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Apollo

GUIDANCE COMPUTER
AND
ASSOCIATED GROUND
SUPPORT EQUIPMENT

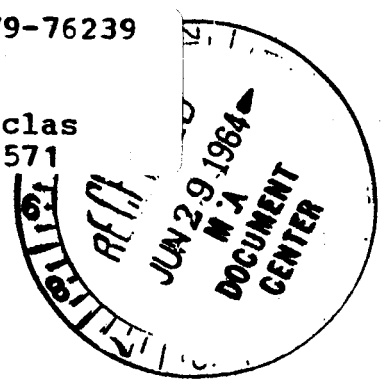
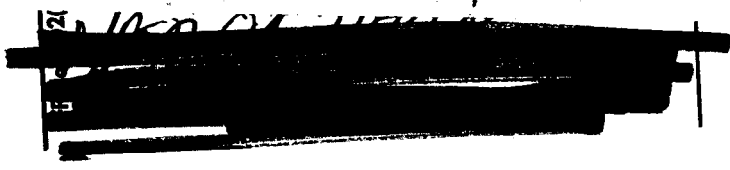
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(NASA-CR-117718) APOLLO GUIDANCE COMPUTER
AND ASSOCIATED GROUND SUPPORT EQUIPMENT
MONTHLY TECHNICAL REPORT, 1-31 MAY 1964
(Raytheon Co.) 62 p

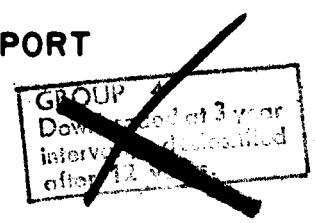
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MONTHLY TECHNICAL REPORT
NO.23
FR-4-306



RAYTHEON COMPANY
SPACE AND INFORMATION SYSTEMS DIVISION



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RAYTHEON

MONTHLY TECHNICAL REPORT NO. 23

FR-4-306

APOLLO GUIDANCE COMPUTER AND ASSOCIATED
GROUND SUPPORT EQUIPMENT

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Reporting Period

1 May 1964 - 31 May 1964

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SPACE AND INFORMATION SYSTEMS DIVISION

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SECTION 1
PROGRAM MANAGEMENT

This is Monthly Technical Report No. 23 issued in accordance with Work Statement for Industrial Support E-1097. Information contained in this report relates to the period 1 May through 31 May 1964.

One hundred ninety-four TD's have been received to date; 135 have been formally accepted, 81 have been completed, superseded, or incorporated into other TD's, 54 are active. Man Hour Status Charts and Active Resident Status Charts are grouped at the end of this section of the report. The Raytheon Apollo Milestone Chart has been updated and included as figure 1-1. The Raytheon Apollo Hardware Delivery Schedule is shown in figure 1-2.

The progress of active TD effort is normally reflected in the following sections of the report as indicated:

Section 1: R-1, R-9, R-123, R-129, R-145.

Section 2: R-49, R-95, R-108, R-122, R-132, R-134, R-139.

Section 3: R-55, R-67, R-79, R-82, R-86, R-102, R-148.

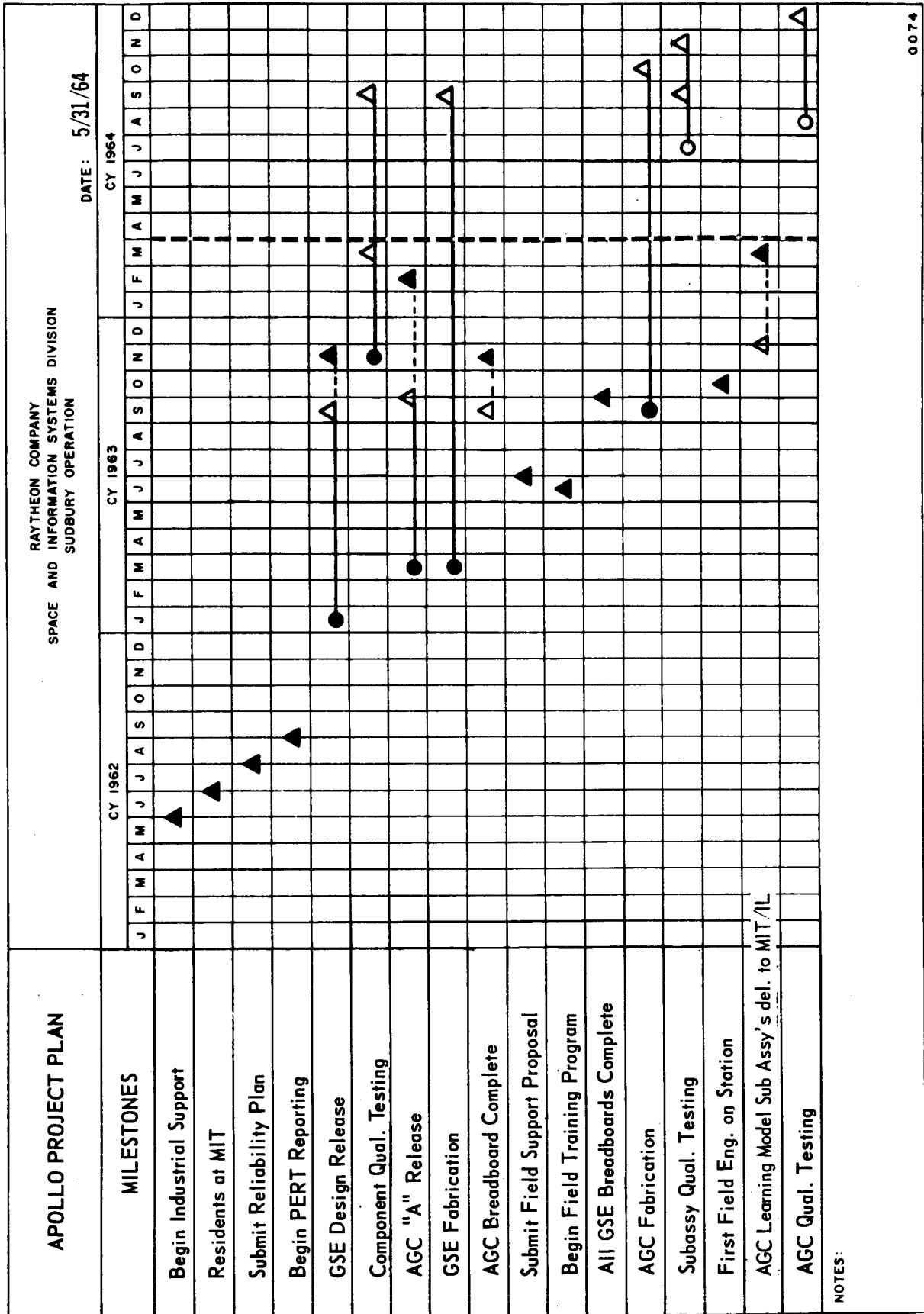
Section 4: R-8, R-58, R-89, R-90, R-136, R-143.

