

UNCLASSIFIED

AD **409 007**

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA



UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government 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.

CATALOGED BY DDC

AS AD No. 409007

409 007

N-63-4-2

BOEING



SEATTLE, WASHINGTON

17

THE **BOEING** COMPANY

CODE IDENT NO. 81205

unclassified 6-26-63

NUMBER D2-14934-6

TITLE WS-133A Maintainability Program, Final Report

MODEL NO. WS-133A CONTRACT NO. AF04(647)-289

ISSUE NO. 6 ISSUED TO DDC

SPECIAL LIMITATIONS ON ASTIA DISTRIBUTION

ASTIA may distribute this report to requesting agencies subject to their security agreement, approved fields of interest, and the following:

- ☒ UNLIMITED—To all agencies of the Department of Defense and their contractors.
- ☐ LIMITED—To U. S. Military organizations only.

This report may be distributed to nonmilitary agencies not approved above subject to Boeing approval of each request.

NOTE: the LIMITED category may be checked only because of actual or potential patent, proprietary, ethical, or similar implications.

PREPARED BY Earl Hardy

10 June 1963

SUPERVISED BY Don Heck

17 June 1963

APPROVED BY William H. Wirt

20 June 1963

APPROVED BY D. A. Cole

21 Jun 63

CLASS & DISTR APPROVED BY D. A. Cole

21 Jun 63
(DATE)

REV SYM _____

VOL. NO. _____ OF _____
SECT. _____ PAGE _____

ACTIVE PAGE RECORD

SECTION	ORIG REL PAGE NO.	REV SYM	ADDED PAGES						SECTION	ORIG REL PAGE NO.	REV SYM	ADDED PAGES					
			PAGE NO.	REV SYM	PAGE NO.	REV SYM	PAGE NO.	REV SYM				PAGE NO.	REV SYM	PAGE NO.	REV SYM	PAGE NO.	REV SYM
										I							
										II							
										III							
										1							
										2							
										3							
										4							
										5							
										6							
										1.							
										2.							
										3.							
										4.							
										7							
										8							
										9							
										10							
										5.							
										11							
										12							
										6.							
										13							
										thru							
										69							
										7.							
										70							
										thru							
										357							

US 4001 0000 ORIG. 8/62

2-5142-2

REV SYM _____

BOEING NO. D2-14934-6

SECT. PAGE 11

FOREWORD

This document, D2-14934-6, entitled "WS-133A Maintainability Program Final Report," is submitted to AFBSD/STL in accordance with the requirements of:

**Technical Directive 62-4488
dated 28 May 1962, "Main-
tainability Requirements
Program;
CCN 448 dated 28 May 1962;
CCP 803 dated 5 October 1962;
and CCN 926 dated 4 June 1963.**

CCN 448 authorized a formal Minuteman Maintainability effort and provided a limited level of funding for the operation of a Maintainability Engineering Group. This Group acted as a focal point for product maintainability and conducted studies, analyses and liaison leading to design action.

CCN 926 terminated the formal M program, authorized by CCN 448, as of 30 June 1963.

TABLE OF CONTENTS

	<u>PAGE</u>
FOREWORD	iii
TABLE OF CONTENTS	1
REFERENCES	2
1.0 <u>PURPOSE</u>	3
2.0 <u>SCOPE AND BACKGROUND</u>	3
3.0 <u>SUMMARY</u>	4
4.0 <u>MAINTAINABILITY REVIEW AND EVALUATION</u>	7
4.1 MAINTAINABILITY REVIEWS	7
4.2 MAINTAINABILITY ACTION REQUESTS (MAR)	9
4.3 MAINTAINABILITY REVIEW REPORTS (MRR)	9
4.4 FIELD LIAISON REPORTS	10
5.0 <u>MAINTAINABILITY TEST AND DEMONSTRATION</u>	11
5.1 TEST AND DEMONSTRATION PLAN	11
5.2 TEST AND DEMONSTRATION EQUIPMENT LIST	11
5.3 MAINTAINABILITY EVALUATION/OBSERVATION (E/O) REPORTS	12
6.0 <u>REPORT/STATUS AND SUMMARY</u>	13
6.1 MAINTAINABILITY REVIEW STATUS SUMMARY	13
6.2 MAR STATUS SUMMARY	15
6.3 MRR SUMMARY	19
6.4 EVALUATION/OBSERVATION (E/O) REPORTS	21
6.5 DEMONSTRATION REQUIREMENTS STATUS SUMMARY	32
7.0 <u>REPORTS</u>	70

REFERENCES

- a. MIL-M-26512B, "Maintainability Requirements for Aerospace Systems and Equipment," dated 23 March 1962.
- b. 6120-7822-DU-RD1, "Maintainability Criteria, Preliminary," dated 16 March 1962.
- c. T. D. 62-4488, "Maintainability Requirements Program," dated 28 May 1962.
- d. CCN 448, dated 28 May 1962.
- e. CCP 803, dated 5 October 1962.
- f. D2-14475, "WS-133A Maintainability Program Plan."
- g. D2-4747-1, "Maintainability Design Criteria for Minuteman Electronic Equipment."
- h. D2-4747-2, "Maintainability Design Criteria for Minuteman Transportation and Handling Equipment."
- i. D2-4747-3, "Maintainability Design Criteria for Minuteman Facilities and Facilities Equipment."
- j. Boeing letter 2-5261-2-249, dated December 20, 1962, with enclosure, "List of WS-133A Equipment Selected for Maintainability Demonstrations."
- k. D2-14256 "Minuteman Maintainability Guide for Design Criteria."
- l. CCN 926, dated 4 June 1963..



REFERENCES

- a. MIL-M-26512B, "Maintainability Requirements for Aerospace Systems and Equipment," dated 23 March 1962.
- b. 6120-7822-DU-RD1, "Maintainability Criteria, Preliminary," dated 16 March 1962.
- c. T. D. 62-4488, "Maintainability Requirements Program," dated 28 May 1962.
- d. CCN 448, dated 28 May 1962.
- e. CCP 803, dated 5 October 1962.
- f. D2-14475, "WS-133A Maintainability Program Plan."
- g. D2-4747-1, "Maintainability Design Criteria for Minuteman Electronic Equipment.
- h. D2-4747-2, "Maintainability Design Criteria for Minuteman Transportation and Handling Equipment."
- i. D2-4747-3, "Maintainability Design Criteria for Minuteman Facilities and Facilities Equipment."
- j. Boeing letter 2-5261-2-249, dated December 20, 1962, with enclosure, "List of WS-133A Equipment Selected for Maintainability Demonstrations."
- k. D2-14256 "Minuteman Maintainability Guide for Design Criteria."
- l. CCN 926, dated 4 June 1963..

1.0 PURPOSE

The purpose of this document is to present The Boeing Company's final report on the WS-133A maintainability program implemented by CCN 448 of contract AF 04(647)-289. This program was terminated by CCN 926, dated 4 June 1963.

2.0 SCOPE AND BACKGROUND

This report represents the sixth and last of a monthly series. It covers the entire reporting period from 18 October 1962 thru 31 May 1963. The first report covered the period from 18 October thru 31 December 1962. Each succeeding report covered a monthly period from the first thru the last day of each month.

Technical Directive 62-4488 directed The Boeing Company to develop maintainability criteria and to conduct a maintainability program in accordance with these criteria. This direction was acted on and followed. Definitive documentation was submitted to BSD in the form of D2-14256 - "Minuteman Maintainability Guide for Design Criteria" and D2-14475 - "WS-133A Maintainability Program Plan."

The maintainability program plan was in two parts: (1) a design review and evaluation plan; and (2) a test and demonstration plan. Program status and progress relative to the execution of these plans was reported to BSD thru the aforementioned monthly reports. This final report contains program data and information as of 31 May 1963.

3.0 SUMMARY

The report covers a period from October 1962 thru May 1963. It encompasses only a part of the four-year-plus maintainability effort on WS-133A. The maintainability program in effect prior to CCN 448 was communicated to AFBSD in Boeing letter # 2-5262-0-32, dated 5 December 1961, as follows:

"The present Minuteman maintainability program funding and technical considerations have been based upon the implications of MIL-D-9412C functional analysis. This effort is augmented by a group of maintainability specialists who accomplish the following:

- a) Evaluation of Action Requests which effect maintainability;
- b) Investigation of Source Control Documents;
- c) Evaluation of Figure 'A' design;
- d) Participation in PDR's, CDR's, etc;
- e) Mockup evaluation;
- f) CCN 184 observation of tests at STP III and Vandenberg to report M problems in the interface between hardware and maintenance personnel."

Upon acceptance of CCN 448, the Maintainability Engineering Group continued the above program and, in addition, expanded the maintainability effort as follows:

- a) At the request of AFBSD, maintainability review of specific "figure A" hardware was initiated. Those figure A's available at Seattle were reviewed and the balance were being reviewed by sending maintainability engineers to the operating bases.
- b) A test and demonstration plan was submitted to AFBSD. The plan included a list of scheduled WS-133A test and performance demonstrations to be used to demonstrate equipment maintainability. Of the 33 figure A items selected for maintainability demonstration, 32 figure A's, including 108 separate maintenance events, were observed, evaluated, and reported by maintainability engineers.

3.0 (Continued)

- c) In November 1962 a maintainability engineer was assigned to Vandenberg to observe maintenance events, demonstrations, T.O. verification and validation, etc. This engineer reported all maintainability problems to the Maintainability Engineering Group (Seattle) for investigation and evaluation.
- d) Surveillance of field liaison reports to obtain maintainability data resulted in assignment of 109 field reports to maintainability engineers so that problem areas could be coordinated with the design groups.
- e) An engineer was assigned to the "soldering" maintainability problem area, as a continuation of the soldering study and meetings (Maintainability Review Meeting No. 1, at Boeing Seattle, 9 January 1962; and Maintainability Review Meeting No. 2, at RCA; Camden, 18 January 1962). Changes were not accomplished pending direction from AFBSD as per paragraph D, page 8, Minutes of M Review Meeting No. 2, quote: "BSD/STL will make their recommendations and issue implementing direction - - -". Except for a few items covered by TWX's from AFBSD to Boeing (BSQA-19-6-24, dated 19 June 1962, and BSQA-25-6-31, dated 25 June 1962) no recommendations or directions were received. ECP action resulting from the above was subsequently cancelled by AFBSD due to limitation of funds.
- f) In compliance with Technical Directive 62-4488 and CCN 448, a "Minuteman Maintainability Guide for Design Criteria" was compiled and issued as Boeing document, D2-14256. As an outgrowth of this "criteria" document and the requirement for a "maintainability checklist" for designers and maintainability engineers, preparation of a "M checklist" was initiated. This checklist would have been a list of approximately 800 to 1000 items with each item cross referenced and indexed to applicable MIL-STD documents or specifications. If sufficient manpower is authorized, this checklist will be completed as a part of the WS-133B Maintainability Program.

Of the many Maintainability problems encountered during the period of this report, the problems requiring major design changes remain unchanged due to economic limitations. Only "make-work" ECP's were being approved. A MAR was not issued unless a cost study indicated a net savings to the Customer. For these reasons a majority of the M problems on which action was initiated were handled by verbal coordination or by issuing a MRR requesting a change of the product improvement nature. A considerable number of changes have been made on publications and hardware by use of manufacturing options, PRR's, and by accompanying other changes or publication revisions. Due to the time delay in completing a change, many minor M proposals are yet to be accomplished.

Two major conclusions may be drawn from this Maintainability Program:

- a) The Minuteman Weapon System has an acceptable level of maintainability in many areas of air vehicle and ground equipment. Due to the "remove and replace" concept for on-site maintenance, the "actual maintenance" downtime (actual repair or maintenance in progress on equipment) should be a small percentage of total downtime.
- b) It is paramount that a Maintainability Program be initiated during the very early stages of a system development program. Once production is under way and the system end item is placed in service, the cost of an equipment change may be prohibitive. In addition, there is a time delay from the initiation of a maintainability program to the time it is fully effective. For example, time is consumed in the preparation of and obtaining approval for program plans and design criteria documents; and in the hiring, training and indoctrination of personnel on a specific weapon system.

4.0 MAINTAINABILITY REVIEW AND EVALUATION

4.1 MAINTAINABILITY REVIEWS

4.1.1 Program

As part of the Maintainability (M) effort under CCP-803 and the WS-133A Maintainability Program Plan (D2-14475), specific figure "A" items were to be reviewed for M and soldering in accordance with criteria as specified in 6120-7822-DU-RD1, and D2-14256 "Minuteman Maintainability Guide For Design Criteria." Major M problem areas revealed by these reviews were reported through initiation of a Maintainability Action Request (MAR). Minor M problems of the product improvement type were reported to the Design Project through a Maintainability Review Report (MRR).

4.1.2 Figure "A" Items To Be Reviewed

a) The following figure "A" items, selected by the customer, have been reviewed for Maintainability.

- 1) 1207 Drier, Air Compressor;
- 2) 1281 Fault Locator Set, AN/GSM-69;
- 3) 1288 Battery, Storage;
- 4) 1337 Distribution Box;
- 5) 1338 Console, Communications Control;
- 6) 1367 Motor/Generator, PU-521;
- 7) 1380 Distribution Box;
- 8) 1385 Distribution Box;
- 9) 1412 Signal Assembly, Voice Reporting;
- 10) 1423 Antenna Group, AN/GRA-72;
- 11) 1424 Antenna, AS-113/GRC-113;
- 12) 1425 Antenna System, H.F., Receiving & Transmitting;
- 13) 1425 Antenna, H.F., Transmitting, Hardened;

4.1.2 (Continued)

- 14) 1607 Security and Alarm Set;
- 15) 3007 Test-Set, Explosive Set Circuitry;
- 16) 3092 Test-Set, Programmer Group;
- 17) 4018 Adapter AN/GSM-61;
- 18) 4043 Elevator, Work Cage;
- 19) 4152 Test Equipment; Electronic Facility, Base Maintenance;
- 20) 4220 Test-Set, Relay;
- 21) 4252 CIV Set, AN/GSQ-65;
- 22) 4344 Fault Locator, SCN Cable;
- 23) 4451 Controller, Azimuth Drive;
- 24) 4487 Command Signal Simulator;
- 25) 4489 Simulator Set, Electronic Functions;
- 26) 4491 Start-Up Unit;
- 27) 4515 Static Frequency Changer;
- 28) 4523 Common Power Supply;
- 29) 4539 Test Set, VRSA;
- 30) 4601 Function Simulator; H.F./UHF Radio;
- 31) 4632 Test-Set, Electric Power, LF;
- 32) 4633 Test-Set, Electric Power, LCF.

b) The Minutes of the Maintainability Review Meetings held at Boeing on 9 January 1962, and at RCA, on 16 January 1962 (file



4.1.2 (Continued)

No. 2-6331-0-366, dated 7 February 1962) listed certain figure "A" items which were not reviewed due to non-availability of hardware. These items were to be reviewed on a schedule compatible with equipment availability.

- c) Other figure "A" items were to be reviewed as problem areas became identified by review of Field Service Reports, System Test Action Requests, Unsatisfactory Reports, M Evaluation/Observation (E/O) Reports, and other field reports prepared by Boeing organizations.

4.2 MAINTAINABILITY ACTION REQUESTS (MAR)

Status of all MAR's initiated to date is contained in the MAR Status Summary (See section 6.2). A copy of issued MAR's immediately follows the MAR Status Chart. During the period covered by this final report, the following MAR's were issued:

- a) 1-1283-A1, revision 1, Motor Generator Set, LF;
- b) 2-7724-A1, Nozzle Control Unit Test Set;
- c) 3-1282-A1, revision 1, storage Battery Shock Mounts, LF.

4.3 MAINTAINABILITY REVIEW REPORTS (MRR)

During the month of May, MRR's were completed on the following equipment and sent to the cognizant design group. In compliance with CCN 926, dated 4 June 1963, a copy of each MRR issued to date immediately follows the MRR Status Chart (see section 6.3).

- a) 28-1283-1, M-G Set, Control Assy Access Plate;
- b) 29-1367- Rev. A , M-G Set, LCF;
- c) 30-MGE-1 Storage Identification of Removable Items in MGE Cases;
- d) 31-4319, Adapter Set - Connector;
- e) 32-1201, Programmer Group

4.4 FIELD LIAISON REPORTS

Surveillance of operational activities to obtain additional Maintainability data was accomplished thru review of STAR's (System Test Action Requests), FSR's (Field Service Reports), UR's (Unsatisfactory Reports), and BIAR's (Base Installation Action Requests). During the reporting period, 290 STAR's, 293 BIAR's, 20 UR's, and 270 FSR's were reviewed for Maintainability implications. Of these reports, maintainability surveillance was initiated on: 41 STAR's, 21 BIAR's, 36 FSR's, and 11 UR's.

