theory drawings are generally a combination of several other types of line drawings such as block diagrams, schematic diagrams, etc., and as such are not governed by specific requirements other than those which may apply to the respective types.

10.2.2.4 Wiring Diagrams. Parallel lines on wiring diagrams, as a general rule, shall not be less than 1/8-inch apart when reduced to printed size.

Reference designations for main components illustrated in a wiring diagram shall be lettered with a No. 100 Leroy guide and No. 00 Leroy pen at 1 to 1 or a No. 200 Leroy guide and a No. 2 Leroy pen at 2 to 1. Lettering size and pen weight of reference designations for elements within main components shall be as specified in the general requirements (paragraphs 10.2.1.2 and 10.2.1.3).

10.2.2.5 Schematic Diagrams. Electrical symbols used in schematic diagrams will conform to MIL-STD-15. The symbols will be drawn with a No. 10 Leroy electrical guide and No. 0 Leroy pen at 1 to 1, or a No. 20 Leroy electrical guide and a No. 1 Leroy pen at 2 to 1.

Lettering that consists of more than one line shall be set flush left. The placement of reference designations for symbols shall be such that the relationship of symbol to reference designation is obvious.

Parallel lines on schematic diagrams, as a general rule, shall not be less than 1/8-inch apart when reduced to printed size.

10.2.2.6 Loop Diagrams. Loop diagrams shall conform to the requirements established for block diagrams (paragraph 10.2.2.1) and schematic diagrams (paragraph 10.2.2.5).

Electrical, electronic, and mechanical symbols used in loop diagrams shall conform to those shown in MIL-STD-15 (given under single-line diagrams) paragraph 1.5 and MIL-STD-17A.

Electrical and electronic symbols shall be drawn with a No. 10 Leroy electrical guide at 1 to 1 or a No. 20 Leroy electrical guide at 2 to 1.

Mechanical symbols shall be drawn to a size equal to that shown in MIL-STD-17A; i.e., 1 to 1 size.

Reference designations for main components of a loop diagram shall be lettered with a No. 100 Leroy guide and a No. 00 Leroy pen at 1 to 1 or a No. 200 Leroy guide and a No. 1 Leroy pen at 2 to 1. Lettering size and pen weight of reference designations within main components shall be as specified under general requirements (paragraph 10.2.1.2 and 10.2.1.3).

10.2.2.7 Orthographic Drawings. Main outlines and large details of orthographic views will be drawn with a No. 0 Leroy pen (or equivalent) at 1 to 1 or with a No. 1 Leroy pen (or equivalent) at 2 to 1. Fine details and dimension lines and arrows will be drawn with pens that are two sizes smaller.

Equipment placarding in orthographic drawings shall be treated as an element of the object being drawn and the size of the lettering shall be shown proportionally. For example, the "ON-OFF" lettering of a switch may appear smaller than the No. 60 Leroy guide requirement provided in paragraph 10.2.1.3.

Fractional values for dimensions shall be lettered with a slash mark, e.g., 2-3/4.

10.2.2.8 Three-Dimensional Drawings. Three-dimensional drawings will be made by using isometric projection on 30-30-degree axes.

The main outline of an object will be drawn with a No. 0 Leroy pen (or equivalent) for 1 to 1 illustrations, or a No. 1 Leroy pen (or equivalent) for 2

to 1 illustrations. Fine detail of an object will be drawn with pens that are two sizes smaller than those used for the main outline.

Shading shall be kept to a minimum and shall be used only to clarify detail. Shading is determined by having the light source come from an upper position. Shading shall be drawn with a No. 1 Leroy pen (or equivalent) for 1 to 1 illustrations or with a No. 3 Leroy pen (or equivalent) for a 2 to 1 illustration. Artype or Zipatone shading sheets (lines, dots, graduated patterns) may be used provided they will reproduce sharply.

10.2.2.9 Cross-Section Drawings. Cross-section drawings may be either orthographic or three-dimensional and will reflect the specific requirements defined for each of these types.

10.2.2.10 Composite Drawings. Composite drawings are generally three-dimensional and will reflect the requirements defined in paragraph 10.2.2.8. Illustrations not originally intended for composite presentation may be used in a reduced size provided the resulting line weight is dense enough to reproduce.

10.3 TONAL ART

The objective of the general requirements outlined in this section is to establish the basic ground rules for achieving uniformity of presentation in illustration size, lettering, and illustration identification of tonal art.