Section 5: R-10, R-16, R-18, R-63, R-75, R-83, R-125, R-163, R-164,
R-165.

Section 6: R-11, R-21, R-26, R-33, R-39, R-43, R-66, R-91, R-112,
R-131.

Section 7: R-107, R-109, R-110, R-111, R-113, R-114, R-116, R-141,
R-152

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NOTES:

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Figure 1-1. Raytheon Apollo Milestone Chart

SECTION 2

COMPUTER SUBSYSTEM

2.1 APOLLO GUIDANCE COMPUTERS

AGC 4A was updated during the reporting period to reflect the revised wirelist which was issued on 18 March, 1964. This modification had been delayed because AGC 4A was being used to test core ropes. Tapes are now available for the Core Rope Tester (CRT), however, and the AGC 4A is no longer performing this testing function. Ropes tested during May are as follows:

<u>Serial No.</u>	<u>Type</u>	<u>Times Tested</u>
06	Eclipse	3
33	Eclipse	2
09	Artemis	2
10	Artemis	3
11	Warning	1
12	Artemis	4
18	Artemis	2
19	Artemis	2
25	Artemis	5

The G & N harness (tray C) for AGC 5 was completed on 11 May. All AGC 5 items except for replacement trays A and B were delivered to MIT/IL during the reporting period. Vendor delays have slipped the anticipated completion dates for AGC 5 replacement trays A and B to 14 July and 28 June, respectively.

System testing of AGC 6 continued this month using the Computer Test Set, (CTS) as well as a Main and Navigation Panel DSKY. Most of the problems encountered during the test were due to errors in the temporary interface cables or noise in the test connector cable. The final revision of the Final Test Method (FTM) was used and several changes were made to the

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Interface Signal Measurement and DSKY checkout parts. The FTM portion dealing with core program checkout was not attempted because the necessary ropes were not available. Considerable time was expended in attempting to get the Core Rope Simulator (CRS) running properly with AGC 6, however, the CRS was consistently dropping or picking up particular bits. Effort using the CRS was temporarily stopped to enable checkout in other computer areas. Following computer checkout with the CTS and all available erasable memory test programs, the computer was sent for potting and test, except for tray A which required additional wiring. Units which are gating delivery of AGC 6 are system integration of the AGC/CTS Operation Console, R1 and R2 FTM ropes, and tray A. The anticipated delivery date for AGC 6 is now 26 June, 1964.

The testing of A trays for AGC 7 has been initiated using the AGC 4A monitor. The memory timing, micrologic registers, and basic instructions have been checked out. The end connector and coldplate are being subjected to environmental test to evaluate the vibration fixture prior to complete environmental testing of the AGC. The anticipated completion date for AGC 7 is 13 July, 1964.

Fully potted DSKY's for AGC 8 will be available during the next reporting period. AGC 8 will be the first system to undergo environmental testing. The gating items for completion of the system are tray B modules, as well as the availability of CTS 7 and AGC/CTS Operation Console 2. The anticipated completion date for this system is 6 August, 1964.

2.2 DISPLAY AND KEYBOARD UNITS (DSKY's)

Navigation and Main Panel DSKY's were completed and made available for system testing during the reporting period. A problem evolved in the DSKY harness lead dress which required the addition of two brackets onto the cable. As a result of the addition of minor cable lead dress modifications, and cable tie down points, the DSKY configurations proved to be satisfactory. Plans have also been made for improved DSKY moisture resistance. Addi-

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tional potted areas have been added to the backs of the electroluminescent lights, as well as to the keyboard, brightness potentiometer, and UPTL switch terminals for system 8 DSKY's and subsequent.

A gasket for sealing has been designed and the tooling order is in process. These gaskets will be retrofitted into system 8 and subsequent DSKY's when available. A mechanical stop for the brightness potentiometer has been designed which will also be incorporated into system 8 and subsequent DSKY's. This stop will prevent failure of the potentiometer internal stop under conditions of mishandling.

2.3 PROGRAM SUPPORT

Artemis procedures and test implementation methods have been incorporated into the initially published FTM document for use during AGC factory sell-off. Minor revisions to these procedures were also made during the reporting period.

The Artemis, EXTEST and AGC Factory Diagnostic programs were used extensively during May for verification of AGC operational and functional capabilities, as well as for diagnostic assistance in the isolation of malfunctions.

A program which exercises the 24 hour clock in word IN 1 of the AGC erasable memory has been programmed and checked out. This program will be submitted as an integral part of the first FTM sell-off of the AGC.

Wiring maps have been prepared for all Artemis ropes. These maps designate the route that each wire follows during the manufacture of core ropes.

A series of IBM 1401 programs have been prepared to produce punched paper tapes for the CRS, CRT, and CTS phases of core rope manufacture. An IBM 1012 paper tape punch will be used for the tape preparation procedure.

A series of programs have been produced for the MH-800 computer to verify each punched paper tape produced during the core rope manufacturing procedure. These programs will correct hardware mispunching which has been prevalent in the past.

DIT-MCO revision C control tapes were produced for the machine, hand-wrap, and end connector phases. Revisions have been made to automatically provide parameters through paper tape rather than the use of manual procedures at the console. The DIT-MCO flexowriter is now being used to provide parameter identification printouts.