4.4.1 Maintainability Surveillance

In those cases where reviews indicated a maintainability problem, M Engineers were assigned to work the problem with the design organization. If the proposed solutions to problems reported thru the above Field Liaison Reports did not satisfy maintainability requirements then a MAR or MRR was initiated as appropriate.

5.0 MAINTAINABILITY TEST AND DEMONSTRATION

5.1 TEST AND DEMONSTRATION PLAN

Tests and performance demonstrations already scheduled for other purposes at the STP III installation, Vandenberg Air Force Base, and Minuteman Wing installations were utilized to provide as many Maintainability demonstrations as possible. Maintainability Engineers participated in those tests and demonstrations having inherent Maintainability significance. Observations were documented by E/O Reports.

Equipment items with Maintainability features having major impact upon the operation and maintenance of the Weapon System were selected. Only demonstrations involving these items were documented, pending both BSD approval of the equipment list and contractual coverage of any additional tests considered necessary by the Customer.

5.2 TEST AND DEMONSTRATION EQUIPMENT LIST

The "List of WS-133A Equipment Selected for Maintainability Demonstrations" was transmitted to BSD by letter 2-5261-2-249, dated December 20, 1962. This list identified applicable maintenance operations which may be observed during remaining scheduled test and demonstration activities, to provide Maintainability demonstrations of the selected Figure "A" equipment items. It also identified, for each selected equipment item, those maintenance operations which should be demonstrated but were not at that time known to be included within any scheduled test or demonstration.

The "Demonstration Requirements Status Summary" (Section 6.4 of this report) provided monthly amplification and updating of the "List of WS-133A Equipment Selected for Maintainability Demonstrations." It contained a tabulation of the maintenance operations which should be demonstrated for each selected "Figure A" equipment item, and identified any scheduled events which were known to include these operations. It also contained a completion record, which provided completion dates and observer report numbers for all demonstrations which had been accomplished during current and previous reporting periods.

5.2 (Continued)

Of the 33 Figure A items selected for maintainability demonstration, 32 were observed and evaluated by maintainability engineers during at least one maintenance event. 108 separate maintenance events were observed, evaluated, and reported (E/O reports). Of the remaining maintenance events listed, 178 were unscheduled and no observations were made pending authority from BSD to establish additional demonstrations. The remaining scheduled events would have been observed had the program not been terminated.

5.3 MAINTAINABILITY EVALUATION/OBSERVATION (E/O) REPORTS

E/O Reports were prepared for both "dynamic" observations of maintenance and "static" evaluation of M design. The reports provided the basis for subsequent corrective action on any observed deficiencies, and were submitted monthly in this document series as a demonstration record.

- a) A "Static" evaluation is a complete visual inspection made on a non-interference basis whenever equipment becomes conveniently available. "Dynamic" observations are made during applicable maintenance operations using actual equipment. In either case an E/O Report "documents" the demonstration results.
- b) Each completed E/O Report was evaluated by the Maintainability Engineers who had Maintainability review responsibility for the specific "Figure A" items of equipment identified in the report. When Maintainability deficiencies were identified in a report, MAR's and/or MRR's were initiated for appropriate action.
- c) Fifty-nine E/O Reports were written during the period covered by this document: They were prepared by the Maintainability Engineers who participated in the M demonstrations. The reports are contained in Section 6.5.

6.0 REPORT STATUS AND SUMMARY

This section contains status charts and summaries of Maintainability Action Requests (MAR's), Maintainability Evaluation/Observation (E/O) Reports, and Maintainability Review Reports (MRR's).

- 6.1** The Maintainability Review Status Chart contains an up-to-date summary of the Figure A equipments reviewed in accordance with the discussion contained in Section 4. As additional Figure A items were reviewed they were entered on this chart with notations as to action taken and date review was completed. This chart includes all figure A equipments where the maintainability review was cumulated by the issuance of a MAR or MRR. Many reviews and investigations did not result in a formal report but were cumulated by verbal reports or meetings, and coordination sheets addressed to the cognizant design group.

MAINTAINABILITY REVIEW STATUS CHART

FIG. 'A' NO.	SUBJECT	ACTION REPORT		DATE REVIEW COMPLETED
		M AR NO.	M RR NO.	
1367	Motor-Generator, PU-521 (LCF)	3-1282-A1	1-1367	December 14, 1962
1282/1288	Battery Storage		2-1282	December 14, 1962
1243/1338	Consoles (telephone & transmitter control)		3-1243	December 14, 1962
1369	Antenna Set		4-1369	December 14, 1962
4488	Decoder Kit	1-1283-A1	5-4488	December 14, 1962
1283	Motor-Generator, PU-515		6-1283	December 21, 1962
4252	Code Insert-Verifier Set		7-4252	December 21, 1962
1370	Lighting Equipment Group		8-1370	December 21, 1962
1201	Programmer Group	2-7724-A1	9-1201	December 21, 1962
4523	Common Power Supply		10-4523	December 24, 1962
3109	Alarm Set Test Set		11-3109	January 8, 1963
Various	Electrical Equipment Cases, MGE		12-MGE	January 18, 1963
1337	Distribution Box J-1296		13-1337	January 23, 1963
1412	Voice Reporting Signal Assembly		14-1412	January 21, 1963
6950	HSM-80C Section 49 Skirt		15-6950	January 22, 1963
1380	Distribution Box, J-1312		16-1380	January 23, 1963
3007	Test Set, Explosive Set Circuitry		17-3007	January 29, 1963
7724	NCU Zero Alignment Test Set			January 22, 1963
4018	Test Adapter Group		18-4018	February 7, 1963
4491	Start-Up Unit, LF		19-4491	February 26, 1963
3092	Test Set, Programmer Group	23-3109 rev A	20-3092	February 25, 1963
4490	Simulator Set Missile Launch		21-4490	February 26, 1963
1373/1374	Electric Surge Arrestor		22-1373	March 6, 1963
3109	Test Set, Alarm Set, GSM-59		23-3109 rev A	March 5, 1963
3013	Test Set, Consoles		24-3013	March 12, 1963
4388	Test Set, Telephone, GTM-3		25-4388	March 21, 1963
4152	Test Equipment, Electronic Facility		26-4152	April 16, 1963
4167	Electrical Load Bank		27-4167	April 17, 1963
1283	M-G Set, Control Assy. Access Plate		28-1283	April 24, 1963
1367	M-G Set, LCF		29-1367 rev 1	May 9, 1963
MGE	Storage-Identification of Removable Items in MGE Cases		30-MGE-1	May 13, 1963
4319	Adapter Set - Connector	31-4319		May 13, 1963
1201	Programmer Group		32-1201	May 21, 1963

6.2 MAR STATUS SUMMARY

The MAR Status Chart, page 18 , contains an up-to-date list of MAR's issued and the current status of each MAR. Copies of MAR's were included in each monthly progress report, until such time as they were considered closed. MAR's requiring no further consideration by either the originating engineer or the organization responsible for corrective action were closed. This status was assigned by the MAR originator only when one of the following has been achieved:

- a) An authorized hardware, procedure, specification or other corrective action had been found to satisfy the MAR problem;
- b) The organization responsible for action rejected the request for corrective action and the MAR originator concurred with reasons given for the rejection.
- c) The MAR originator considered that the MAR required no further action because of related actions taken, events occurring, or status changing after initiation of the MAR.

6.2.1 MAR #1-1283-A1 Rev. 1 was issued and "closed" out, during this reporting period. The MAR was "closed" by the maintainability engineer because of the following status and actions, as reported by the equipment manager:

- a) PRR #11646 provides M-G Set start-up and shutdown procedure placards at all bases as A & CO items;
- b) A "capsulated" starting and stopping procedure is being provided on the M-G Sets, American Electronics Inc. Part No. 302405. The correct stopping procedure is identified by part no. 102282 revision C and the correct starting procedure is identified by part no. 101670 revision D;
- c) The 10-20945-2 M-G Set used in the launch control facility of Wing II and on has a disconnect device to prevent DC motor starting of the M-G Set.

6.2.2 MAR #7724-A1 was issued, and "closed" out by the M Engineer after the M problem was eliminated by PRR #11602. This PRR provided for replacement of the entire cable and connector by a simple "shorting" plug.

6.2.3 MAR # 3-1282-A1, revision 1 was closed out by the M engineer upon receipt of a reply from design engineering, which outlined their position as follows:

"The following chronological list of actions has occurred concerning official action taken by Boeing and by the Air Force on the subject of additional battery shock-mounting provisions."

6/6/62 MCL 964 prepared by Ralph M. Parsons Co. to provide Additional Shock attenuation for the LF Batteries effectivity All Bases.

6/13/62 FWG assigned FCR 160 to MCL 964 approving it for design and submittal to the CCB.

6/22/62 CCB deferred FCR 160 for studies of alternate solutions.

6/26/62 CCB approved FCR 160 for MAFB & VAFB only. Studies for alternate solutions for follow-on wings to continue.

8/17/62 Letter from Piccolo directing Boeing to submit ECP to incorporate alternate solution because of considerable savings in cost.

8/24/62 CCB directed Boeing to submit a new FCIR & ECP to provide an alternate solution for Ellsworth and on.

9/10/62 MCL 1188 prepared by Boeing and submitted to FWG.

9/12/62 FWG assigned FCR 187 to MCL 1188 approving it for design and submittal to the CCB.

9/20/62 ECP 391 to provide modifications to the battery shock mounts that were necessary to accommodate the FCR 187 facilities changes.

10/2/62 FCR 187 reviewed by CCB and disapproved in favor of FCR 160 R-1. The basic reason for this action was that ECP 391, which was required to support FCR 187 had not been submitted in time. This scheduling is the result of the "URGENT" priority assigned to ECP 391 in accordance with standard AF policy. Action on FCR 187 was deemed necessary by the CCB on this date in order to meet construction schedules at EAFB.

6.2.3 (Continued)

10/2/62 FCR 160 R-1 CCB revised effectivity to include EAFB, MTAFB & WAFB.

11/1/62 ECP 391 cancelled because of CCB directive dated 10/2/62.

It should be noted from the above past actions that the alternate shock mount as suggested in reference (a) was identical to ECP 391 and FCR 187. These changes were turned down by the Air Force even though they had adequate knowledge of costs and other factors influencing the design of the battery shock mounts. Because this subject has been reviewed and acted upon by the Air Force, it is believed that this group should not re-open the subject."

6.2.4 Other M₁ AR's were initiated but not issued when it was found that the Boeing design groups and BSD were fully aware of the M problem area and actively working the problem. Thus MAR's on personnel access shelter, standardization of logic symbology by all contractors (MIL-STD-806), G&C Cooler, RCA power supply drawers (ECP 477), and many others were not initiated when coordination with design engineering found the M problem being actively worked.

M A R S T A T S C H A R T

M A R NO,	SUBJECT	DATE ISSUED	STATUS
1-1283-A1 Rev. 1 2-7724-A1 3-1282-A1	DC Drive Motor Disconnect, M-G Set NCU Zero Alignment Test Set Launch Facility Battery Shock Mounts *MAR copies are included in section 7.0	March 20, 1963 January 22, 1963 December 5, 1962	Closed* Closed* Closed*

6.3 MRR SUMMARY

CCN-869 dated 11 April 1963, directed that a copy of all MRR's be furnished to BSD/STL. During the period covered by this final report, thirty-two MRR's were issued and seven MRR's were in the initial stages of preparation. A copy of the coordination sheet by which the MRR's were transmitted to the Design Group is shown on the next page. Copies of the thirty-two MRR's which were prepared and forwarded to the Design Group are included in section 7.0 of this report.

COORDINATION SHEET

GROUP INDEX

SUBJECT

NO.

ITEM NO.

DATE

MODEL

1. BSD has requested that certain Figure A items be reviewed for Maintainability (M). The M reviews are conducted as part of the M effort authorized by CCP-803, and CCN-448.
2. Figure A _____ has been reviewed and a copy of the Maintainability Review Report, MRR # _____, is attached.
3. The M problem areas and/or features which are listed on the MRR's are of the product improvement type; they are features which do not meet the M design goals identified by the customer in Technical Directive #62-4488, and/or the M design criteria set forth in D2-14256 "Minuteman Maintainability Guide For Design Criteria." These problem areas and/or recommendations should be considered for incorporation in any product improvement proposals (PRR, ECP, etc).

Prepared by:

Approved by:

cc: Andrews, J. H.	50-69
Barker, J. M.	50-66
Booth, J. M.	51-35
Classon, N. E.	53-35
Cole, D. A.	43-86
Kiyono, M. M.	50-66
Larson, W. J.	50-66
Marcella, J. B.	53-76
Ranney, D.	14-01
Slebodnick, E.	VAFB
Smith, A. H.	VAFB
Waters, E. A.	39-88
Wetz, W.	50-69
Whitney, E. S.	50-66

6.4 EVALUATION/OBSERVATION (E/O) REPORTS

Each E/O Report consists of a M Checklist and a supplementary rating analysis. The checklist contains numerical ratings for all major Maintainability features observed and evaluated during the indicated demonstration event. The supplementary rating analysis accompanying the checklist both substantiates the numerical ratings and provides constructive recommendations. The recommendations propose specific improvements to be made in order to attain "Good" Maintainability.

The following pages contain a status summary of the actions taken to follow-up on the comments contained in the E/O reports. The first column lists the E/O report number. Column two shows the action taken by the Maintainability Engineering Group on each report item or recommendation. The third column reflects the actions taken to correct the M problem area. Where the numbered items are blank in column two and three, it indicates that the action is still "in work" or that the M problem has not yet been satisfactorily solved.

Copies of the fifty nine E/O reports which were completed during the period of this report are included in section 7.0.

MAINTAINABILITY STATUS SUMMARY ON OBSERVED FIGURE A EQUIPMENT		
REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-1201-1/3092-1 Fault Isolation of Programmer Group	1. Co-ordination Sheet MEG-3-34	1. Publications incorporated the recommendations into T.O. 21-SM80A-2-3, Control and Monitoring System.
EO-1201-2/4487-1 Drawer Checkout	2. MRR 20-3092, Maintainability Review of Programmer Group Test Set, AN/GSM-57. 3. MRR 9-1201, Maintainability Review of Programmer Group.	2. 3. PRR # 11383 provided pigtail leads with crimp-on connectors for 24 diodes. ECP-358 cancelled by BSD. This ECP would have provided significant improvements in maintainability for the LF Control and Monitor System.
	4. MRR 32-1201, Maintainability Review of Programmer Group. 5. MRR 10-4523, Maintainability Review of Common Portable Power Supply.	4. 5. Letter 2-6511-00-110 presents comments on the subject MRR, however no firm corrective action is taken.

REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-1213-1/1251-3 Drawer Checkout and Static Evaluation	1. Co-ordination Sheet SES/M-61-200	1. CCP 803-1 cancelled by BSD. CCN 448 provided funds for Maintainability studies.
EO-1214-1 Static Evaluation, Liquid Cooling Equipment EO-1214-2 Replacement of Chiller, Water Refrigerating	1. Verbal co-ordination with design on the problems reported.	1..
EO-1228-1/1251-1/4012-1 Demonstration 1-20, Fault Isolation EO-1228-2 Evaluation and Drawer Checkout, Status - Command Message Processing Group	1. Co-ordination Sheet SES/M-61-200 2. Co-ordination Sheet SES/M-62-248 3. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases. 4. MRR 30-MGE-1, Maintainability Review of Storage - Identification of Removable Items.	1. CCP 803-1 cancelled by BSD. CCN 448 provided funds for Maintainability studies. 2. Recommended changes were incorporated into T.O. 21- SM80A-2-3, Control and Monitor System. 3. OED 208 denied ECP number by BSD. 4.

15-491-100

REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-1243-1/3013-1 TAT Class I Demonstration, Console Checkout	1. Co-ordination Sheet MEG-3-47 2. MRR 24-3013 Maintainability Review of Communications - Launch Control Consoles Test Set, AN/ GSM-58 3. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases. 4. MRR 3-1243/1338, Maintainability Review of Launch Control and Communications Control Consoles. 5. MRR 30-MGE, Maintainability Review of MGE Storage Space Identification. 6. Co-ordination Sheet MEG-3-26 7. Co-ordination Sheet SES/M 62-214, Testing and Repair of Figure A 1243 Power Filter.	1. Recommendations to be in- corporated in T.O. 21-SM80A-2-3, Control and Monitor System. 2. 3. OED 208 denied ECP number by BSD. 4. Unit will remain as is with soldered connections 5. 6. Recommendation incorporated in T.O. 21-SM80A-2-3, Control and Monitor System. 7. Power Filter will be maintained at SMSB using AN/GSM-82 Test Equipment.

REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-1265-1/4018-4/1251-2 Drawer Checkout and Static Evaluation	1. Co-ordination Sheet 61-200	1. CCP-803-1 cancelled by BSD. CCN 448 provided funding for Maintainability studies.
EO-1251-4 Drawer Checkout and Static Evaluation	1. Co-ordination Sheet 61-200	1. CCN 448 issued to provide Maintainability studies.
EO-1283-1 Maintenance Replacement of the M-G Set	1. Co-ordination Sheet MEG-3-108	1. Functional Test Document to be revised.
EO-1283-2 Motor Generator Shutdown and Start	2. MRR 6-1283, Maintainability Review of the Motor-Generator Set, PU-515.	2. ECP 381 cancelled by BSD. This ECP would have provided plug-in relays for the M-G Set.
EO-1283-3 Brush Adjustment	3. MRR 28-1283 Maintainability Review of LF Motor-Generator Set.	3. Design group states RFI will increase 3db if one fastener is omitted. Physics Technology states a hinged cover with line contact and Beryllium - Copper Foil shielding will give better RFI protection than the present configuration.
	4. MAR 1-1283-A1 Maintainability Action Request on lack of a disconnect switch for the DC motor.	4. Letter 2-6522-24-456 presents pros and cons of two proposed fixes. Requests Systems Analysis for a recommended solution.

12-4-1-288

BOEING

NO. D2-14934-6

PAGE 25



REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
	5. MAR 1-1283-A1-Rev. 1, Maintainability Action Request on LF and LCF Motor Generator Startup and Shutdown Instructions.	5. PRR #11646 incorporates M-G set startup and shutdown procedure placards at all bases as A & CO items. The M-G Sets being installed at the present time have starting and stopping procedure placards attached. No means of ensuring that previously installed sets have these placards exists. The 10-20945-2 M-G sets at the Launch Control Facility will have a DC disconnect device.
EO-1284-2 Static Evaluation	1. Verbal co-ordination with the design group on the addition of a variable resistor on the voltage regulator cards.	1. ECP 431 would have added variable resistor, BSD cancelled this portion of the ECP.
EO-1289-1/4152-2/1284-1 Power Supply Checkout and Static Evaluation	1. Verbal co-ordination with the design group on the addition of a variable resistor on the 1289 voltage regulator cards.	1. ECP 431 would have added variable resistor, BSD cancelled this portion of the ECP.
EO-1337-1 Evaluation - Distribution Box J-1269/GSW-4	1. MRR 13-1337, Maintainability Review of the Distribution Box.	1.

02-401-1-88

REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-1337-2 Unscheduled Maintenance During Missile Emplacement	2. Copy of EO-1337-2 forwarded to the cognizant design groups.	2.
EO-1338-1 Evaluation, Communication Control Console	1. MRR 3-1243/1338, Maintainability Review of Launch Control and Communications Control Console.	1. Unit will remain as is with soldered connections.
EO-1367-1 Motor Generator Checkout	1. MRR 1-1367, Maintainability Review of Motor-Generator, PU-521 (LCF). 2. MRR 29-1367 Rev. A, Maintain- ability Review of the Launch Control Facility Motor Generator Set. 3. Co-ordination with design group pertaining to a DC disconnect switch for the M-G Set.	1. No action planned. 2. Engineering is generating an ECP proposal to take action. 3. ECP 279 approved. The 10- 20945-2 M-G set has a DC disconnect device. Wing II & on.
EO-1412-1 Replacement of Faulty Audio Reproducer Module EO-1412-2 Inspection, Voice Reporting Signal Assembly	1. MRR 14-1412, Maintainability Review of Voice Reporting Signal Assembly.	1.

REPORT NUMBERS	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-3092-2 Functional Test, Programmer Group Test Set	1. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases.	1. OED 208 denied ECP number by BSD.
EO-3092-3 Incorporation of Modifica- tion and Use at the LF, Programmer Group Test Set	2. MRR 20-3092, Maintainability Review of Programmer Group Test Set, AN/GSM-57.	2.
EO-3092-4 Fault Locator Programmer Group Test Set	3. MRR 30-MGE, Maintainability Review of MGE Storage Space Identification.	3.
	4. EO-3092-4 forwarded to the cognizant design group.	
EO-3109-1 T.O. 21-SM80A-2-4 Validation	1. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases.	1. OED 208 denied ECP number by BSD.
EO-3109-2 Static Evaluation Alarm Set Test Set, AN/GSM-59	2. MRR 23-3109 Rev. A1, Maintain- ability Review of Alarm Set Test Set.	2. No action will be taken since equipment will be for Wing I only.
EO-3109-3 Evaluation Alarm Set Test Set, AN/GSM-59	3. Co-ordination Sheet MEG-3-77, Maintainability input for proposed additions to Figure A 3109 equip- ment.	3. OED 218 is in work as an engineering proposal. ECP 587 is now awaiting BSD approval.
	4. MRR 30-MGE, Maintainability Re- view of MGE Stor. Space Identif.	4.

51-81-28

BOEING

NO. D2-14934-6

PAGE 28

REPORT NUMBER	MGROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-4012-2 Static Evaluation of Data Analysis Central Test Set (ACO equipment)	1. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases. 2. MRR 30-MGE, Maintainability Review of MGE Storage Space Identification. 3. Co-ordination sheet 61-200	1. OED 208 denied an ECP number by BSD. 2. 3. CCN 448 issued to provide Maintainability studies.
EO-4018-1 Maintainability Evaluation of Figure A 4018 Equipment EO-4018-2 Engineering Evaluation of Programmer Stepping Switches EO-4018-3 Operational Checkout of Test Adapter Group	1. MRR 18-4018, Maintainability Review of Figure A 4018, Test Adapter Group.	1.
EO-4043-1 Utilization Elevator-Work Cage, Passenger and Equip. EO-4043-2 Replacement of Damaged Power Cable	1. Verbal co-ordination with the cognizant design groups on ECP's 539, 392, 474, and 235.	1. ECP's are in-work and will improve design of Elevator-Work cage from a Maintainability viewpoint.



REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
EO-4043-3 Proof loading		
EO-4043-4 T.O. V&V of T.O. 21-SM80A-2-10 Section III		
EO-4095-1 Inspection of Tie-down Hatch Fasteners on the SSCBM	1. Co-ordination, Sheet MEG-3-272 Procedure for Removing and Installing SSCBM access doors.	1. Systems Test concurrent with recommendations.
EO-4152-1 T.O. V&V, Electrical Test and Maintenance Table	1. MRR 26-4152, Maintainability Review of Base Maintenance Electronic Facility Test Equipment 2. MRR 27-4167, Maintainability Review of the Avtron Electrical Load Bank 3. Co-ordination Sheet MEG-3-85 sent to Minuteman Publications. 4. Co-ordination Sheet MEG-3-87 sent to Minuteman Publications	1. ECP 549 is correcting transposed connectors on the Electrical Dummy Loads. 2. Co-ordination sheet RPIE/GFP 363 reply states MIL-STD-803 does not apply to GFP and that Technical Order should be revised to call out new procedures for the adjustment of the Load Bank. 3. Revisions will be incorporated into T.O. 33D9-6-21-1 4. Revisions will be incorporated into T.O. 31X3-12-8-2.
EO-4490-1 Static Evaluation - Missile Launch Electrical Functions Simulator Set.	1. MRR 21-4490, Maintainability Review of the AN/GSM-62	1.

REPORT NUMBER	M GROUP ACTION ON OBSERVED FIGURE A EQUIPMENT	ACTION TAKEN
	2. MRR 12-MGE Maintainability Review of Portable ACO/MGE Electrical Equipment Cases. 3. MRR 30-MGE, Maintainability Review of MGE Storage Space Identification	2. OED 208 denied ECP number by BSD. 3.
EO-4252-1 Inspection, Code Insert- Verifier	1. MRR 7-4252, Maintainability Review of the Code Insert- Verifier Set	1. Co-ordination Sheet CLCS 27-2-268 answers Maintainability recommendations.
EO-4489-1 Evaluation - Message Generator	1. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases. 2. MRR 30-MGE, Maintainability Review of MGE Storage Space Identification.	1. OED 208 denied ECP number by BSD. 2.
EO-4491-1 T.O. Verification Launch Facility Start-Up Unit EO-4491-2 Evaluation - LF Start-Up Unit EO-4491-3 Static Evaluation -LF Start- Up Unit	1. MRR 19-4491, Maintainability Review of Launch Facility Start- Up Unit. 2. MRR 12-MGE, Maintainability Review of Portable ACO/MGE Electrical Equipment Cases. 3. MRR 30-MGE, Maintainability Review of MGE Storage Space Identification.	1. 2. OED 208 denied ECP number by BSD. 3.

6.5 DEMONSTRATION REQUIREMENTS STATUS SUMMARY

The following Demonstration Requirements Status Summary contains an up-to-date schedule of maintainability demonstration events for each selected "Figure A" item. Completion dates and E/O Report numbers are listed for those demonstrations which have occurred during the reporting period. The Summary also lists those maintenance operations which should be demonstrated but are currently "unscheduled." A copy of all E/O Reports referred to in this summary may be found in paragraph 7.0.

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
1201 Programmer Group	Organisational-Level Checkout	Technical Approval Demonstration 1-18, Malmstrom AFB	11-7-62	EO-1201-1	1-18-63			
		Technical Approval Demonstration 1-15, Vandenberg AFB						
	Organisation-Level Fault Isolation	Technical Approval Demonstration 1-18, Malmstrom AFB	11-7-62	EO-1201-1	1-18-63			
		Technical Approval Demonstration 1-15 Vandenberg AFB						
	Field-Level Checkout	Verification T. O. 31X3-12-8-2, par. 7-11, 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
		Verification: T. O. 31X3-12-8-2, par. 7-11, 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	Drawer A2	Technical Approval Demonstration 1-14, Malmstrom AFB						
		Technical Approval Demonstration 1-11, Vandenberg AFB						
	(Part No. -44)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
		Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -53)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
		Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(1201)	(Field -Level Checkout)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -56)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -58)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -59)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	Drawer A4 (Part No. -56)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -62)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -63)	Verification: T. O. 31X3-12-8-2, par. 7-12A, 7-13	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	Drawer A6 (Part No. -40)	Verification: T. O. 31X3-12-8-2, par. 11-17 thru 11-23	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -50)	Verification: T. O. 31X3-12-8-2, par. 11-17 thru 11-23	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	(Part No. -53)	Verification: T. O. 31X3-12-8-2, par. 11-17 thru 11-23	3-28-63	EO-1201-2/ 4487-1	4-3-63			
	Drawer A7	Verification: T. O. 31X3-12-8-2, par. 12-15 thru 12-19	3-28-63	EO-1201-2/ 4487-1	4-3-63			

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD						
			PREVIOUS			CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	
(1201)	Field-Level Fault Isolation	Drawer A1	UNSCHEDULED						
		Drawer A2	Technical Approval Demonstration 1-14, Malmstrom AFB						
		Drawer A3	UNSCHEDULED						
		Drawer A4	UNSCHEDULED						
		Drawer A6	UNSCHEDULED						
		Drawer A7	UNSCHEDULED						
	1211 Launcher Environmental Control System	Organizational - Level Checkout		UNSCHEDULED					
Inspection			UNSCHEDULED					4/27/63 5/4/63	1211-1 1221-2
Organizational-Level Fault Isolation			UNSCHEDULED						
Organizational - Dampers D-1, Level Adjust- ment			UNSCHEDULED						
Dampers D-3, D-3A, D-3B			UNSCHEDULED						
	Damper D-4		UNSCHEDULED						
	Damper D-5		UNSCHEDULED						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
(211)	(Organizational - Level Adjustment) PE-4	Switches PE- 2, PE-3, PE-4			4/27/63	1211-1	5/14/63	
	Switch PE-5	Pressure Regulator PC-1						
	Flow Sensor FA-1	Flow Sensor FA-2						
	Thermostat TC-1	Thermostat TC-4						
	Thermostat TC-5	Thermostat HL-1						
	Thermostat TA-1, TA-6	Thermostat TA-2, TA-5						
	Thermostat TA-4	Low Temp. Cutout						
	Oil Pressure Cutout	Pressure Reg PRV-2						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(7211)	(Organizational- Level Adjustment)	Restrictors						
		Brine Balancing						
		Air Flow Balancing						
		Emerg. Water Flow Balancing						
		Pressure Gage						
		Temperature Gage						
		Chiller Unit						
		Emerg. Cooling Unit						
		Misc. Components						
		Chiller Unit						
	Field-Level Fault Isolation	Emerg. Cooling Unit						
		Misc. Components						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(1211)	Field-Level Adjustment	High Pressure Cutout	UNSCHEDULED					
		Low Pressure Cutout	UNSCHEDULED					
		Oil Pressure Cutout	UNSCHEDULED					
		Low Temp. Cutout	UNSCHEDULED					
		Damper D-1	UNSCHEDULED					
		Damper D-2	UNSCHEDULED					
		Switches PE-2, PE-3	UNSCHEDULED					
		Pressure Reg. PC-1	UNSCHEDULED					
		Restrictor RS-1	UNSCHEDULED					
		Pressure Gage	UNSCHEDULED					
		Temp. Gages TG-4, TG-5	UNSCHEDULED					
		Restrictor RS-1A	UNSCHEDULED					
		Switch PR-5A	UNSCHEDULED					
		Switches PE-6A, PE-7A	UNSCHEDULED					
		Thermostat TA-3	UNSCHEDULED					
		Thermostat HL-2	UNSCHEDULED					

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	DATE COMPLETED	REPORT NO.	DATE COMPLETED
(1211)	Field-Level Adjustment	High Pressure Cutout						
		Low Pressure Cutout						
		Oil Pressure Cutout						
		Low Temp. Cutout						
		Damper D-1						
		Damper D-2						
		Switches PE-2, PE-3						
		Pressure Reg PC-1						
		Restrictor RS-1						
		Pressure Gage						
		Temp. Gages TG-4, TG-5						
		Restrictor RS-1A						
		Switch PR-5A						
		Switches PE-6A, PE-7A						
		Thermostat TA-3						
		Thermostat HL-2						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE	DATE COMPLETED	REPORT NO.	DATE
1213 Command-Status Message Processing Group (LCF)	Organizational-Level Checkout	Revalidation; T. O. 21-SM80A-2-3, par. 2-36 thru 2-39 UNSCHEDULED						
	Complete							
	Organizational Level Fault Isolation	UNSCHEDULED						
	Field-Level Checkout	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7	3-6-63	EO-1213-1/ 1251-3	3-8-63			
	CV-1236 Drawer							
	MX-3686 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						
	MX-3687 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7	3-6-63	EO-1213-1/ 1251-3	3-8-63			
	CV-1243 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7	3-6-63	EO-1213-1/ 1251-3	3-8-63			
	CV-1237 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						
	MX-3742 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7	3-6-63	EO-1213-1/ 1251-3	3-8-63			
	MU-446 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						
	CV-1249 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7	3-6-63	EO-1213-1/ 1251-3	3-8-63			
	CV-1250 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT		DATE COMPLETED	DATE COMPLETED
			NO.	REPORT DATE	NO.	REPORT DATE		
8213	Field-Level Fault Isolation	CV-1236 Drawer						
		MX-3686 Drawer						
		MX-3687 Drawer						
		CV-1243 Drawer						
		CV-1237 Drawer						
		MX-3742 Drawer						
		MU-446 Drawer						
		CV-1249 Drawer						
		CV-1250 Drawer						
	Field-Level Adjustment	CV-1237 Drawer						
	Inspection							