10.3.1 GENERAL REQUIREMENTS. Tonal art will be supplied by all Participating Contractors as continuous-tone, mounted, and flapped board art with callouts on acetate overlays or as reduced-to-size, glossy, 120 or finer screened prints.

10.3.1.1 Illustration Size. The final size of tonal art will be governed by the complexity of the object to be shown.

The preferred original tonal art size is 2 to 1.

Tonal art shall not have borders but will have crop marks indicated on all four corners of the estimated border size. The crop marks shall be 1/4-inch outside of the image area at 1 to 1 size. The crop marks shall be placed 1/2-inch outside of the image area at 2 to 1 size. In addition, a reduction size will be shown by either a horizontal or vertical arrow which will indicate the reduction size (in inches) and the percentage of reduction.

The acetate overlay will be keyed to the tonal art with three register marks.

10.3.1.2 Lettering Size. Lettering size for 1 to 1 illustrations shall be a No. 60 Leroy guide and made with a No. 0000 Leroy pen. Lettering size for 2 to 1 illustrations shall be a No. 120 Leroy guide and made with a No. 0 Leroy pen.

10.3.1.3 Illustration Identification. Blocks of illustration control numbers shall be assigned to each Contractor for use in integrated manuals. Each illustration prepared by a Contractor shall bear a next-in-sequence control number in the lower right-hand corner of the live-art area. The control number will be lettered with a No. 60 Leroy guide at 1 to 1 size and placed 1/8-inch up and 1/8-inch in from the lower right-hand corner and outside the live-art area as defined by the crop marks.

Classified illustrations shall be marked with the appropriate classification at the top and bottom and front and back of the illustration.

The top of the illustration when viewed in normal reading position shall be marked "TOP."

10.3.2 SPECIFIC REQUIREMENTS. Specific requirements for tonal art affect two major areas of tonal art preparation: retouching and screening.

10.3.2.1 Retouching. Retouching will be performed only to the degree that it will clarify and improve the photographic print for reproduction while retaining the original photographic quality.

Scratches, dents, shadows, and reflections appearing in photographs shall be removed by retouching. Areas lacking contrast may be highlighted by retouching, but excessive retouching of photographs shall be avoided.

10.3.2.2 Screening. Tonal art shall be screened and shall have a square-cut screened background.

E-1186
(Rev. 6)

DISTRIBUTION LIST

J. Barker	R. Millard	(5)
D. Dolan	M. Murley	
E. Driscoll	J. Nevins	
L. Finkel	G. Ogletree	
J. Gilmore	J. Reed	
K. Greene	M. Sapuppo	
E.C. Hall	N. Sears	
E.J. Hall	G. Silver	
D. Hanley	W. Stameris	
D. Hoag	E. Thorup	
P. Kerrigan	R. Weatherbee	
A. Laats	L. Zimmerman	
L. Larson	Apollo Library	(2)
T. Lawton	Tech Doc Center	(6)
G. Mayo		

External:

NASA/ RASPO (1)
AC Electronics (3)
Kollsman (2)
Raytheon (2)

MSC:

National Aeronautics and Space Administration (21&1R)
Manned Spacecraft Center
Houston, Texas 77058
ATTN: Apollo Document Control Group (BM 86) (18&1R)
M. Holley (2)
T. Gibson (1)

KSC: (1R)

National Aeronautics and Space Administration
J. F. Kennedy Space Center
J. F. Kennedy Space Center, Florida 32899
ATTN: Technical Document Control Office

LRC: (2)

National Aeronautics and Space Administration
Langley Research Center
Hampton, Virginia
ATTN: Mr. A. T. Mattson

GA: (3&1R)

Grumman Aerospace Corporation
Data Operations and Services, Plant 25
Bethpage, Long Island, New York
ATTN: Mr. E. Stern

NAR: (8&1R)

North American Rockwell, Inc.
Space Division
12214 Lakewood Boulevard
Downey, California 90241
ATTN: CSM Data Management
D/096-402 AE99

NAR RASPO: (1)

NASA Resident Apollo Spacecraft Program Office
North American Rockwell, Inc.
Space Division
12214 Lakewood Boulevard
Downey, California 90241

GE: (1)

General Electric Company
Apollo Systems
P. O. Box 2500
Daytona Beach, Florida 32015
ATTN: E. P. Padgett, Jr. /Unit 509