2.4 SPECIAL TOOLING

To date, over 5,200 matrices have been produced and processed. Minor difficulties have arisen in the Eubanks Wire Stripper being used in conjunction with the Semi-Autowrap System. The wire has a tendency to get caught in the supply tube. Investigations are being made to determine whether the fault lies in the equipment or with the wire. Preliminary results indicate that the use of wire which does not conform to specification may be the determining cause. Special equipment for the insertion of .125 center Malco pins has been completed and is operational. The Equipment Development Notification will be signed as soon as heavier magazine springs are available. Fabrication of the equipment to be used for the insertion of .200 center Malco pins is on schedule with an anticipated completion date of 30 June, 1964. The service manual for the core rope weaving machines is being updated to reflect latest equipment modifications. In addition, an equipment set-up procedure will be included in the updated manual.

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SECTION 3

GROUND SUPPORT EQUIPMENT

3.1 SIMULATION COMPUTER

All modules for Tray A, System 1, are complete and have been successfully tested. All modules for Tray B, System 1 with the exception of B8 have been completed and are being tested. The gating items for completion of B8 are the K cores which are undergoing unit test. One set of four trays sent to RCA in Ohio for wirewrapping has been completed and is in transit back to Raytheon. The end connector for System 1 has been wirewrapped by machine to the modified card deck which eliminates one level of wiring.

The cabinet for System 1 was delivered on 13 May, 1964. The cabinets for Systems 2 and 3 will be delivered during the next reporting period. The frame has been completed and is awaiting the return of trays prior to continuation of assembly effort. The junction box wiring began on 19 May; the unit is now undergoing electrical testing. Because of flyable signal and connector requirement changes, cables nos. 3, 4, 8, 9, 10, and 11 were redesigned and new drawings issued.

Changes and additions to the Simulation Computer which are being studied for integration into the present configuration are as follows:

1. Use of 28V output from PSA or internal power
2. Modification of J box to channel all non-common DSKY signals to the Main DSKY connector
3. Allowance for operation with the Core Rope Simulator

Changes to flyable modules are still being picked up in the modules for the Simulation Computer. A drawing updating program to document these production changes is in process.

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3.2 CORE ROPE SIMULATOR

Forty Core Rope Simulator (CRS) drawings were released between 8 and 12 May, 1964. These releases constitute approximately 90% of all drawings required for this task. The drawings which have not yet been released are: 1) The five connector drawings; 2) The signal interconnection diagram; 3) The logic diagram; 4) The module plate assembly. These drawings all require information which is obtained by programming the logic diagram. The one shot module for the CRS was completed and released on 22 May, 1964.

3.3 COMPUTER TEST SET

The updating of Computer Test Set (CTS) 2 for Block I AGC testing is in process. The anticipated completion date for the updating is 15 June, 1964. The retrofits for CTS 7 and 8 have been completed. The electrical changes effected by the retrofit were completed on CTS 4. These changes will correct two discrepancies, double punching in the tape prepare mode and generating a false stop condition (Pinc problem). The fabrication of CTS 7 and 8 has been completed and the final sale of CTS 7 is in process.

3.4 AGC/CTS OPERATION CONSOLE

Operation Console 1 is being integrated with CTS 4 and AGC 6. Final test and sale of this console has been completed.

3.5 COMPUTER SIMULATOR

The marked drawings for the Computer Simulator retrofit were completed and are being processed.

3.6 AGC CALIBRATION SYSTEM

Engineering effort is currently being expended to design the modification for the AGC Calibration System.

SECTION 4
FACTORY TEST EQUIPMENT

Apollo factory test equipment is divided into four categories: AGC in-process, GSE in-process, AGC/GSE in-process, and AGC/GSE incoming inspection test stations. The status of Apollo factory test equipment is shown in table 4-1.

TABLE 4-1
APOLLO FACTORY TEST EQUIPMENT

Test Station		Remarks
Number	Name	
AGC/GSE Incoming Inspection		
1201	Pulse Transformer	* Checkout complete
1202	Semiconductor Leakage	* Checkout complete
1203	Gross Leak	* Checkout complete
1204	Oscillator (GSE)	* Checkout complete
1205	Helium Leak	* Checkout complete
1206	Automatic Semiconductor (TACT)	* Checkout complete
1207	Lead	* Checkout complete
1208	Visual	* Checkout complete
1209	High-Temperature Storage	* Checkout complete
1210	Constant Acceleration	* Checkout complete
1212	Micrologic	* Checkout complete
1213	Relay	* Checkout complete
1214	Power Supply	* Checkout complete
1215	Resistor	* Checkout complete
1216	Micrologic Burn-in	* Checkout complete
1217	Transistor Burn-in	* Checkout complete
1218	Diode Burn-in	* Checkout complete

* Indicates test station in use.

TABLE 4-1
APOLLO FACTORY TEST EQUIPMENT (continued)

Test Station		Remarks
Number	Name	
AGC/GSE Incoming Inspection		
1220	Tape Wound Rope Core	Electrical design complete; semi-automatic mechanical handler in development
1221	Capacitor	* Checkout complete
1222	Indicator Light	* Checkout complete
1224	Transformer and Inductor	* Checkout complete
1225	Power Semiconductor	* Checkout complete
1226	Power Semiconductor	In fabrication
1227	Relay (for AGC)	* Checkout complete
1228	Thermal Shock	* Checkout complete
1229	Marking	* Checkout complete
1230	Propagation Delay	* Checkout complete
1231	Integrated Sense Amp- lifier	* Checkout complete
1233	Varicap	* Checkout complete
AGC In-Process		
1002	Micrologic Stick	* Checkout complete
1003	Erasable Memory	* Checkout complete
1004	Core Rope	* Checkout complete
1006	DSKY	* Checkout complete
1008	Power Supply	* Checkout complete
1009	AGC Oscillator	Being fabricated
GSE In-Process		
1101	Control Panels	Checkout complete
1102	Computer Simulator	
1103	Computer Test Set	
1104	Module	

*Indicates test station in use.

TABLE 4-1
APOLLO FACTORY TEST EQUIPMENT (continued)

Test Station		Remarks
Number	Name	
GSE In-Process (continued)		
1105 1106	Operation Console Coldplate	*Checkout complete
AGC/GSE In-Process		
1301 1302	Module Interconnection Assemblies	* Checkout complete

*Indicates test station in use.