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	DATE COMPLETED	REPORT NO.	DATE
1214 Ground Guidance and Control Liquid Cool- ing Equipment	Organizational-System Checkout Level Checkout	UNSCHEDULED						
	Pump Package Operation	Technical Approval Demonstration 1-15, Malmstrom AFB						
	Electronic Con- trol Amplifier	Technical Approval Demonstration 1-12, Vandenberg AFB						
	Organizational-Level Fault Isolation	UNSCHEDULED						
	Remove and Replace Chiller	UNSCHEDULED						
	Remove and Replace Pumping Assembly	Technical Approval Demonstration 1-15, Malmstrom AFB	3-13-63	EO-1214-1	3-15-63			
	Field-Level Checkout	Technical Approval Demonstration 1-12, Vandenberg AFB						
	Water Chiller	Technical Approval Demonstration 1-13, Malmstrom AFB						
	Pumping Assem- bly	Verification; T. O. 35E9-35-1, par. 3-4						
	Electronic Con- trol Amplifier	Verification; T. O. 35E9-35-1, par. 3-21						
Field-Level Fault Isolation	Water Chiller	Verification; T. O. 35E9-35-1, par. 3-30						
	Pumping Assem- bly	UNSCHEDULED						
	Electronic Con- trol Amplifier	UNSCHEDULED						
	Inspection	UNSCHEDULED	3-8-63	EO-1214-1	3-8-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
1228 Status-Command Message Processing Group (LF)	Organizational-Level Checkout	Technical Approval Demonstration 1-20, Malmstrom AFB	11-7-62	EO-1228-1	11-29-62			
		Technical Approval Demonstration 1-17, Vandenberg AFB						
		Unscheduled			4/15/63	1228-2	4/19/63	
	Organizational-Level Fault Isolation	Technical Approval Demonstration 1-20, Malmstrom AFB	11-7-62	EO-1228-1	11-29-62			
		Technical Approval Demonstration 1-17, Vandenberg AFB						
	Field-Level Checkout	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	MC-3775 Drawer							
	MX-3776 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	CV-1254 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	KY-411 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						
	Field-Level Fault Isolation	UNSCHEDULED						
	MC-3775 Drawer							
	MX-3776 Drawer	UNSCHEDULED						
	CV-1254 Drawer	UNSCHEDULED						
	KY-411 Drawer	UNSCHEDULED						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
1243 Launch Control Console	Organisational-Level Checkout	Technical Approval Demonstration 1-22, Ellsworth AFB	1-29-63	EO-1243-1	1-30-63			
	Organisational-Level Fault Isolation	UNSCHEДУLED						
	Field-Level DC Power Filter Checkout	Verification; T. O. 31X3-3-9-2-1 par. 11-2						
	Telephone Xmtr. Control	Verification; T. O. 31X3-3-9-2-1, par. 13-3, 13-4, fig. 13-1						
	Field-Level DC Power Filter Fault Isolation	UNSCHEДУLED						
	Telephone Xmtr. Control	UNSCHEДУLED						
	Removal, Replacement, and Checkout of Launch Control Panel	Technical Approval Demonstration 1-18, Vandenberg AFB	1-29-63	EO-1243-1	1-30-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
1251 Digital Data Group (LFP)	Organizational-Level Checkout	Technical Approval Demonstration 1-20, Malmstrom AFB Technical Acceptance Demonstration 1-20, Ellsworth AFB	11-7-62	EO-1228-1/ 1251-1/4Q24	11-29-62	1251-5	5/24/63	
	Organizational-Level Fault Isolation	Technical Approval Demonstration 1-20, Malmstrom AFB	11-7-62	EO-1228-1/ 1251-1/ 4012-1	11-29-62			
	Field-Level Checkout	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-4-63	EO-1265-1/ 4018-4/ 1251-2	3-8-63			
	DT-252 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	MX-3772 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-6-63	EO-1213-1/ 1251-3	3-8-63			
	MX-3773 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						
	CV-1253 Drawer	Verification; T. O. 31X2-32-3-2, par. 8-5, 8-7						
	Field-Level Fault Isolation	UNSCHEDULED						
	DT-252 Drawer	UNSCHEDULED						
	MX-3772 Drawer	UNSCHEDULED						
	MX-3773 Drawer	UNSCHEDULED						
	CV-1253 Drawer	UNSCHEDULED						
	Field-Level Adjustment	Verification; T. O. 31X2-32-3-2, par. 29-8 thru Figure 29-4	4-8-63	EO-1251-4	4-24-63			
	DT-252 Drawer	Verification; T. O. 31X2-32-3-2, par. 19-10 thru Fig. 19-6						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
1265 Digital Data Group (LCF)	Organizational- Level Checkout	Revalidation; T. O. 21-SM80A-2-3, par. 2-36 thru 2-39						
	Partial	UNSCHEDULED						
	Complete	UNSCHEDULED						
	Organizational-Level Fault Isolation	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-4-63	EO-1265-1/ 4018-4/ 1251-2				
	Field-Level Checkout	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	T-869 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-4-63	EO-1265-1/ 4018-4/ 1251-2				
	R-1096 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	AM-3159 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-4-63	EO-1265-1/ 4018-4/ 1251-2				
	MX-3681 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	MX-3682 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	MX-3683 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
	MX-3684 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7						
Inspection	MX-3685 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-4-63	EO-1265-1/ 4018-4/ 1251-2				
	ID-979 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-25-63					
	R-1131 Drawer	Verification; T. O. 31X2-32-3-2, par. 18-5, 18-7	3-4-63	EO-1265-1/ 4018-4/ 1251-2				
		UNSCHEDULED	3-4-63	EO-1265-1/ 4018-4/ 1251-2				

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	DATE COMPLETED	REPORT NO.	DATE COMPLETED
(1265)	Field-Level Fault Isolation	T-869 Drawer	UNSCHEДУLED					
		R-1096 Drawer	UNSCHEДУLED					
		AM-3159 Drawer	UNSCHEДУLED					
		MX-3681 Drawer	UNSCHEДУLED					
		MX-3682 Drawer	UNSCHEДУLED					
		MX-3683 Drawer	UNSCHEДУLED					
		MX-3684 Drawer	UNSCHEДУLED					
		MX-3685 Drawer	UNSCHEДУLED					
		ID-979 Drawer	UNSCHEДУLED					
		R-1131 Drawer	UNSCHEДУLED					
	Field-Level Adjustment	T-869 Drawer	Verification; T.O. 31X2-32-3-2, par. 18-13					
		R-1096 Drawer	Verification; T.O. 31X2-32-3-2, par. 18-13 thru fig. 19-7					
		AM-3159 Drawer	Verification; T.O. 31X2-32-3-2, par. 18-13 thru fig. 20-7					
		ID-979 Drawer	Verification; T.O. 31X2-32-3-2, par. 22-8					
		R-1131 Drawer	Verification; T.O. 31X2-32-3-2, par. 18-13 thru fig. 23-3					

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
1283 Motor-Generator (LF)	Organizational-Level Checkout Inspection	Verification; T. O. 21-SM80A-2-II, par. 2-23 Unscheduled			5/7/63	1283-4	5/23/63	
	Organizational-Level Fault Isolation	UNSCHEDULED						
	Organizational-Level Brush Adjustment	UNSCHEDULED	4-10-63	EO-1283-3	4-12-63			
	Organizational-Level Shutdown	Verification; T. O. 21-SM80A-2-II, par. 2-19 thru 2-22	3-20-63	EO-1283-2	3-22-63			
	Removal and Replacement	UNSCHEDULED	3-16-63	EO-1283-1	3-19-63			
1284 Power Supply Group (LF)	Organizational- Level Checkout	Verification; T. O. 21-SM80A-2-II, par. 2-26						
	Relays	Verification; T. O. 21-SM80A-2-II, par. 2-27						
	Organizational- Level Fault Isolation	UNSCHEDULED						
	Relays	UNSCHEDULED						
	Organizational-Level Shutdown	UNSCHEDULED						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
(1284) 1289 Power Supply Group (LCF)	Field-Level Checkout (Fig. A 1284 and 1289)	Verification: T. O. 35C2-2-63-1, par. 4-4 thru fig. 4-2	3-12-63	EO-1289-1/ 4152-2/ 1284-1	3-14-63			
		Verification: T. O. 35C2-2-63-1, par. 4-4 thru fig. 4-2	3-12-63	EO-1289-1/ 4152-2/ 1284-1	3-14-63			
		Verification: T. O. 35C2-2-63-1, par. 4-4 thru fig. 4-2	3-12-63	EO-1289-1/ 4152-2/ 1284-1	3-14-63			
	Field-Level Fault Isolation (Fig. A 1284 and 1289)	UNSCHEDULED						
		UNSCHEDULED						
		UNSCHEDULED						
	Inspection	UNSCHEDULED						
	Organizational-Level Checkout	Verification: T. O. 21-SM80A-2-II, fig. 1-10C	3-12-63	EO-1284-2	3-15-63			
	Organizational-Level Fault Isolation	UNSCHEDULED						
	Field-Level Checkout	(See Fig. A 1284)	3-12-63	EO-1289-1/ 4152-2/ 1284-1	3-14-63			
	Field-Level Fault Isolation	(See Fig. A 1284)						
	Inspection	UNSCHEDULED	3-12-63	EO-1289-1/ 4152-2/ 1284-1	3-14-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
1296 Restricted Area Anti-Intrusion Alarm Set Group	Organizational- Level Checkout	VRSA Input Inner Security Outer Security	Verification; T. O. 21-SM80A-2-4, par. 2-4A thru fig. 1-9 Verification; T. O. 21-SM80A-2-4, par. 2-4A thru fig. 1-9 Verification; T. O. 21-SM80A-2-4, par. 2-4A thru fig. 1-9					
	Organizational- Level Fault Isolation	VRSA Input Inner Security Outer Security	UNSCHEDULED UNSCHEDULED UNSCHEDULED					
	Organizational- Level Adjustment	Receiver- Transmitter Converter- Monitor	UNSCHEDULED UNSCHEDULED UNSCHEDULED					
	Field-Level Checkout	Receiver Transmitter Converter- Monitor Power Suppl.	Verification; T. O. 31X3-2-12-2, par. 7-19 thru fig. 10-2 Verification; T. O. 31X3-2-12-2, par. 8-8 thru fig. 8-2 Verification; T. O. 31X3-2-12-2, par. 9-6 thru fig. 9-4					
	Field-Level Fault Isolation	Receiver- Transmitter Converter- Monitor Power Supply	UNSCHEDULED UNSCHEDULED UNSCHEDULED					
	Field-Level Adjustment	Receiver- Transmitter Converter- Monitor	UNSCHEDULED UNSCHEDULED UNSCHEDULED					

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
1337 Distribution Box (LCF)	Organizational-Level Checkout	Verification: T.O. 21-SM80A-2-II, Par. 2-30 thru 2-32			3/20/63	1337-2	5/10/63	
	Organizational-Level Fault Isolation	UNSCHEDULED						
	Organizational-Level Shutdown	UNSCHEDULED						
	Inspection	UNSCHEDULED						
	Organizational-Level Checkout	UNSCHEDULED	2-22-63	EO-1337-1	2-24-63			
1338 Communication Control Console	Organizational-Level Fault Isolation	UNSCHEDULED						
	Field-Level Checkout (Arm & Status Panel)	Verification: T.O. 31X3-3-9-2-1, fig. 11-1						
	Field-Level Fault Isolation	UNSCHEDULED						
	Inspection	UNSCHEDULED	3-5-63	EO-1338-1	3-8-63			
	Organizational-Level Checkout	Verification: T.O. 21-SM80A-2-II, fig. 1-10A	1-2-63	EO-1367-1	1-2-63			
1367 Motor-Generator (LCF)	Organizational-Level Fault Isolation	UNSCHEDULED						
	Organizational-Level Servicing	UNSCHEDULED						
	Organizational-Level Alignment	Verification: T.O. 21-SM80A-2-II, par. 1-31						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT DATE
1412 Voice Reporting Signal Assembly	Organizational-Level Checkout	UNSCHEDULED						
	Organizational-Level Fault Isolation/Replacement	UNSCHEDULED						
	Field-Level End-to-End Checkout	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-2			3/20/63	1337-2		5/10/63
	Audio Reproducer A	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-3						
	Audio Reproducer B	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-4						
	Input Signal Converter No. 1	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-5						
	Input Signal Converter No. 2	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-6						
	Input Signal Converter No. 3	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-7						
	Input Signal Converter No. 4	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-8						
	Sequence Step-down Control	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-9						
	Interrogation Control	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-10						
	Audio Amplifier	Verification: T.O. 31S1-2GSW4-2, par. 7-4, 7-5, fig. 7-1, 7-11						
	Field-Level Fault Isolation	UNSCHEDULED	1-4-63	EO-1412-1	1-4-63			
	Field-Level Component Replacement	UNSCHEDULED						
	Inspection	UNSCHEDULED	1-14-63	EO-1412-2	1-22-63	1-12-63		5/29/63

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE	DATE COMPLETED	REPORT NO.	DATE
3013 Communication - Launch Control Consoles Test Set	Organizational-Level (1243) Utilization	Technical Approval Demonstration 1-20, Vandenberg AFB	1-29-63	EO-1243-1/ 3013-1	1-30-63			
		Technical Approval Demonstration 1-18, Vandenberg AFB	1-29-63	EO-1243-1/ 3013-1	1-30-63			
		Technical Approval Demonstration 1-22, Ellsworth AFB						
		UNSCHEDULED						
3092 Programmer Group Test Set	Field-Level Checkout	UNSCHEDULED						
	Field-Level Fault Isolation	UNSCHEDULED						
	Voltmeter Calibration	UNSCHEDULED						
	Organization-Level (1201) Utilization	Technical Approval Demonstration 1-15, Vandenberg AFB	11-7-62	EO-1201-1/ 3092-1	1-18-63			
		Technical Approval Demonstration 1-18, Malmstrom AFB						
		Verification; T. O. 33D9-III-3-1, par. 5-26	2-15-63	EO-3092-2	2-19-63			
	Field-Level Checkout	Unscheduled Functional Test	4-3-63	EO-3092-3	4-5-63			
	Field-Level Fault Isolation	UNSCHEDULED					4/22/63 3092-4	

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(3092)	Field-Level Adjustment	Verification; T.O. 33D9-III-3-1, par. 8-6 thru fig. 8-3						
	Clock	Verification; T.O. 33D9-III-3-1, par. 8-6 thru fig. 8-3						
	Evaluator A	Verification; T.O. 33D9-III-3-1, par. 8-6 thru 8-13						
	Evaluator B	Verification; T.O. 33D9-III-3-1, par. 8-6 thru 8-14						
	Evaluator C Phase 1	Verification; T.O. 33D9-III-3-1, par. 8-6 thru 8-15						
	Evaluator C Phase 2	Verification; T.O. 33D9-III-3-1, par. 8-6 thru 8-16						
	Evaluator D	Verification; T.O. 33D9-III-3-1, par. 8-6 thru fig. 8-3						
	Evaluator E	Verification; T.O. 33D9-III-3-1, par. 8-6 thru fig. 8-3						
	Reset and Generator	Verification; T.O. 33D9-III-3-1, par. 8-6 thru 8-19						
	Pulse Generator Reset	Verification; T.O. 33D9-III-3-1, par. 8-6 thru fig. 8-3						
	Latching Relay Bias	Verification; T.O. 33D9-III-3-1, par. 11-5						
	Voltmeter Calibration	UNSCHEDULED						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
3109 Alarm Set Test Set	Organizational - Incomplete Level Utilization (1296)	Attempted Verification; T. O. 21-SM80A-2-4	10-15-62	EO-3109-1	10-15-62			
	VRSA Input	Verification; T. O. 21-SM80A-2-4, par. 2-4A thru fig. 1-9						
	Inner Security	Verification; T. O. 21-SM80A-2-4, par. 2-4A thru fig. 1-9						
	Outer Security	Verification; T. O. 21-SM80A-2-4, par. 2-4A thru fig. 1-9						
	Field-Level Utilization (1296)	Verification; T. O. 31X3-2-12-2, par. 7-18 thru fig. 10-2						
	Field-Level Checkout	UNSCHEDULED						
	Antenna Simulator	Verification; T. O. 33D9-137-2-1, par. 5-16 thru 5-22						
	Field-Level Adjustment	Verification; T. O. 33D9-137-2-1, fig. 8-1						
	Antenna Test Set	Verification; T. O. 33D9-137-2-1, fig. 8-3						
	Inspection	UNSCHEDULED	1-17-63 2-22-63	EO-3109-2 EO-3109-3	1-17-63 3-2-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	DATE COMPLETED	REPORT NO.	DATE COMPLETED
4012 Data Analysis Central Test Set	Organizational-Level (1228, 1251) Utilization	Technical Approval Demonstration 1-20, Malmstrom AFB	11-7-62	EO-1228-1/ 1251-1/402-3	11-29-62			
	Field-Level Checkout	Technical Approval Demonstration 1-17, Vandenberg AFB Unscheduled Verification; T. O. 33D9-133-3-1, par. 4-10 thru 4-12				4/27/63	4012-3	5/22/63
	Self-Verification	Verification; T. O. 33D9-133-3-1, fig. 4-1A, 4-2A						
	Meter Relay	Verification; T. O. 33D9-133-3-1, fig. 7-1, 7-2						
	Oscillator	Verification; T. O. 33D9-133-3-1, fig. 7-1, 7-2						
	Test Signal	Verification; T. O. 33D9-133-3-1, fig. 7-1, 7-2						
	Field-Level Fault Isolation	UNSCHEDULED						
	Inspection	UNSCHEDULED	2-5-63	EO-4012-2	2-6-63			
	Field-Level Utilization	Technical Approval Demonstration 1-14, Malmstrom AFB Unscheduled Vandenberg AFB						
	(1201)	Verification; T. O. 31X2-32-3-2	3-4-63	EO-1265-1/ 4018-4/ 1251-2	3-6-63			
4018 Test Adapter Group	(1201)	Verification; T. O. 31X3-12-8-2						
	(3092)	Verification; T. O. 33D9-111-3-1, par. 5-26						
	(4252)	Verification; T. O. 31X2-62-4-1, par. 5-9						
	(1201)	Unscheduled				4/29/63	4018-5	5/15/63