SECTION 5

RELIABILITY

5.1 RELIABILITY ENGINEERING

Five types of pulse transformers manufactured by four different vendors to SCD 1006762 were chemically depotted during the reporting period to analyze the reliability of their mechanical design and construction. This examination indicated the following potential failure mechanisms in two of the five devices:

- 1) Inadequate anchorage of the transformer leads to insure against leads being pulled out.
- 2) No anti-rotation mechanism to keep the leads from twisting internally, thereby, breaking their connections from the fine wire winding on the core.
- 3) Inadequate sleeving to prevent leads from shorting together.

The evaluation showed that three different types of devices were mechanically sound. These devices will be subjected to complete electrical and environmental stresses in qualification tests.

The noise level requirements on the output of the core ropes (fixed memory) required a re-evaluation of current matching techniques. Studies of the problem revealed that the diodes can be matched to meet system requirements. However, tight controls must be maintained during the process. A special test circuit with a resolution of 0.1 mv has been designed and put into operation. The diodes are being matched within 2 mv. The possibility of integrating eight of these diodes on a single chip is also being investigated.

5.2 COMPONENTS ENGINEERING

Various insulated wire samples have been sent to the analysis laboratory

for testing. No completion date has been established at this time. Ninety five percent of the qualification test plans have been submitted on this program. Effort is also being expended in setting up and calibrating the electroluminescent panel test set. The present schedule calls for delivery of these parts during the next reporting period.

5.3 RELIABILITY STATISTICS AND ANALYSIS

Recommendations for a new Apollo Field Failure Report form were made to AC Spark Plug and MIT/IL during the reporting period. The new form should be available for comment soon. A generation breakdown of GSE has also been submitted for use with the failure report form. A package for an Apollo Block I maintainability program was prepared in May in a joint effort with Field Operations.

5.4 RELIABILITY ANALYSIS LABORATORY

A routine inspection of transistors which conform to SCD 1006752 was conducted during the reporting period. Four units were received in each lot except for ID 8486 from which three were received. All of these devices proved to be electrically sound.

All of these units showed signs of purple plague, some quite pronounced. One of the base bonds was found open when the cap was removed (figure 5-1a) indicating that the contact had been tenuous. On another unit, base and emitter bonds were removed with only a slight pull on the lead unit (figure 5-1b and c).

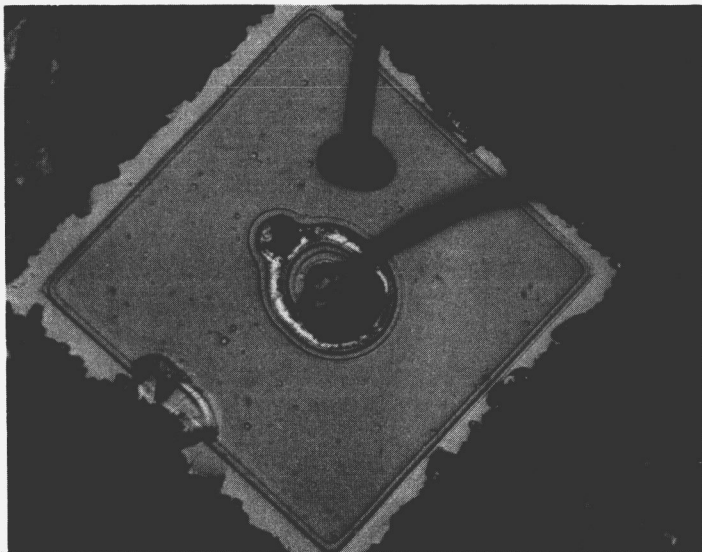
Several other interesting points were noted. One unit (figure 5-1d) had a long string of black material extending from under the emitter bond to near the edge of the chip. This material was very brittle. It crumbled and fell away from the chip when probed. It appeared to be carbonized material,

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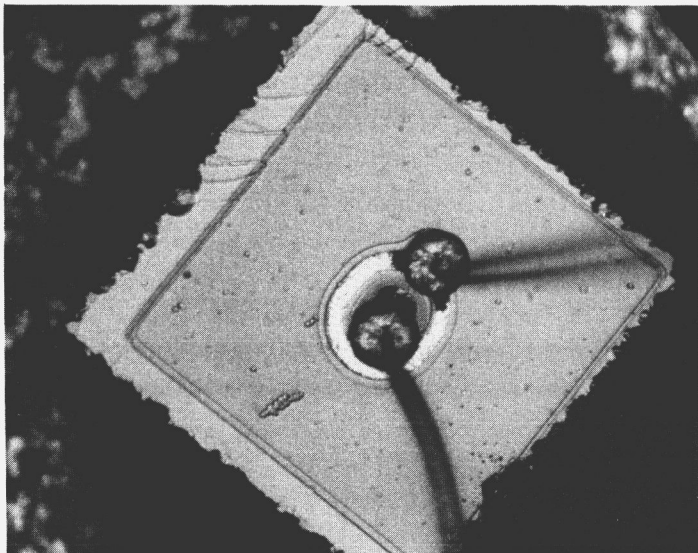
however, it did not cause a device failure. Another unit (figure 5-1e) had the base and emitter gold bonds very close to each other. In the photo, they appear to be touching although they are not actually in contact. There is some vertical displacement. A cross section of another unit (figure 5-1f) revealed a rather poor chip to header bonding. While this condition may not have led to failure in this case, it has been the cause in others.