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	DATE
(4018)	Field-Level Checkout	Self Test	2-25-63	EO-401A-3	2-27-63			
		Module A4						
		Module A5						
		Module A5 (Model A)						
		Generator A6						
		Converter A7						
		Simulator A8						
		MX-3618 Stimuli Eval. Circuit						
		Voltage Reg. Circuit						
		Buffer Amp. Circuit						
		Eval. & Univib. Circuit						
		False Eval. Circuit						
		Self Test Circuit						
		Response Time Evaluator						
		Ref. Voltage						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE	DATE COMPLETED	REPORT NO.	DATE
(4018)	(Field-Level Adjustment)	MX-4214 Self Test Circuit						
		Stimuli Gen. (25-33140)						
		Stimuli Gen. (25-33141)						
		PP-3377 Univibrator Circuit						
		Clock Pulse Simulator (25-33111)						
		Clock Pulse Simulator (25-33115)						
		Clock Pulse Supply (25-33112)						
		Clock Pulse Supply (25-33113)						
		Power Supply (25-33122)						
		Power Supply (25-33125)						
		Power Supply (25-33126)						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	DATE COMPLETED	REPORT NO.	DATE COMPLETED
(4018)	(Field-Level Adjustment)	PP-3378 Power Supply (25-33132)						
		Power Supply (25-33135)						
		Power Supply (25-33136)						
		PP-3376 Power Supply (25-33106)						
		Power Supply (25-33123)						
	Inspection		2-5-63 2-11-63	EO-4018-1 EO-4018-2	2-8-63 2-14-63			
4043 Passenger and Equip- ment Elevator-Workage			12-18-62 3-26-63	EO-4043-1 EO-4043-3	12-18-62 3-29-63			
	Organization-Level Utilization	Proof Loading Test Verification: T. O. 35A4-2-31-1						
	Field-Level Checkout							
	Field-Level Fault Isolation							
	Field-Level Servicing							
	Field-Level Repair		1-25-63	EO-4043-2	1-25-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
4152 Electronic Facility- Base Maintenance Test Equipment	Field-Level Utilization	Verification; T. O. 31X3-12-8-2, par. 11-17 thru 11-23	2-18-63	EO-4152-1	2-21-63			
	(1201 Drawer A6, Part No. -40)	Verification; T. O. 31X3-12-8-2, par. 11-17 thru 11-23						
	(1201 Drawer A6, Part No. -50)	Verification; T. O. 31X3-12-8-2, par. 12-15 thru 12-19						
	(1201 Drawer A7)	Verification; T. O. 31X3-3-9-2-1, par. 13-3, 13-4, fig. 13-1						
	(1243 Telephone Xmtr. Control)	Verification; T. O. 31X3-3-9-2-1, fig. 14-1						
	(1338 Arm & Status Panel)							
	(3092 Self Test Gen.)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-3						
	(3092 Clock)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-3						
	(3092 Evaluator A)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-13						
	(3092 Evaluator B)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-14						
	(3092 Evaluator C01)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-15						
	(3092 Evaluator C02)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru 8-16						
	(3092 Evaluator D)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-3						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(4152)	(Field Level Utilization)	Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-3						
		Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-19						
		Verification; T. O. 33D9-111-3-1, par. 8-6 thru fig. 8-3						
		Verification; T. O. 33D9-137-2-1, par. 5-16 thru 5-22						
		Verification; T. O. 33D9-137-2-1, fig. 8-1						
		Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 33D9-14-26-1, par. 5-10, fig. 5-1						
		Verification; T. O. 31S1-2GSW4-2						
		Verification; T. O. 33D9-5R-4-1	3-29-63					
		Verification; T. O. 35C2-2-63-1	3-12-63	EO-1289-1/ 4132-2/ 1284-1			3-14-63	
		Verification; T. O. 31X3-2-12-2, par. 7-19 thru fig. 10-2						

DEMONSTRATION	REQUIREMENTS	STATUS	SUMMARY
1	1.1	1.1.1	1.1.1.1
2	2.1	2.1.1	2.1.1.1
3	3.1	3.1.1	3.1.1.1
4	4.1	4.1.1	4.1.1.1
5	5.1	5.1.1	5.1.1.1
6	6.1	6.1.1	6.1.1.1
7	7.1	7.1.1	7.1.1.1
8	8.1	8.1.1	8.1.1.1
9	9.1	9.1.1	9.1.1.1
10	10.1	10.1.1	10.1.1.1
11	11.1	11.1.1	11.1.1.1
12	12.1	12.1.1	12.1.1.1
13	13.1	13.1.1	13.1.1.1
14	14.1	14.1.1	14.1.1.1
15	15.1	15.1.1	15.1.1.1
16	16.1	16.1.1	16.1.1.1
17	17.1	17.1.1	17.1.1.1
18	18.1	18.1.1	18.1.1.1
19	19.1	19.1.1	19.1.1.1
20	20.1	20.1.1	20.1.1.1
21	21.1	21.1.1	21.1.1.1
22	22.1	22.1.1	22.1.1.1
23	23.1	23.1.1	23.1.1.1
24	24.1	24.1.1	24.1.1.1
25	25.1	25.1.1	25.1.1.1
26	26.1	26.1.1	26.1.1.1
27	27.1	27.1.1	27.1.1.1
28	28.1	28.1.1	28.1.1.1
29	29.1	29.1.1	29.1.1.1
30	30.1	30.1.1	30.1.1.1
31	31.1	31.1.1	31.1.1.1
32	32.1	32.1.1	32.1.1.1
33	33.1	33.1.1	33.1.1.1
34	34.1	34.1.1	34.1.1.1
35	35.1	35.1.1	35.1.1.1
36	36.1	36.1.1	36.1.1.1
37	37.1	37.1.1	37.1.1.1
38	38.1	38.1.1	38.1.1.1
39	39.1	39.1.1	39.1.1.1
40	40.1	40.1.1	40.1.1.1
41	41.1	41.1.1	41.1.1.1
42	42.1	42.1.1	42.1.1.1
43	43.1	43.1.1	43.1.1.1
44	44.1	44.1.1	44.1.1.1
45	45.1	45.1.1	45.1.1.1
46	46.1	46.1.1	46.1.1.1
47	47.1	47.1.1	47.1.1.1
48	48.1	48.1.1	48.1.1.1
49	49.1	49.1.1	49.1.1.1
50	50.1	50.1.1	50.1.1.1
51	51.1	51.1.1	51.1.1.1
52	52.1	52.1.1	52.1.1.1
53	53.1	53.1.1	53.1.1.1
54	54.1	54.1.1	54.1.1.1
55	55.1	55.1.1	55.1.1.1
56	56.1	56.1.1	56.1.1.1
57	57.1	57.1.1	57.1.1.1
58	58.1	58.1.1	58.1.1.1
59	59.1	59.1.1	59.1.1.1
60	60.1	60.1.1	60.1.1.1
61	61.1	61.1.1	61.1.1.1
62	62.1	62.1.1	62.1.1.1
63	63.1	63.1.1	63.1.1.1
64	64.1	64.1.1	64.1.1.1
65	65.1	65.1.1	65.1.1.1
66	66.1	66.1.1	66.1.1.1
67	67.1	67.1.1	67.1.1.1
68	68.1	68.1.1	68.1.1.1
69	69.1	69.1.1	69.1.1.1
70	70.1	70.1.1	70.1.1.1
71	71.1	71.1.1	71.1.1.1
72	72.1	72.1.1	72.1.1.1
73	73.1	73.1.1	73.1.1.1
74	74.1	74.1.1	74.1.1.1
75	75.1	75.1.1	75.1.1.1
76	76.1	76.1.1	76.1.1.1
77	77.1	77.1.1	77.1.1.1
78	78.1	78.1.1	78.1.1.1
79	79.1	79.1.1	79.1.1.1
80	80.1	80.1.1	80.1.1.1

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS				CURRENT	
			DATE COMPLETED	REPORT NO.	REPORT DATE	DATE COMPLETED	NO.	REPORT DATE
(4152)	(Field-Level Utilization) (1296 Converter-Monitor) (1296 Power Supply) Inspection	Verification: T. O. 31X3-2-12-2, par. 8-8 thru fig. 8-2 Verification: T. O. 31X3-2-12-2, par. 9-6 thru fig. 9-4 UNSCHEДУLED						
	Field-Level Checkout Maintenance Table Elec. Dummy Loads DA-304, 305, 306 Test Set Power Supply TS-1795 Dummy Decoder Test Set TS-1796 Adapter-Conconnector MX-4283 Adapter-Conconnector MX-4284 Telephone Rptr. Test Sets TS-1819, 1821, 1822 Test Adapter MX-4453 Rev'r-Xmtr Alarm Set T. S. TS-1826 Converter-Monitor Test Set TS-1825	Verification: T. O. 33D9-6-21-1, par. 4-46, fig. 4-25 Verification: T. O. 33D9-6-21-1, par. 4-48, Fig. 9-3, 9-4, 9-5 Verification: T. O. 33D9-6-21-1, par. 4-50, fig. 4-26, 9-6 Verification: T. O. 33D9-6-21-1, par. 4-52, Fig. 9-7 Verification: T. O. 33D9-6-21-1, par. 4-54, Fig. 9-8 Verification: T. O. 33D9-6-21-1, par. 4-56, Fig. 9-9 Verification: T. O. 33D9-6-21-1, par. 4-58, Fig. 9-10, 9-11, 9-12 Verification: T. O. 33D9-6-21-1, par. 4-60, fig. 9-13 Verification: T. O. 33D9-6-21-1, par. 4-62, fig. 9-14 Verification: T. O. 33D9-6-21-1, par. 4-64, fig. 4-27, 4-28, 9-15			5/3/63	4152-3	5/23/63	

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(4152)	(Field-Level Checkout)	Power Supply Test Set TS-1820	3-26-63					
		Test Set Voltage Regulator TS-1794						
		Comm. Test Set Tester TS-1789						
		VRSA Test Set Tester TS-1823						
		VRSA Test Set Adapters MK-685						
		Elec. Dummy Load DA-312						
		Connector-Adap- ters MX-4650, 4651, 4652						
		Asimuth Drive Controller Test Set TS-1849						
		Test Adapter MX-4451						
		Power Supply Test Set TS-1861						
		Power Supply Test Set TS-1860						
		Power Supply Test Set TS-1862						
		Elec. Dummy Load DA-321						
		Verification: T. O. 33D9-6-21-1, par. 4-66, fig. 9-16						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT DATE
(4152)	(Field-Level Checkout)	Verification: T.O. 33D9-6-21-1, par. 4-102, fig. 9-36						
		Verification: T.O. 33D9-6-21-1, par. 4-104, fig. 9-37						
		Verification: T.O. 33D9-6-21-1, par. 4-106, fig. 4-36, 9-38						
		Verification: T.O. 33D9-6-21-1, par. 4-108, fig. 9-39	3-26-63					
		Verification: T.O. 33D9-6-21-1, par. 4-110, fig. 9-40						
		Verification: T.O. 33D9-6-21-1, par. 4-112, fig. 9-41						
		Verification: T.O. 33D9-6-21-1, par. 4-114, fig. 9-42						
		Verification: T.O. 33D9-6-21-1, par. 4-114, fig. 9-43						
		Verification: T.O. 33D9-6-21-1, par. 4-114, fig. 9-44						
		Verification: T.O. 33D9-6-21-1, par. 4-116, fig. 4-37, 9-45						
		Verification: T.O. 33D9-6-21-1, par. 4-118, fig. 4-38, 9-46						
		Verification: T.O. 33D9-6-21-1, par. 4-120, fig. 4-39, 4-40, 9-47						
		Verification: T.O. 33D9-6-21-1, par. 4-122, fig. 4-41, 9-48						
		Verification: T.O. 33D9-6-21-1, par. 4-124, fig. 4-42, 9-49						
		Verification: T.O. 33D9-6-21-1, par. 4-126, fig. 4-43, 9-50	3-26-63					

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT DATE
(4152)	(Field-Level Checkout)	Adapter Test Set TS-1841						
		Simulator Test Set TS-1879						
		Cooler Test Set TS-1880						
		Alarm Set T. S. Tester TS-1878						
	Field-Level Adjustment	Cooling Air Fixture Rotation						
4252 Code Inserter-Verifier Set		Converter-Moni- tor Test Set						
		Launch Simu- lator Test Set						
	Field-Level Utilization							
	Field-Level Checkout	V. U. Readers & Function Sel. Assy						
		Power Supply Control						
		Code Indicator						
		Coder Unit Code Pack						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(4252)	(Field-Level Checkout)	Launch Control Coder Unit						
		Regulated Power Supply						
		Unregulated Power Supply						
		Verifier Unit Indicator Assy.						
		Command Signals Decoder Ver. Unit						
		Launch Control Panel Ver. Unit						
		End-to-End						
		Field-Level Fault Isolation						
		V. U. Readers & Function Sel. Assy.						
		Power Supply Control						
		Code Indicator						
		Coder Unit Code Pack						
		Launch Control Coder Unit						
		Regulated Power Supply						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS		CURRENT			
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE	REPORT
(4252)	(Field-Level Fault Isolation) Unregulated Power Supply Verifier Unit Indicator Assy. Command Signals Decoder Ver. Unit Launch Control Panel Ver. Unit	UNSCHEDULED						
		UNSCHEDULED						
		UNSCHEDULED						
		UNSCHEDULED						
	Field-Level Adjustment Power Supply Control Code Indicator Reg. Power Supply Verifier Unit Indicator CSD Verifier Unit Coder Unit Brushes	Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 31X2-62-4-1						
		Verification; T. O. 31X2-62-4-1						
	Inspection	UNSCHEDULED	11-7-62	EO-4252-1	11-7-62			
		UNSCHEDULED						
4487 Command Signals Decoder Simulator	Organizational- Partial Level Utilization	Verification; T. O. 21-SM80A-2-3, par. 2-67C thru 2-67F						
	Complete	UNSCHEDULED	3-28-63	EO-1201-2/ 4487-1	4-3-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
4489 Message Generator	Organizational- Partial Level Utilization Complete	Verification: T. O. 21-SM80A-2-3, par. 2-67C thru 2-67F UNSCHEDULED						
	Field-Level Checkout	Verification: T. O. 33D9-58-4-1 UNSCHEDULED	3-29-63					
	Field-Level Fault Isolation	UNSCHEDULED						
	Inspection	UNSCHEDULED	3-1-63	EO-4489-1	3-4-63			5/2/63
4490 Missile and Launch Electrical Functions Simulator Set	Organizational- Partial Level Utilization Complete	Verification: T. O. 21-SM80A-2-3, par. 2-67C thru 2-67F UNSCHEDULED						
	Field-Level Checkout	Verification: T. O. 33D9-14-26-1, par. 5-10, fig. 5-1 Verification: T. O. 33D9-14-26-1, par. 5-12 UNSCHEDULED	2-11-63 2-22-63	EO-4490-1 EO-4490-2	2-11-63 2-25-63	4/29/63	4450-3	5/28/63
	Field-Level Fault Isolation	UNSCHEDULED						
	Inspection	UNSCHEDULED						

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.	DATE COMPLETED	REPORT NO.
4491 Launch Facility Start-Up Unit	Organizational- Partial Level Utilization	Verification; T. O. 21-SM80A-2-3, par. 2-67C thru 2-67F	1-25-63	EO-4491-1	2-6-63			
	Complete	Verification; T. O. 21-SM80A-2-3, par. 2-66 thru fig. 2-37						
	Field-Level Checkout	UNSCHEDULED						
	Field - Level Fault Isolation	UNSCHEDULED						
	Field-Level Adjustment	UNSCHEDULED						
	Cyrol Start Assy. Power Supply Assy.	UNSCHEDULED						
	Inspection	UNSCHEDULED	2-15-63 2-27-63	EO-4491-2 EO-4491-3	2-18-63 2-27-63			

DEMONSTRATION REQUIREMENTS STATUS SUMMARY

FIGURE A EQUIPMENT ITEM	MAINTENANCE OPERATION	DEMONSTRATION EVENT	COMPLETION RECORD					
			PREVIOUS			CURRENT		
			DATE COMPLETED	REPORT NO.	DATE	DATE COMPLETED	REPORT NO.	DATE
1209 Water Control System, LF and Miscellaneous Systems, LF	Inspection	Unscheduled, Ellsworth AFB				5/7/63	1209-1	5/23/63
1323 LCF Power Distribution System	Inspection	Unscheduled, Ellsworth AFB				4/26/63	1323-1	5/26/63
1329 LF Power Generation and Distribution System	Inspection	Unscheduled, Ellsworth AFB				5/1/63	1329-1	5/22/63
4388 Telephone Test Set T AN/GTM-3	Organizational Level Checkout/ SIN	Technical Acceptance Demonstration I-24, Ellsworth AFB				4/30/63	4388-1	5/23/63
4523 Power Supply PP-3267/GSM	Field Level Fault Isolation	Unscheduled, Ellsworth AFB				5/8/63	4523-1	5/23/63

7.0 REPORTS

On the following pages, copies of the various Maintainability reports are reproduced as follows:

**Maintainability Action Requests (MAR's),
Pages 71 thru 81**

**Maintainability Review Reports (MRR's),
Pages 82 thru 148**

**Evaluation/Observation Reports (E/O),
Pages 149 thru 357.**

MAINTAINABILITY ACTION REQUEST			
WS-133 WEAPON SYSTEM			
The Boeing Company Aero-Space Division Seattle Washington MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	<table style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> ROUTING ACTION: <u>F. L. Strum</u> ORGAN. <u>2-6522</u> M.S. <u>52-26</u> CC: <u>K. Niebauer</u> 52-26 <u>J. E. Ercolini</u> 52-26 <u>D. A. Cole</u> 43-86 <u>J. M. Barker</u> 50-66 <u>E. S. Whitney</u> 50-66 </td> <td style="width: 50%; vertical-align: top;"> PAGE: <u>1</u> M A R No. <u>1-1283-A1 Rev. 1</u> DATE: <u>March 20, 1963</u> DATE REPLY DUE: <u>April 25, 1963</u> </td> </tr> </table>	ROUTING ACTION: <u>F. L. Strum</u> ORGAN. <u>2-6522</u> M.S. <u>52-26</u> CC: <u>K. Niebauer</u> 52-26 <u>J. E. Ercolini</u> 52-26 <u>D. A. Cole</u> 43-86 <u>J. M. Barker</u> 50-66 <u>E. S. Whitney</u> 50-66	PAGE: <u>1</u> M A R No. <u>1-1283-A1 Rev. 1</u> DATE: <u>March 20, 1963</u> DATE REPLY DUE: <u>April 25, 1963</u>
ROUTING ACTION: <u>F. L. Strum</u> ORGAN. <u>2-6522</u> M.S. <u>52-26</u> CC: <u>K. Niebauer</u> 52-26 <u>J. E. Ercolini</u> 52-26 <u>D. A. Cole</u> 43-86 <u>J. M. Barker</u> 50-66 <u>E. S. Whitney</u> 50-66	PAGE: <u>1</u> M A R No. <u>1-1283-A1 Rev. 1</u> DATE: <u>March 20, 1963</u> DATE REPLY DUE: <u>April 25, 1963</u>		
FIGURE A NO. <u>1283</u> SYSTEM <u>LF Electrical Power</u> SUBSYSTEM <u>Motor-Generator Set</u>			
Statement of Problem: The Launch Facility Motor-Generator Set, Figure A 1283, does not have a disconnect device for input power to the DC drive motor. DC power to the Motor-Generator Set is applied and removed by making or breaking the energized contacts of recepticle J2 and plug P2. Contact failures will result unless the application and removal of DC power is made in a specified sequence. Improper connection or removal of the DC input will result in failure of the plug and the Motor-Generator's DC recepticle. Ten failures at MAFB, seven at VAFB, two at CAFB, and three at STP III have resulted from improper application and removal of DC power to the Motor-Generator. Emphasis on the correct procedure has reduced A & CO failures, however an instruction placard to ensure that SAC maintenance teams and Boeing A & CO personnel at upstream Minuteman bases use the correct procedure is needed on the Motor-Generator control panel. <u>Recommendation:</u> Provide a permanent "WARNING" placard on the control assembly of the Motor-Generator. Instructions on the placard would refer the maintenance technician to T.O. 21-SM80A-2-11 for the correct startup and shutdown procedures. The same placard can be placed on the LCC Motor-Generator Set. Advantages of the placard proposed are simplicity and no need to update due to equipment changes. ATTACHMENTS: Cost Effectiveness Summary M Cost Study References Recommended Placard			
Minuteman Finance J. Niederkrome	Minuteman System Analysis R. B. Grobe		
M Engineer: <u>A. Henschel</u> A. Henschel	Approved by: <u>D. Heck</u> D. Heck	Approved by:	

COST EFFECTIVENESS SUMMARY

WEAPON SYSTEM ELEMENTS

☐ Missile
☐ Launch Control Facility
☒ Launch Facility
☒ OGE
☐ MOE
☐ RPIK

CHANGE TASKS AND FUNCTIONS

☒ ECP Processing (or PRR)
☐ Research and development
☒ Retrofit and TCTO
☐ Special change-retrofit equipment
☐ Publications and drawings
☒ Figure A, forms B, C, C-1 changes
☐ Manufacturing changes
☐ Hardware changes
☐ Mandatory, "make-work" changes
☒ Customer directed
☒ Boeing initiated

LOGISTIC SUPPORT

☐ Maintenance loading & time lines
☐ Manhours and personnel requirements
☐ Crew-vehicle hours and trips
☐ "On-site" vs SMSB vs Depot repair
☐ Spares
☐ Test and maintenance equipment
☐ Training
☐ Transportation
☐ Supply functions

OPERATIONAL FACTORS

☒ Downtime or availability
☐ Reliability
☐ Standardization & interchangeability
☐ Compatibility (PAS, 465L, radio nets, power, CFE, test equipment, etc.)
☐ Interfaces and secondary faults
☐ Schedule impact
☒ Safety and hazards
☒ Human factors (MIL-STD-803)

NOTE: This is a preliminary cost study to ascertain if the M proposal will result in a savings to the customer. Values used are gross figures and do not constitute official Boeing cost estimates. Their use is limited to planning purposes and trade studies for this M proposal.

Cost of Maintenance

\$56,196/year

\$561,960/ 10 years

Cost of Placards

\$40,000 initial cost

\$40,000 total cost

Savings

\$16,196/1st year

\$521,960 total savings

See accompanying M Cost Study for calculation of above figures.

Recommended Placard

WARNING

Current dangerous to human life and equipment will exist if proper startup and shutdown procedures are not used for this Motor-Generator. Refer to T.O. 21-SM80A-2-11 for the correct procedures.

M COST STUDY

Given Information and Assumptions

- 1.) Cost of crew-vehicle hour = \$68/hour
- 2.) Cost of missile downtime/hour = \$90/hour
- 3.) Cost of W715 connector = \$150
- 4.) 15 hours to correct a DC input connector failure.
- 5.) Motor-Generator Sets will be recycled for overhaul every three years.
- 6.) New SAC maintenance personnel will constantly cycle into the Weapon System due to Air Force personnel leaving the service.
- 7.) Failures can be reduced by 95% if the correct motor-generator start-up and shutdown procedures are used. (Assumption based on MAFB A&CO experience)
- 8.) Cost Study will be based on projected failures which are based upon the failure rate that has occurred.
- 9.) This study is based on an assumed 10-year period.

Cost Calculation

A. Cost of Maintenance to customer over a 10-year period.

- 1.) Failures due to procedure short cuts and correct procedure not being followed.

10 per AFB during A & CO (Assumed - MAFB & VAFB failures as a basis)
39 per AFB per 10 years (see attached graph) - Assumed failures

total failures (5 AF Bases)

A & CO 10 x 4 (Malmstrom won't be counted, failures have already occurred) = 40 A & CO failures.

Failure during
SAC Maintenance 39 x 5 = 195 SAC failures
Total = 235

95% can be prevented by the instruction placard .95 (235) = 223
preventable failures

- 2.) Cost of each failure:

15 hours/failure x \$68/crew-vehicle hr. = \$1020/failure (manhours)

2. (Continued)

15 hours/failure x \$90/missile hour = \$1350/failure (missile downtime)

1 connector/failure = \$150

Total \$2520/failure

3. Cost of failures (10 year period)

223 failures x \$2520/failure = \$561,960

B. Cost of placards for M-G sets

800 placards are needed

Assume a nominal cost of

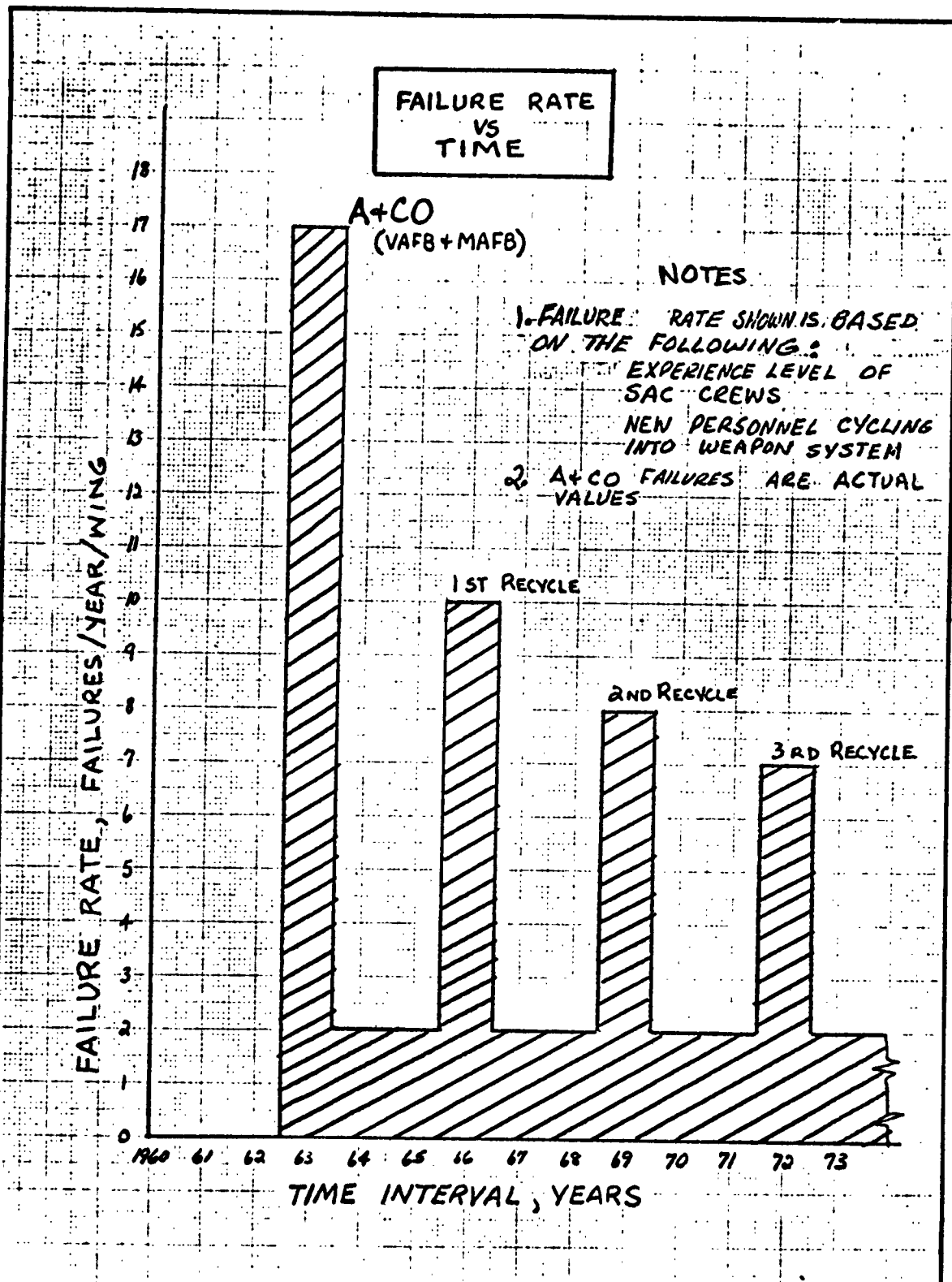
\$50/LF to properly placard

Cost = \$40,000

C. Weapons System savings - maintenance only

Cost of failures - cost of fix = savings

\$561,960 - \$40,000 = \$521,960



CALC			REVISED	DATE	PROJECTED FAILURE RATE LF MOTOR-GENERATOR D-C INPUT CABLE - MALMSTOM	
CHECK						
APR						
APR						
By:	Henschel	3-21-3			THE BOEING COMPANY	PAGE

References

- 1.) FSR MAFB 341 SMW-46F, Failure of M. G. Set, Figure A 1283, Voltage Regulator and D. C. Input Connector, October 9, 1962.
- 2.) FSTR VAFB-394MS-56F, Cable Failure, MG Set in LF #4, October 15, 1962.
- 3.) FSTR 2-5243-851, Interim Fix on T-11 until ECP 472 Incorporation, December 3, 1962.
- 4.) UR CSD #18-63-65, Voltage Regulator Failure Figure A 1283, January 22, 1963.
- 5.) Memo 2-5263-1-1006, Cable Failure MG set, Figure A 1283, September 25, 1962.
- 6.) FSR MAFB 341 SMW-96F, Repairing DC Input Cable (W715) and Connectors on the Motor Generator Set at the Launch Facility, November 19, 1962.
- 7.) MAR 1-1283-A1, DC Drive Motor Disconnect, October 30, 1962.
- 8.) Letter 2-6522-24-456, Figure A 1283 Motor-Generator DC Input Power Connector Failures.
- 9.) Memo 2-6522-14-27, New DC Input Connector for Figure A 1283 Launch Facility Motor-Generator Set, October 30, 1962.
- 10.) FR 063548, DC Input Recepticle Burnt, MAFB F-07, December 31, 1962.
- 11.) FR 023652, DC Input Plug damaged by DC arc, MAFB F-08, December 20, 1962.
- 12.) FR 038279, DC Input Plug Badly Burnt, MAFB F02, December 18, 1962.
- 13.) FR 020215, DC Input Plug Burnt, MAFB C-08, November 27, 1962.
- 14.) UE-R 111634, Pin # 2 of Plug P-2 is badly burnt, MAFB, November 21, 1962.
- 15.) FR 038214, Voltage Regulator Failure, MAFB B-06, November 20, 1962.
- 16.) FR 057656, Pins on DC Input Damaged, MAFB A-07, October 2, 1962.
- 17.) FR 056883, Burnt DC Input pins, MAFB A-10, September 28, 1962.
- 18.) FR 056957, Plug P02 Burnt, MAFB A-02, September 21, 1962.
- 19.) FR 037210, Plug P02 Motor-Generator Set damaged, MAFB A-11, September 8, 1962.
- 20.) FR 040053, Plug P02 of cable W715 damaged, CAFB T-11, August 10, 1962.

- () 21.) FR 038817, Plug P02 to Motor-Generator Set is burnt , CAFB T-11, October 17, 1962.
- 22.) FR 056897, DC Input recepticle pins are burnt, MAFB A-09, July 27, 1962.
- 23.) FR 056899, DC Input Plug of cable W715 is damaged, MAFB A-09, July 27, 1962.
- 24.) FR 065833, DC Input recepticle pins are burnt, VAFB LF-5, October 17, 1962.
- 25.) FR 065818, DC Input recepticle on Motor-Generator are burnt, VAFB LF-2, October 17, 1962.
- 26.) FR 030436, DC Input connector pins are burnt, VAFB LF-4, Oct. 1, 1962.
- 27.) FR 030415, DC Input Connector pins burnt, VAFB LF-4, August 6, 1962.
- 28.) FR 052091, DC Input Connector pins melted, VAFB LF-2, August 3, 1962.
- 29.) FR 046213, DC Input recepticle of Motor-Generator damaged by arc, VAFB LF-4, June 12, 1962.
- () 30.) FR 021800, DC Input recepticle burnt, STP III, January 4, 1962.
- 31.) STAR STP-174-T-M, Connection of cable W715 to LF Motor-Generator, April 23, 1962.
- 32.) STAR STP-198-T-M, Connection of cable W715 to LF Motor-Generator, May 10, 1962.
- 33.) BIAR MAFB-100-T Interim Reply, 21-51001 Cable Failures Figure A 1248, Summary and Problem Analysis, February 22, 1963.
- 34.) Excerpts from Synopsis of Electrical/Electronic Problems on Operational Ground Equipment Encountered at VAFB for Period August 1 through October 1, 1962.
- 35.) Memo 2-6545-03-810, Trip Report to Malmstrom AFB, October 2-5, 1962, J. L. Apperson from H. A. Bowman, October 8, 1962.
- 36.) Coordination Sheet ELU/S-1036, Malmstrom AFB LF Motor-Generator Problem, P. T. Wendel from H.A.Bowman, September 13, 1962.
- 37.) D2-7818 Volume 5, Acceptance Functional Test Procedure, Power Supply Group OA-3386/GSW-4, revised February 21, 1963.
- 38.) T.O. 21-SM80A-2-11, revised March 8, 1963.