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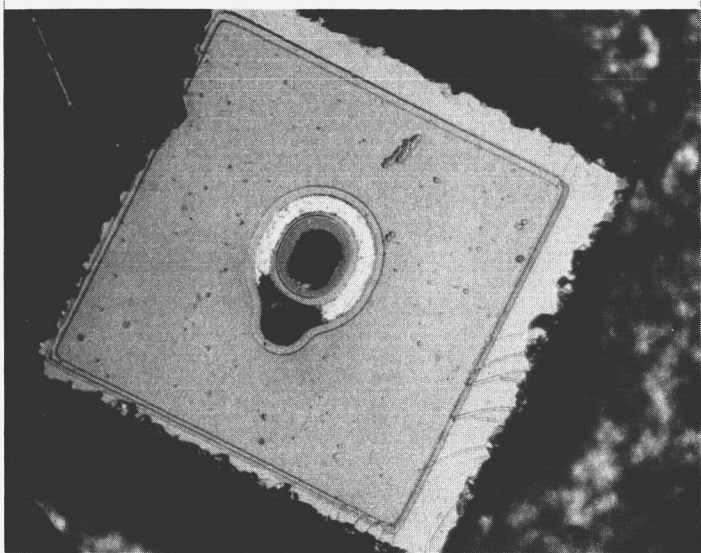
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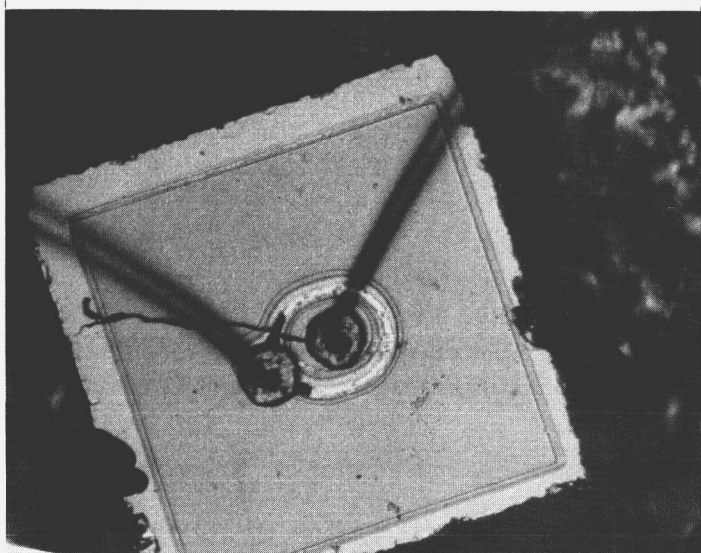
(b)

Figure 5-1. Transistor Analysis Results - Sheet 1 of 3

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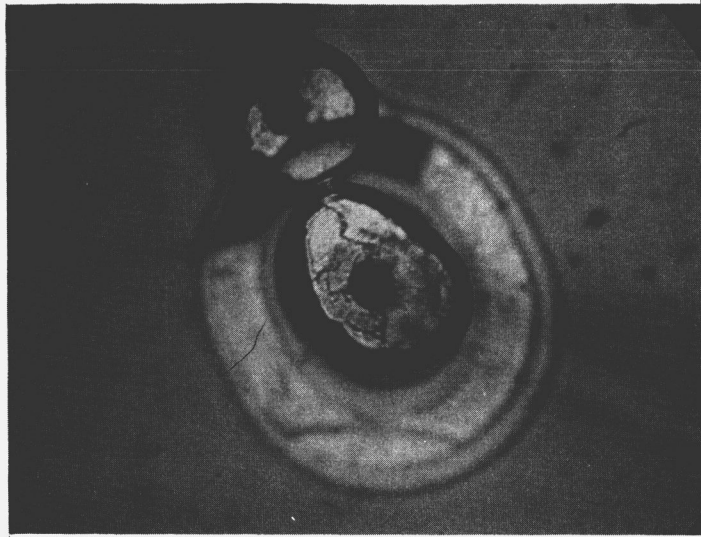
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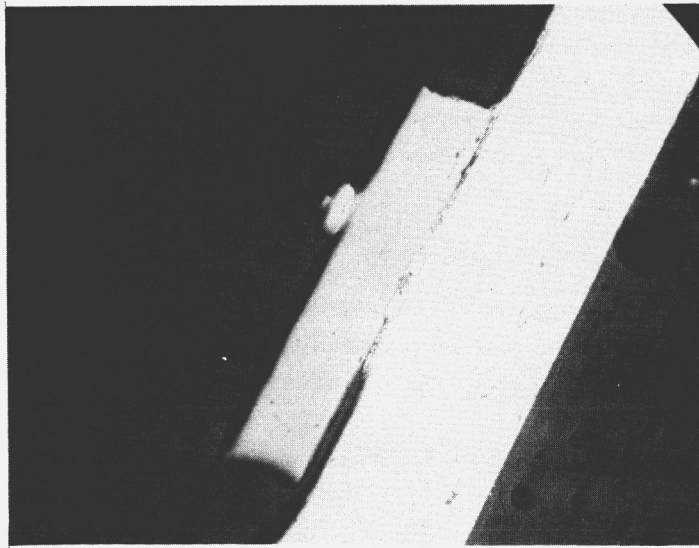
(d)

Figure 5-1. Transistor Analysis Results - Sheet 2 of 3

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(e)



(f)

Figure 5-1. Transistor Analysis Results - Sheet 3 of 3

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SECTION 6
DOCUMENTATION

Apollo Documentation Milestone Charts are presented in this section. It should be noted that the specification control drawing section lists only SCD's in process. Table 6-1 is a summary of the SCD effort.

TABLE 6-1
SPECIFICATION CONTROL DRAWINGS

Type		Received	Completed	Cancelled	In-Process
AGC	Revisions	25	25	0	0
	Class B	162	120	33	9
GSE	Revisions	143	143	0	0
	Class B	218	180	34	4
PSA	Revisions	41	41	0	0
	Class B	181	155	26	0



APOLLO DOCUMENTATION MILESTONES

DATE: 5/31/64

DOCUMENT SERIES: Special Process (ND)	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
			X	X	X	X	X	X	X	X	X	
1002009	Embedding and/or Staking with Silicone Rubber	I	X	X	X	X	X	X	X	X	8/14/63	Class "A"
1002017	Special Test Requests for Sense Amplifier	I	X	X	X	X	X	X	X	X	2/15/63	Class "B"
1002019	General Marking	I	X	X	X	X	X	X	X	X	6/26/63	Class "A"
1002025	Std-Weld Repair	I	X	X	X	X	X	X	X	X	9/20/63	
1002026	Inspection Criteria of Welds in Electrical Assemblies	I	X	X	X	X	Cancelled	Cancelled	8/21/63			Refer to ND 1002005
1002027	Wire Stripping, Magnetic	I	X	X	X	X	Cancelled	Cancelled	6/21/63			
1002028	Core Replacement	I	X	X	X	X	Cancelled	Cancelled	6/21/63			
1002029	Fixed Memory Wiring	I	X							5/30/64		
1002030	Matrix Bonding	I	X	X	X	X	X	X	X	12/15/63	12/30/63	Class "A"
1002031	Wire Wrapping	I	X	X	X	X	X	X	X	1/31/64	2/21/64	Class "A"
1002032	Fabrication of Wiring Harness in Wired Assemblies	I	X	X	X	X	X	X	X	X	9/10/63	Class "A"
1002107	Wire, PVC Insulated, Nylon Jacketed	I	X	X	X	X	X	X	X	1/31/64	2/21/64	Class "A"
1002117	Process for Encapsulating with Thermally Cond. Resin	I	X	X	X	X	X	X	X	X	9/5/63	Class "A"