MAINTAINABILITY ACTION REQUEST					
WS-133 WEAPON SYSTEM					
The Boeing Company Aero-Space Division Seattle Washington MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	<table style="width: 100%;"> <tr> <td style="width: 35%;">ROUTING</td> <td style="width: 65%;"> PAGE: 1 of 2 MAR No. 2-7724-A1 DATE: 22 January 1963 DATE REPLY DUE: 5 February 1963 </td> </tr> <tr> <td> ACTION: <u>Kazuo Kobayaski</u> ORGAN. <u>2-6433</u> M.S. <u>42-93</u> CC: <u>Dan Ranney 14-01</u> <u>D. A. Cole 43-86</u> <u>Dan Supplee 34-03</u> </td> <td></td> </tr> </table>	ROUTING	PAGE: 1 of 2 MAR No. 2-7724-A1 DATE: 22 January 1963 DATE REPLY DUE: 5 February 1963	ACTION: <u>Kazuo Kobayaski</u> ORGAN. <u>2-6433</u> M.S. <u>42-93</u> CC: <u>Dan Ranney 14-01</u> <u>D. A. Cole 43-86</u> <u>Dan Supplee 34-03</u>	
ROUTING	PAGE: 1 of 2 MAR No. 2-7724-A1 DATE: 22 January 1963 DATE REPLY DUE: 5 February 1963				
ACTION: <u>Kazuo Kobayaski</u> ORGAN. <u>2-6433</u> M.S. <u>42-93</u> CC: <u>Dan Ranney 14-01</u> <u>D. A. Cole 43-86</u> <u>Dan Supplee 34-03</u>					
FIGURE A NO. <u>7724</u> SYSTEM <u>Nozzle Control Unit</u> SUBSYSTEM <u>BGS-116 Test Set</u>					
Statement of Problem: Failure of the connector/cable on the NCU Zero Alignment Test Set, which is returned to Boeing Seattle for repair, is affecting Plant 77 capability for maintenance of the NCU. Factors of Problem: 1. The connector which mates with the NCU is "molded" to the cable which connects the NCU to the test set and proper facilities to do this molding are not available at Plant 77. 2. Spares Provisioning, organization 2-5274, can not authorize an entire figure A as a spare. 3. The cable is not provided as a spare; Drawing # 25-26801 calls out separate components to make up this cable. 4. Six of these figure A items have been sent from Plant 77 to Boeing for repair. One unit has been returned to Plant 77 after 75 days turn-around time and the others are still at Boeing after 25 days. 5. The test sets have a high usage factor. BIAR-Plant 77-130T, December 12, 1962, states "connectors become damaged thru constant normal usage." Discussion: The connector mates with a connector on the NCU and, if a damaged test set connector is used, resultant damage to the NCU connector requires that the NCU be returned to Autonetics for repair. Plant 77 has been unable to mold					
Minuteman Finance J. Niederkrome <i>[Signature]</i>	Minuteman System Analysis R. B. Grobe <i>[Signature]</i>				
M Engineer: <i>Carl Hardy</i> E. Hardy	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	Approved by:			

(Discussion(Continued)

or pot the connector to the cable. This molding is required because test set is used in a hazardous area.

The current high failure rate for this test set plus the lengthy turn-around time requires that a change be made in the present repair concept or that the quantity authorized at Plant 77 be increased for this figure A.

NOTE: Since the cost of this figure A is only \$790, increased authorization for this item at Plant 77 can be provided at a relative low cost; therefore a cost study will not be made. The problem here is not costs but that a maintenance bottleneck is to be prevented.

Recommendation:

Redesign of the connector/cable to make it replaceable at Plant 77.

Note:

This is a preliminary cost study to ascertain if the M proposal will result in a savings to the customer. Values used are gross figures and do not constitute official Boeing cost estimates. Their use is limited to planning purposes and trade studies for this M proposal.

M	MAINTAINABILITY ACTION REQUEST WS-133 WEAPON SYSTEM	M
The Boeing Company Aero-Space Division Seattle Washington MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	ROUTING ACTION: <u>F. L. Strum</u> ORGAN. <u>H&D Power Unit</u> M.S. <u>52-26</u> CC: <u>K. Niebauer</u> 52-26 <u>P. Koenig</u> 52-91 <u>J. M. Barker</u> 50-66 <u>D. A. Cole</u> 43-86	PAGE: <u>1 of 2</u> M A R No. <u>3-1282-A1</u> , Revision <u>1</u> DATE: <u>February 14, 1963</u> (December 5, 1962) DATE REPLY DUE: _____
FIGURE A NO. <u>1282</u> SYSTEM <u>Electrical</u> SUBSYSTEM <u>Storage Battery</u>		
Statement of Problem: Difficulty is being experienced in installing Launch Facility battery shock mounts at operational sites. References: (a) Parson Drawing SK-161 (b) FSR No MAFB 341 SMW-53F (c) BSD Drawing SK-162 Field Service Report received from Malmstrom Air Force Base (reference b) reports considerable difficulty in installing Launcher battery shock mounts. This same difficulty can be expected whenever batteries must be moved or replaced during the life of the weapon system. Investigation and review of an alternate mount such as that represented by BSD drawing SK-162 (reference c) indicates elimination of the installation and maintenance problem. Cost studies show that due to simplicity of design, an overall savings of approximately \$655,220 can be realized. This savings is based upon effectivity at Wing III. As the savings is approximately \$625 per Launch Facility, it is recommended that this change be effected as soon as possible. Recommend ECP be processed to change shock mounts to ones similar to BSD drawing SK-162 (reference c).		
Minuteman Finance J. Niederkrome <i>J. Niederkrome</i>		Minuteman System Analysis R. B. Grobe <i>R. B. Grobe</i>
M Engineers R. L. Stearns <i>R. L. Stearns</i>	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	Approved by: _____

WEAPON SYSTEM ELEMENTS

☐ Missile
☐ Launch Control Facility
☐ Launch Facility
☐ OGE
☐ MGE
☐ RPIE

CHANGE TASKS AND FUNCTIONS

☒ ECP Processing (or PRR)
☒ Research and development
☐ Retrofit and TCTO
☐ Special change-retrofit equipment
☒ Publications and drawings
☒ Figure A, forms B, C, C-1 changes
☐ Manufacturing changes
☐ Hardware changes
☐ Mandatory, "make-work" changes
☐ Customer directed
☐ Boeing initiated

LOGISTIC SUPPORT

☒ Maintenance loading & time lines
☒ Manhours and personnel requirements
☐ Crew-vehicle hours and trips
☐ "On-site" vs SMSB vs Depot repair
☐ Spares
☐ Test and maintenance equipment
☐ Training
☐ Transportation
☐ Supply functions

OPERATIONAL FACTORS

☐ Downtime or availability
☐ Reliability
☐ Standardization & interchangeability
☐ Compatibility (PAS, 465L, radio nets, power, GFE, test equipment, etc.)
☐ Interfaces and secondary faults
☐ Schedule impact
☐ Safety and hazards
☐ Human factors (MIL-STD-803)

COST SUMMARY

	Cost	Savings
R&D	\$50,000	
Publications & Drawings	5,000	
Form C	2,000	
Cost of modifying batteries \$17.00/unit 12 units/LF, 150 LF/wing & 7 wings (Wings III through IX)		
Total cost of battery change \$17X12X150X7	214,200	
Old shock mount \$1800 for material/unit 240 manhours for manufacture.		
New shock mount \$1800 for material/unit 184 manhours (56 less manhours) \$10.00/hr. 150 LF/wing & 7 wings		
56X \$10X13X150X7 = Manufacturing savings		\$588,000
Savings of 2 manhours per unit on installation at \$12.40/hr.		
\$12,40X2X13X150X7 =		338,420
Totals	\$271,200	\$926,420
Net Savings		\$655,220

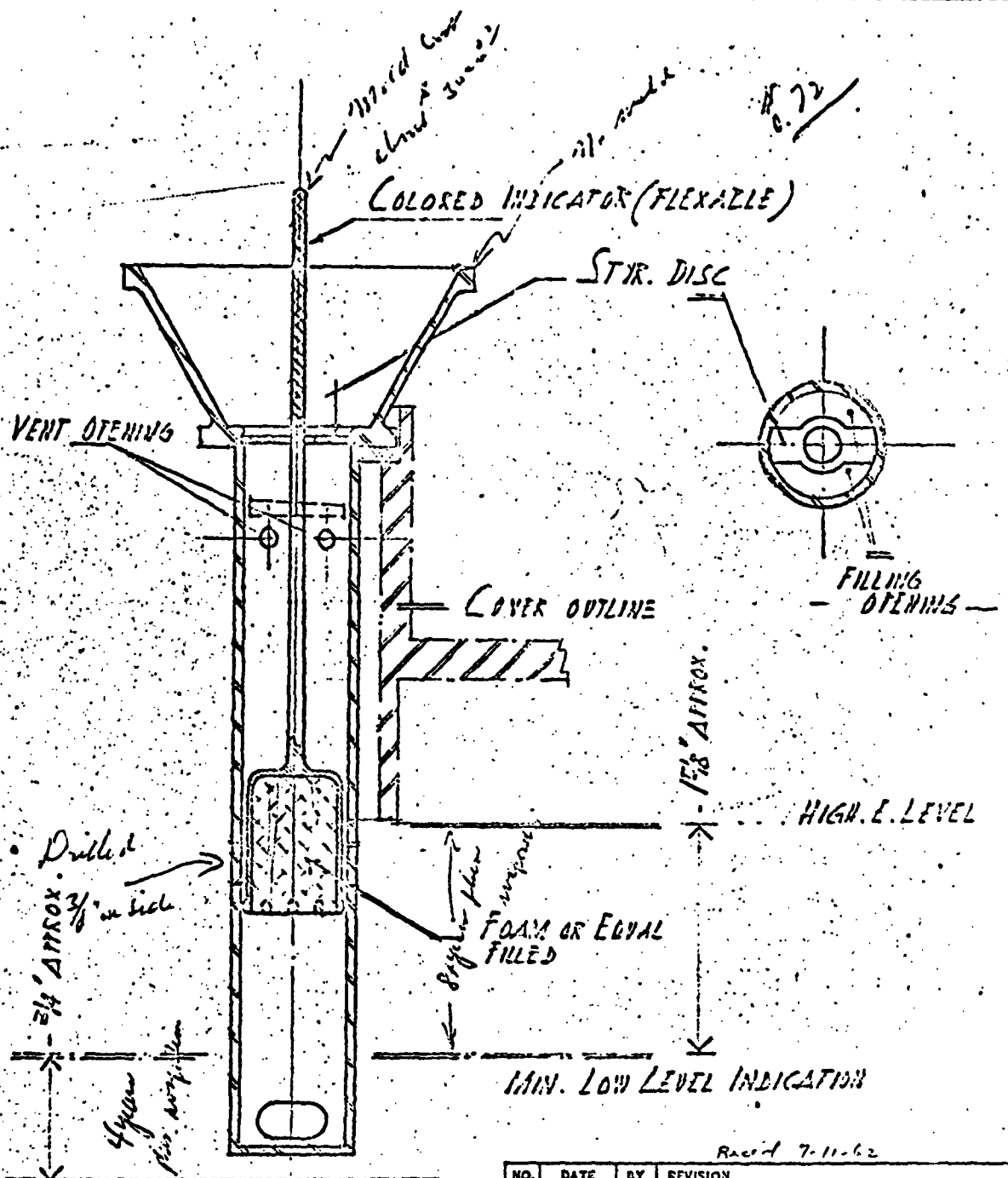
Note:

This is a preliminary cost study to ascertain if the M proposal will result in a savings to the customer. Values used are gross figures and do not constitute official Boeing Cost estimates. Their use is limited to planning purposes and trade studies for this M proposal.

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 1</u> M R R No. <u>1-1367</u> DATE: <u>December 26, 1962</u>
FIGURE 'A' NO. 1367 TITLE Motor-Generator, PU-521 (LCF)		
1. The generator control panel is mounted on the side of the M-G set. This requires that the entire M-G set be removed, by hoist, from the LCF floor well to accomplish any repair or maintenance on components of the control panel. <u>Recommendation:</u> By reducing the height of the M-G set mounting rails from 8 inches to 5 or 6 inches, the control panel can be mounted on top of the M-G set and thus be accessible without removing the M-G set from the floor well. The control panel, as presently dimensioned, can be mounted atop the M-G set and still provide access to the brush cover-plates. 2. Six large can-type condensers are mounted by hold-down straps which terminate in a bolt extending through a hole in the control panel back. There is inadequate space between the M-G set and the control panel for removal of the nuts which fasten the hold down straps. <u>Recommendation:</u> Approximately 15 other condensers on this control panel are mounted by hold down straps which are secured by screws that are accessible from the front of the control panel. This should be the standard strap and the bolt-type straps should be replaced by the screw-type straps.		
M Engineer: E. Hardy <i>Carl Hardy</i>	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	Approved by:

2-5260-0-15C

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: 1 of 2 M R R No. 2-1282 DATE: December 26, 1962
FIGURE 'A' NO. 1282/1288 TITLE Battery, Storage (LF & LCF)		
The storage batteries have no provision for checking the level of the electrolyte, as called for in the form C. Discussion: a) The form C maintenance analysis of these figures A calls for a fluid level indicator; b) Field Service Report # MAFB-341SMQ-127F, dated 10 December, 1962, states that batteries at various sites have been found with a low electrolyte level which required refilling. It appears that the batteries will require frequent checking, at least during stabilization of a new LF; c) The Vendor for the batteries has designed a fluid level indicator for these batteries, see attached C & D Batteries drawing # J-8669; d) The total cost for the fluid level indicators, including amortization of the cost of the manufacturing molds, is estimated at 72 cents each; e) As designed, the fluid level indicator will also serve as a funnel for adding water to the batteries. This will reduce the time required to check and/or add to battery fluid and also reduce the likelihood of spilled fluid or battery acid overflow; Recommendation: Recommend that all storage batteries be provided with fluid-level indicators.		
M Engineer: E. Hardy <i>Earl Hardy</i>	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:



BOTTOM OF STRAP

NO.	DATE	BY	REVISION
C & D BATTERIES of Construction, Pa., Africa, Ind. DIV. THE ELECTRIC AUTOLITE CO.			
FILLING FUNNEL & LEVEL INDICATOR FOR HXC - 211			
DRAWN	F. H. H. H.		APPROVED
CHECKED	C. H. H. H.		DRAWING NO.
DATE	7-7-62		J- 8667
SCALE	1" = 1"		

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 1</u> MRR No. <u>3-1243</u> DATE: <u>December 26, 1962</u>
FIGURE 'A' NO. 1243/1338 TITLE Consoles, Launch Control, & Communications		
During the Maintainability Meeting held at TBC, 9 January, 1962, both consoles, Figures A 1243 and 1338, were partially reviewed for <u>M</u> and soldering. Pages 5, 6, 7, and 11 of attachment C to the minutes of this meeting, reference # 2-6331-0-346, lists <u>M</u> discrepancies for the panels which were reviewed. To complete the <u>M</u> review of the consoles, the Control, Telephone and Transmitter, has been reviewed and the following discrepancies are reported: 1) Component cards are soldered to the wiring harness, i. e., cards are NOT replaceable without soldering; 2) All components of this drawer are soldered in place (excepting 7 plug/connectors at rear of drawer). <u>Recommendation</u> On component cards and high failure-rate components (greater than 0.5 failures/wing/month), provide mechanical connectors and/or "pigtails" for replacement of components at the SMSB without soldering.		
<u>M</u> Engineer: <i>Earl Hardy</i> Earl Hardy	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 1</u> M R R No. <u>4-1369</u> DATE: <u>December 26, 1962</u>	
FIGURE 'A' NO. 1369		TITLE Antenna Set	
This item was not reviewed for M, due to Figure A being cancelled; reference D2-9455, Vol. I, Page I-A73, revision dated October 31, 1962.			
M Engineer: E. Hardy <i>Carl Hardy</i>	Approved by: <i>J. S. McEachern</i> J. S. McEachern		Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 1</u> M R R No. <u>5-4488</u> DATE: <u>December 26, 1962</u>	
FIGURE 'A' NO. 4488		TITLE Decoder Kit	
This item was not reviewed for <u>M</u> due to cancellation of this Figure A; reference D2-9455, Vol. I, page I-A179, revision dated October 22, 1962.			
M. Engineer: <i>Earl Hardy</i> Earl Hardy	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:	

2-5260-0-15C

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 1</u> M R R No. <u>6-1283</u> DATE: <u>December 26, 1962</u>
FIGURE 'A' NO. <u>1283</u> TITLE <u>Motor - Generator, PU-515</u>		
1. Three relays have soldered connections. <u>Discussion</u> This <u>M</u> discrepancy was listed in the Minutes of the Maintainability Review Meeting held at TBC, 9 January, 1962. ECP #381 was initiated to provide plug-in relays. ECP #381 was cancelled by BSD, reference message # BSQC/Col. Cool/8353, dated 13 December, 1962. <u>Recommendation</u> BSD Reconsider		
M Engineer <i>Earl Hardy</i> Earl Hardy	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 6</u> MRR No. <u>7-4252</u> DATE: <u>December 26, 1962</u>
FIGURE 'A' NO. 4252 TITLE Code Inserter-Verifier Set		
The C. I. V. set, Figure A 4252, was reviewed for <u>M</u>and soldering, on 7 November 1962. 1. The C. I. V. set has in excess of 5000 soldered connections. 2. <u>Discussion</u> Elimination of soldering on the C. I. V. set would require a complete re-design effort. Since this set is not "in-line" launch equipment, such expensive redesign is not believed to be justifiable. 3. <u>Recommendation</u> Eliminate soldering and provide plug-in connections where possible, as a product improvement. 4. The attached coordination sheet was submitted to the equipment manager.		
M Engineer: <i>Earl Hardy</i> Earl Hardy	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:

COORDINATION SHEET

TO

J. D. Rough, MGE Design Unit, 2-6527 52-27

NO. SES/M-62-239

ITEM NO.