APOLLO DOCUMENTATION MILESTONES

DATE: 5/31/64

NUMBER	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
			X	X	X	X	X	X	X	X	X	
1002119	Process Specification for Scotchcast No. 8	I	X	X	X	X	X	X	X	X	8/8/63	Class "A"
1002121	Installation of Keenserts	I	X	X	X	X	X	X	X	X	8/8/63	Class "A"
1002126	Process for Embedding with Epoxy Resin	I	X	X	X	X	X	X	X	X	8/8/63	Class "A"
1002183	Casting with 2850 FT Epoxy Resin	I	X	X	X	X	X	X	X	X	9/5/63	Class "A"
1002186	Insulating with Silicone Rubber	I	X	X	Cancelled							
1002212	Filling Coldplate of CTS Handling Fixture With an Inhibited Ethylene Glycol Coolant	I	X	X	X	X	X	X	X	X	4/7/64	Class "B"
1002217	Potting with low density Silicone Rubber	I								5/30/64		
1002221	Application of Epoxy Gel-Coat	I	X	X	X							



APOLLO DOCUMENTATION MILESTONES

DATE: 5/31/64

DOCUMENT SERIES: AGC - Final Test Method (FTM)	APOLLO DOCUMENTATION MILESTONES										REMARKS	
	NUMBER	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS		SUBMIT TO CCB
	Computer - AGC	I	X	X	X	X	X				5/18/64	Required by work statement 11/23/62
	Tray A:											
1003074	Arithmetic	I	X	X	X	X					5/15/64	
1003174-26	Parity	I	X	X	X	X	X				5/15/64	
1003174-2	GSA Service	I	X	X							5/15/64	
1003123	Interface (A19)	I	X	X	X						5/15/64	
1003115	Interface (A20)	I	X	X							5/5/64	
1003174-3	Control Pulse 1	I	X	X							6/12/64	
1003174-4	Control Pulse 2	I	X	X							6/19/64	
1003174-6	Control Pulse 3	I	X	X							6/26/64	
1003174-5	Instruction Decode	I	X	X							5/15/64	
1003174-7	SQ Complex	I	X	X							6/19/64	



APOLLO DOCUMENTATION MILESTONES

DATE: 5/31/64

DOCUMENT SERIES: AGC - Final Test Method (FTM) continued	NUMBER	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
	1003174-8	Time Pulse Counter	I	X	X						6/16/64		
	1003174-9	Bank Register	I	X							6/21/64		
	1003174-10	Ring Counter	I	X							5/7/64		
	1003174-11	Alarms	I	X							5/14/64		
	1003174-13	Counter Service	I	X							5/21/64		
	1003174-12	Counter Priority	I	X							5/28/64		
	1003174-14	Scaler	I	X							6/4/64		
	1003174-15	Ferrite Address	I	X							6/11/64		
	1003174-16	Rate Circuits	I	X							6/18/64		
	1003174-17	Rupt Service	I	X							6/25/64		
	1003174-18	Down-link	I	X							6/25/64		
		Tray B:											
	1003113	Power Switch	I	X							5/15/64		



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DOCUMENT SERIES: AGC - Final Test Method (FTM) continued												
1003527	Oscillator	I								7/31/64		
1003165	Driver Service	I	X	X	X					7/31/64		
1003153	Current Switch	I								7/31/64		
1003069	Erasable Memory	I	X							7/31/64		
1003139	Erasable Driver	I	X	X	X					7/31/64		
1003138	Erasable Sense	I								7/31/64		
1003150	Power Supply Control	I	X							8/28/64		
1003133	Rope	I	X	X	X	X	X	X		8/28/64		
1003167	Strand Gate	I								8/28/64		
1003132	Rope Strand Select	I								8/28/64		
1003178	Rope Driver	I	X							8/28/64		
1003154	Rope Sense Amplifier	I	X							8/28/64		



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			X	X	X	X	X	X	X	X		
1014156	GSE - Test Set	I	X	X	X	X	X	X	X	3/19/64	3/20/64	Required by work statement 11/23/62
1014061	GSE - Simulator	I	X	X	X	X	X	X	X	8/14/63	8/15/63	Required by work statement 11/23/62
1014217	GSE - Calibration Equipment	I	X	X	X	X	X	X	X	1/17/64	12/4/63	Required by work statement 11/23/62
1014465	GSE - Operational Console	I	X	X	X	X	X			5/5/64		Required by work statement
1014064	Diode	I	X	X	X	X	X	X	X	9/30/63	10/10/63	
1014209	Interface Coupling	I	X	X	X	X	X	X	X	1/3/64	3/10/64	
1014096	Driver	I	X	X	X	X	X	X	X	1/3/64	1/24/64	
1014053	Transformer Driver	I	X	X	X	X	X	X	X	1/31/64	5/6/64	New Inputs
1014065-1	Resistor	I	X	X	X	X	X	X	X	11/15/63	1/24/64	
1014034	NOR	I	X	X	X	X	X	X	X	1/3/64	5/6/64	New Inputs
1014079	Gated Flip-flop	I	X	X	X	X	X	X	X	3/2/64	5/6/64	



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DOCUMENT SERIES: DSKY - Final Test Methods (FTM)

NUMBER	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
1003098	DSKY Relay Module	I								6/5/64		
1003530	DSKY Decoding Module	I								6/5/64		
1003097	NAV DSKY Keyboard	I								6/5/64		
1003539	Main DSKY Keyboard	I								6/12/64		
1003524	NAV DSKY	I								6/12/64		
1003540	Main DSKY	I								6/12/64		
1003532	DSKY Power Supply Module	I								6/19/64		



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DOCUMENT SERIES: <u>Interface Specs (ND)</u>		DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
NUMBER	TITLE											
1002076	AGC & DSKY	I	X							5/29/64		
1002192	GSE - Test Set	I	X							6/19/64		
1002193	GSE - Simulator	I	X	X	X	X	X	X	X		10/30/63	Class "A"
1002194	GSE - Calibration Equipment	I	X	X	X	X	X	X	X	3/6/64	4/22/64	
	GSE - Operation Console											



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NUMBER	TITLE	DOCUMENT TYPE								SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
		START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS				
	GSE - Modules											
1014064	Diodes	X	X	X	X	X	X	X	X	1/22/64	3/10/64	Class "B"
1014209	Interface Coupling	X	X	X	X	X	X	X	X	3/13/64	3/31/64	
1014096	Driver	X	X	X	X	X	X	X	X	3/13/64	3/31/64	
1014053	Transformer Driver	X	X	X	X	X	X	X	X	4/6/64	5/6/64	New Inputs
1014065	Resistor*	X	X	X	X	X	X	X	X	1/22/64	3/10/64	Class "B"
1014034	NOR	X	X	X	X	X	X	X	X	1/22/64	3/10/64	Class "B"
1014079	Gated Flip-Flop	X	X	X	X	X	X	X	X	4/18/64	5/19/64	
1014226	Clock	X	X	X	X	X	X	X	X	3/17/64	4/22/64	
1014219	DAC	X	X	X	X	X	X	X	X	2/26/64	3/31/64	
1014230	Interface Receiver	X	X	X	X	X	X	X	X	2/26/64	3/31/64	

*All resistor modules covered under (1) specification



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DOCUMENT SERIES: <u>AGC and GSE Manuals</u>		DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
NUMBER	TITLE											
1021037	Familiarization Manual	II	X	X	X	X	X	X	X	NA	NA	Released to ACSP 2/21/64
1021001	Computer Subsystem Checkout, Maintenance and Repair Manual	I	X	X	X	X	X					Preliminary copy to MIT 15 May 1964
1021000	AGC Test Set Checkout Maintenance and Repair Manual	I	X	X	X	X	X	X				1. To MIT 4/16/64 2. Returned 4/9/64
1021003	AGC Simulator Checkout Maintenance and Repair Manual	I	X	X	X	X	X	X				1. To MIT 12/30/64 2. Returned 4/9/64
1021002	AGC Calibration System Checkout Maintenance & Repair Man.	I	X	X	X	X	X	X				1. To MIT 1/10/64 2. Returned 4/10/64
FR-	Core Rope Simulator Operation and Maintenance Manual	III	X									
1021004	AGC Simulator Field Test/ Procedure	I	X	X	X	X	X	X				TD-R-138 Cancelled
1021005	AGC Test Set Connections Manual (3 Volumes)	I	X	X	X	X						
FR-4-282	Simulation Computer Operation and Maintenance Manual	III	X									
	Information Series	III										
FR-2-100 Series	Issues 1 thru 13 and 15	III	X	X	X	X	X	NA	NA	NA		Complete
	Revisions - Issue 12	III	X	X	X	X	X	NA	NA	NA		Complete
	Issue - 2, 5, 15	III	X	X	X	X	X	NA	NA	NA		



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DOCUMENT SERIES: <u>Reports and Plans</u>	APOLLO DOCUMENTATION MILESTONES										REMARKS	
	NUMBER	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS		SUBMIT TO CCB
		Monthly Technical Progress	II	EACH MONTH								
		Quarterly Technical Progress	II	EACH QUARTER								
		Still Photos (300)	II	AS REQUIRED								
		Motion Pictures (20 min)	II	AS REQUIRED								
		Emergency Action	II	AS REQUIRED								
		Lesson Plan (Training)	III	AS REQUIRED								
		Failure Data	II	AS REQUIRED								
		Qualification Test	I									
		Documentation Plan	II	COMPLETE								To be updated
		Development Plan	II	COMPLETE								To be updated
		Factory Test Plan (GSE)	III									Update as re-quired
		Factory Test Plan (AGC)	III	X								
		Master Summary Schedule	III	COMPLETE								



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NUMBER	TITLE	DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB	REMARKS
DOCUMENT SERIES: Specification Control Drawings												
1006225	Back Shell, 244 Pin Connector	I	X	X	X	X	X	X	X		4/29/64	GSE
1006226	Back Shell, 88 Pin Connector	I	X	X	X							GSE CANCELLED
1006227	Back Shell, 108 Pin Connector	I	X	X	X	X	X	X	X	5/27/64	5/28/64	GSE
1006228	Card	I	X	X	X	X	X	X	X	2/20/64	4/15/64	GSE
1006229	Container, Shipping & Storage Main Display	I	X	X	X	X	X	X	X	4/9/64	4/24/64	GSE
1006230	Container, Shipping & Storage Computer	I	X	X	X	X	X	X	X	4/9/64	4/24/64	GSE
1006231	Container, Shipping & Storage Nav Display	I	X	X	X	X	X	X	X	4/9/64	4/24/64	GSE
1006232	Back Shell, Straight	I	X	X	X	X	X	X	X	5/27/64	5/28/64	GSE
1006233	Back Shell, 90° Bend	I	X	X	X	X	X	X	X	5/27/64	5/28/64	GSE
1006234	Relay	I	X	X	X	X	X	X	X	3/19/64	4/15/64	GSE
1006235	Lamp, Incandescent	I	X	X	X	X	X	X	X	3/19/64	4/13/64	GSE
1006236	Terminal, Lug	I	X	X	X	X	X	X	X	3/12/64	4/15/64	GSE
1006237	Plastic Sheet	I	X	X	X	X	X	X	X	3/20/64	4/15/64	GSE
1006266	Silicone Rubber Compound	I	X	X	X	X	X	X	X	4/14/64	4/22/64	AGC



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			X	X	X	X	X	X	X	X	X	X
1006267	Curing Agent	I	X	X	X	X	X	X	X	4/14/64	4/22/64	AGC
1006268	Connector, Plug, Elec, 244 Pins	I	X	X	X	X	X	X	X	3/23/64	3/31/64	AGC
1006269	Connector, Recept, Elec, 244 Sockets	I	X	X	X	X	X	X	X	3/23/64	3/31/64	AGC
1006270	Chromate Conversion Compound	I	X	X	X	X	X	X	X	3/20/64	3/31/64	AGC
1006271	Ink, Epoxy Base	I	X	X	X	X	X	X	X	3/20/64	4/14/64	AGC
1006693	Connector, Plug, Elec, 68 Pins	I	X	X	X	X	X	X	X	5/21/64		GSE
1006695	Terminal, Coaxial	I	X	X	X	X	X	X	X	3/12/64	4/15/64	GSE
1006696	Tubing	I	X	X	X	X	X	X	X	2/7/64	3/6/64	GSE
1006697	Strap, Cable	I	X	X	X	X	X	X	X	2/7/64	3/6/64	GSE
1006698	Adapter, Connector	I	X	X	X	X	X	X	X	3/20/64	4/15/64	GSE
1006699	Cyclohexanone	I	X	X	X	X	X	X	X	2/7/64	3/6/64	GSE
1006742	Plastic, Polyurethane	I	X	X	X	X	X	X	X	3/6/64	3/18/64	AGC
1006743	Catalyst	I	X									AGC CANCELLED
1006744	Indicator	I	X	X	X	X	X	X	X	5/14/64	5/27/64	AGC



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NUMBER	TITLE	DOCUMENT TYPE								DATE RELEASED BY CCB	REMARKS
		START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB		
1006745	Indicator	X	X	X	X	X	X	X	X	5/14/64	AGC
1006746	Indicator	X	X	X	X	X	X	X	X	5/14/64	AGC
1006748	Catalyst	X									CANCELLED
1006945	Wire	X	X	X	X	X	X	X	X	4/14/64	GSE
1006274	Thinner	X									AGC
1006272	Curing Agent	X	X	X	X	X	X	X	X	5/20/64	AGC
1006275	Magnet Wire	X									AGC
1006273	Screw, Cap	X	X	X	X	X	X	X	X	5/27/64	AGC
1006238	Fastener Ass'y, Captive	X	X	X	X	X	X	X	X	5/28/64	GSE
	K Core	X									CANCELLED
	Epoxy Resin	X									AGC
	Epoxy Resin	X									AGC
	Curing Agent	X									AGC
	Curing Agent	X									AGC



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		DOCUMENT TYPE	START FIRST DRAFT	COMPLETE FIRST DRAFT	REVIEW FIRST DRAFT	INCORPORATE COMMENTS	SIGNATURE CYCLE COMPLETE	MIT COMMENTS	INCORPORATE MIT COMMENTS	SUBMIT TO CCB	DATE RELEASED BY CCB		
	DOCUMENT SERIES: <u>Specification Control Drawings</u>												
1006276	Pigment	I	X	X									AGC
1006277	Silica	I	X	X	X								AGC
1006279	Nut, Hexagon	I	X	X	X								AGC
1006239	Lanyard Assembly	I	X	X	X								GSE
1006240	Cap, Protective, Plastic	I	X	X									GSE
1006241	Plug, Protective, Plastic	I	X	X									GSE
1006242	Channel, Rubber	I	X										GSE
1006280	Pigment	I	X										AGC
1006281	Resin, Urethane Foam	I	X										AGC

SECTION 7
SYSTEMS SUPPORT

7.1 SUPPORT ENGINEERING

7.1.1 Personnel

The deployment of Raytheon field engineers remains unchanged.

7.1.2 Training

Progress for the third class consisting of thirteen field engineers is proceeding on schedule. The present teaching schedule has been updated to include uninterrupted continuation of training during the scheduled vacation period (3 July through 19 July). Instruction has been completed on the entire hardware portion of the AGC. The optical and inertial subsystems are now being presented to the class.

7.1.3 Equipment Status

One failure was reported at ACSP during the reporting period. The failure consisted of an erratic triggering level in the computer Measurement Corporation (CMC) Counter of the AGC Calibration System. A repair was made by the CMC representative in Milwaukee. In addition, a modification will be made to the input circuitry of the counter.

Three failures were reported at Raytheon on Computer Test Set 4. A transformer driver module was found to have no output and was replaced. The failed module is being analyzed to determine the cause of failure. A momentary contact switch was physically broken and replaced. The button for the contact switch was also replaced because a piece of the switch shaft

had lodged within its mounting hole.

7.1.4 GSE Deployment Status

The deployment status of Ground Support Equipment is as follows:

<u>Serial No.</u>	<u>Computer Simulator</u>	<u>AGC Calibration System</u>	<u>CTS</u>
2	MIT/IL	MIT/IL	--
3	MIT/IL	ACSP	MIT/IL
4	ACSP	NAA	RAY
5	ACSP	RAY	ACSP
6	ACSP	MIT/IL	NAA
7	NAA	--	--
8	ACSP	--	--
9	ACSP	--	--
10	ACSP	--	--
11	ACSP	--	--

7.2 LOGISTICS

7.2.1 Maintenance Engineering Analysis

During the reporting period, Raytheon responded to an MIT/IL request for data on the support requirements of the Apollo GSE (AGC/CTS Operation Console, Computer Test Set, AGC Calibration System, and Computer Simulator), as well as for listings of "Soft Consumable Items" and Bulk Item Requirements". This information was forwarded by Raytheon letter. An analysis of these requirements has continued as part of the Maintenance Engineering activity and, as a result, more comprehensive data has been gathered for the "Soft Consumable and Bulk Item Requirements". A letter will be sent to MIT/IL during June to notify them of the latest available information.

7.2.2 Spares Documentation

Recommended Spare Parts List (RSPL) revision information was submitted on schedule. This transmittal was revision number 3 to master list number 3.

A review and analysis of the Core Rope Simulator configuration and design characteristics was begun. Spares recommendations for support of this equipment will be made following the spares analysis.

7.2.3 Spares Production and Status

The Apollo Field Site and Factory Inventory and Consumption Report for April was prepared and submitted. This submission superseded all previous submissions of this report and included Raytheon's recommended site allocations for approved spare parts.

The first submission of the Apollo Field Site and Factory Equipment Status and Location Report was made during the reporting period. Normally, a Description of Authorized Changes forms a part of this report, however, this portion of the report will not be prepared until Retrofit Change Program procedures have been established.