GROUP INDEX

Minuteman Maintainability Group

DATE November 19, 1962

SUBJECT

Maintainability Report, Figure A 4252,
CIV Set AN/GSQ-65

MODEL WS-133A

On 7 November 1962, Figure A 4252, CIV set, was reviewed for Maintainability (M) and soldering. The following soldering and M problem areas were observed. (The immediate action M problem areas are covered in part I of this report and the product improvement areas are covered in part II).

I. M problem areas requiring immediate "make-work" action.

1. Covers (access) to blowers, on top of both racks, are installed with Phillips-head screws. The bottom row of screws has approximately 2 inches of clearance over the screw heads, i.e., requires a screwdriver of less than 2 inches length or even shorter to allow space for a mechanics hand.

Recommendation: Replace the Phillips-head screws with hex-head screws.

Note: slotted hex-head screws (bolts) are preferred whenever possible because they do not "chew-up" as easily as Phillips -head or standard slotted screws and because they can be removed by a screwdriver, nutdriver ("spintite") socket wrench, box wrench, end wrench, or speed wrench.

2. Indicator, Code, ID-1043.

- a) This drawer has 2 labels, A-10 and A-11, showing the location for printed circuit cards which do not exist.

Recommendation: Remove labels "A-10" and "A-11".

- b) 8 printed circuit cards are identified only by drawing number, i.e., there are labels "A-1" through "A-8" pointing to the location (slot) for these cards but, when removed from the drawer, the cards are not identifiable (A#) without drawings, schematic, etc.

Recommendation: Identify cards as "A-1" through "A-8" by use of labels on the card itself.

3. Verify unit, indicator assembly, MX-4262. Same comment as 2(b) above applies to 8 circuit cards in this drawer.
4. Coder Unit/Code Pack, KY-463. The top handle of this drawer prevents removal of the drawer above (Indicator, Code, ID-1043) unless the coder unit is also removed (first).

Recommendation: Bend the handle arms so that the handle will provide removal clearance for the drawer above.

II. M problem areas and soldering of a "product improvement" nature.

1. Power supply drawer, PP-3409.
 - a) 2 wires soldered to top and bottom of FL-1 and FL-2.
 - b) 2 wires soldered to L-1.
 - c) 4 wires soldered to T-1.
 - d) 2 wires soldered to T-2.
 - e) resistor R-1 soldered in place. (4 wires)
 - f) 4 fuse holders have 1 wire soldered. (F1, F2, F3, F4,)
 - g) Top and bottom drawer covers (access) have different type screw heads (2 tools required).
2. Power supply drawer, PP-3410.
 - a) 1 wire soldered to fuse holder. (F1)
 - b) Terminals 1 and 4 have soldered wires on transformers T-1 and T-2.
 - c) 1 wire soldered to circuit breaker CB1.
3. Verify unit indicator assembly, MX-4262.
 - a) 23 switches and/or display lights, on front panel, have 5 or 6 soldered connections, on each.
 - b) "Diode test" switch (S7) has 36 soldered connections.
 - c) 16 diodes (CR-1 to CR-16) soldered in place.
 - d) 16 relays (K1 to K16) each have approximately 12 soldered connections. Splices are located at various points through out the wiring harness. The combination of poor soldering during repair plus splice points throughout the harness should result in a reliability figure which is lower than the reliability figure for plug-in relays. Due to having to "redo" the wiring harness during repair or replacement of a relay, the present configuration lacks maintainability.
4. Control, power supply, C-4172.
 - a) 20 resistors (R17 to R36) soldered in place.
 - b) 16 diodes (CR-5 to CR-20), on TB3 and TB5, are soldered in place.
 - c) 11 switches and/or display lamps (front panel) average 5 soldered connections each.
 - d) Relays K-1 and K-3 to K-14 have an average of 8 soldered connections.

4. (Continued)

- e) R-1 resistor has soldered connections.
- f) L-1 coil has soldered connections.
- g) T-1 transformer has soldered connections.
- h) 5 terminal boards (not plug-in) have many soldered connections for diodes plus a few resistors.
- i) One resistor has no identification.

5. Indicator, Code, ID-1043.

- a) switch S-1 has 2 soldered connections.
- b) switch S-2 has 3 soldered connections.
- c) switch S-3 has 9 soldered connections.
- d) Wires to the connectors on back of the display light assembly, code display, DS1 through DS6, have from 6 to 10 soldered connections.
- e) Motor M-1 has 3 soldered connections.
- f) Resistors, R-1 and R-2, soldered in place.
- g) Condensers, C-1 and C-2, soldered in place.
- h) Stand-off terminals E-1 to E-8 have all components soldered in place.
- i) 6 relays, K-1 to K-6, have an average of 20 soldered connections.

6. Coder unit, launch control, KY-437.

- a) 37 relays, K1 through K37, have many soldered connections on each.
- b) Sub-function, selector switch has 240 soldered connections.
- c) 10 push-button panel switches have an average of 6 soldered connections.
- d) "Code set" controls have many soldered connections and are completely inaccessible for maintenance.
- e) Many components on the bottom of the drawer are soldered.

7. Verifier unit, MX-4263. Readers and function selectors (switches) have approximately 5,000 soldered connections.

8. Verifier unit, Command signals decoder, MX-4260.
 - a) Lamp-test switch is soldered.
 - b) Lamp socket is soldered.
 - c) 8 switches have an average of 5 soldered connections.
 - d) Micro-switch (door signal) is soldered.
9. Verifier unit, Launch Control Panel, MX-4261.
 - a) 7 panel switches have an average of 5 soldered connections.
 - b) Light-test switch is soldered.
10. Access panel (cover) to wiring compartment on left-rear side of rack OA-3950/GY-3631. Cover is mounted with Philips-head screws.

Recommendation: Maintainability improvements desired for "product improvement."

1. High failure-rate components (greater than 0.5 failures/wing/month) which now require soldering should be replaced by components which plug-in or have provision for mechanical connections. When standard off-the-shelf components which have no provision for plug-in or mechanical connection are used, one of the following (or equivalent) methods shall be provided.
 - a) Provide a replaceable assembly consisting of the component with soldered-on "pig-tail" leads to a plug-in or mechanical connector.
 - b) Provide a "gang assembly" (or module, card, etc.) of soldered components with plug-in or mechanical connectors for the entire assembly.
 - c) Provide "pig-tail" leads with crimp-on connectors.
 - d) Provide a "wire harness" soldered to component (s) with the other end terminated in crimp-on connectors or pins for plug and socket connectors.

NOTE: The use of soldered components with their leads spliced throughout the harness (individual disconnect splice on each wire) will probably result in a total reliability figure which is lower than the reliability for a plug-in component. This especially applies to the relays and harness in the drawer, Verifier unit, indicator assembly, MX-4262. In addition, the utilization of plug-in relays will comply with action item #10 of the minutes of the C.D.R. meeting 2-3 May 1962.

2. Maintainability can be greatly improved by using slotted, hex-head screws (bolts) wherever possible. This type screw can be removed by a nut driver ("spintite"), socket set, screw driver, box wrench, open-end wrench, speed wrench, etc. Due to the increased bearing surface, the hex-head screws are not easily damaged as are the Philips-head screws. (The inspector has already directed that the screws on top and bottom

2.(Continued)

drawer covers be replaced on the first production model C.I.V.)

- a) Hex-head screws will greatly facilitate the removal of the drawer covers.
- b) Hex-head screws are recommended for the cover to the wiring on the left-rear side of rack OA-3950/GYK-3631.

Prepared by:

Earl Hardy
Earl Hardy

Approved by:

J. S. McEacheran
J. S. McEacheran
Minuteman Maintainability Group

cc: K. E. Swenson 52-16
J. L. Pfalzer 84-14
J. M. Barker 50-66
D. A. Cole 43-86
M. M. Kiyono 50-66
G. H. Dammann 85-44
W. Larson 50-66
J. Andrews 50-69

EH:clj
1115

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: 1 of 1 M R R No. 8-1370 DATE: December 26, 1962	
FIGURE 'A' NO. 1370		TITLE Lighting Equipment Group, Emergency & Survival	
The Lighting Equipment Group, Figure A 1370 has been reviewed for <u>M</u> and Soldering. This Figure A in its present configuration, as per ECP-19 and drawing # 25-32901, appears to be satisfactory as to <u>M</u> and soldering.			
<u>M</u> Engineer: <i>Earl Hardy</i> Earl Hardy	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran		Approved by:

 MAINTAINABILITY REVIEW REPORT 		
WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 1</u> M R R No. <u>9-1201</u> DATE: <u>December 26, 1962</u>
FIGURE 'A' NO. 1201 TITLE Programmer Group		
The Programmer Group, Figure A 1201, was reviewed for Mand soldering at the Maintainability Review Meeting held at TBC, 9 January 1962. Provisions to correct the M discrepancies reported in the minutes of this meeting, reference # 2-6331-0-366, were included in ECP-358, with the exception of the 24 diodes which are mounted on the 4 heat sinks. PRR #11383, released on 21 December, 1962, provides pigtail leads with crimp-on connectors for these 24 diodes. <u>Recommendation:</u> BSD approval of ECP-358 will provide for satisfactory M on Figure A 1201.		
M Engineer: <i>Carl Hardy</i> E. Hardy	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 2</u> M R R No. <u>10-4523</u> DATE: <u>January 24, 1963</u>
FIGURE 'A' NO. 4523 TITLE Common Power Supply, Portable		
1. The bottom cover of the power supply is secured by four latches per side and two latches per end. The latches on one side are off-set by one-fourth (1/4) inch, i.e., cover and latches appear to be, but are not, symmetrical. <u>Recommendation:</u> Locate the latches so that the cover is symmetrical and fits in either position or make the cover sufficiently asymmetrical so that the proper position is obvious, as 4 latches on one side and 3 latches on the other. 2. Five cables are stored in the bottom cover and they must be positioned in a precise configuration to fit in place. The cable storage configuration is illustrated in a T.O. but the T.O. will not, usually, be available. <u>Recommendation:</u> Locate a placard illustrating the cable storage configuration and cable inventory in the storage compartment of the case. 3. The power supply is a dual chassis with the upper half hinged to the lower half. The Arm-stop, 26-14959-1, restrains the upper half of the chassis from tilting too far back, but it does not hold the upper half in an open position, i.e., nothing prevents the upper half of the chassis from accidentally closing while maintenance is in progress. This condition can readily result in injuries. <u>Recommendation:</u> Conform to MIL-STD-803 section 10.4.3.8.1.6 by providing an Arm-stop that locks in the open position. 4. The blower for the cooling air supply is located in the upper chassis. If the upper chassis is opened while the power is on, no cooling air will be supplied to diode and transistor heat sinks located in the lower chassis.		
M Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	Approved by:

Recommendation:

Provide an interlock switch to cut off power when upper chassis is open.

5. Component cards A-15 and A-24 each contain components of all seven regulator circuits and both cards are rigidly mounted in place with components soldered to the wiring harness.

Recommendation:

Group components so that components of 3 regulators are on one card and components of the other 4 regulators are on the other card.

6. The power supply has two inputs, 120 volts AC and 36 volts DC.

Recommendation:

Design the power supply to require only 120 VAC input (or use 400 cycle, 3 phase input). See paragraph VII and VIII, 4 of CDR for figure A 4523, June 5, 1962.

7. Fault isolation to a replaceable module is not always possible due to lack of test points. See paragraph VIII, 3 of CDR for figure A 4523, June 5, 1962 and T.D. 62-4488, May 28, 1962.

Recommendation:

Provide additional test points. See MIL-STD-803 sections 10.6.1.1 and 10.6.2.2

8. Relay K1 mounting bracket assembly 29-25950-1, in its present position will chafe the wire bundle to J3.

Recommendation:

Reposition the mounting bracket to eliminate the possible interference.

2. a) (Continued)

aisle space because of straight connectors. The connectors and cables limit movement in the aisle, become a hazard and are subject to damage.

Recommendation:

Change straight connectors to right angle connectors indexed to permit the cables to go up to equipment rack connections.

3. a) Electrical equipment case PN BACC35A2B or Zero Mfg. Co. PN ZCC247-439A-D1452-3 have rivetted feet, Zero PN 7-701, lost with case damage in transport and handling of Figure A 3109 Test Sets.

Recommendation:

Feet and case redesign with rework of existing test sets is required to prevent RFI, entrance of contaminants and lack of environment control.

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 2</u> MRR No. <u>12-MGE</u> DATE: <u>17 December 1962</u>
FIGURE 'A' NO. None TITLE Portable ACO/MGE Electrical Equipment Cases		
Statement of Problem: Portable ACO and MGE Figure A's of TBC PN BACC35 series that require electrical equipment cases of the Zero Mfg. Co., 1121 Chestnut Street, Burbank, California for Minuteman are susceptible to having the feet sheared off the cases during transport and handling. Factors of the Problem: The present feet, Zero PN 7-701, are 0.88 inches long, 1.0 inches in diameter and are mounted by rivets, an integral part of the feet. The feet employ a necked down section of metal for insertion at hole locations in the case and these sections are rivetted over AN960-10L washers from the interior. Loss of feet cause failure of electrical equipment cases to comply with GM 07-59-2617A Electro Interference Control Requirements and/or MIL-E-4970A Environmental Control Specifications by entrance of contaminants and moisture. Difficulty can be encountered in stacking of two or more cases, where without these feet on the case bottoms the feet cannot engage in dimples on the lids of the cases below, thereby causing loss of locking in position of cases in a stack. Discussion: Critical factors affecting vulnerability of portable cases to feet damage are: 1) High in-use time; one or more of these std case testers are used on almost every maintenance trip, with utilization time as high as 4986 hrs/month for a single figure A; 2) Weight in excess of 90 pounds for a two-man handling operation; 3) Size; Width up to 28 1/4", length up to 33", heights up to 16" with weights up to 220 lbs; 4) Quantity of cases per ACO/MGE Figure A; i.e. (4) cases Figure A 3065, etc. 5) Nature of work area and access to work area, i.e., cases are stacked, dragged across uneven floors and grates and loaded in and out of truck.		
M Engineer:  L. T. Niemi	Approved by:  J. S. McEacheran	Approved by:

In-use time represents accumulated hours with ACO/MGE units, totalled from loop time less stopover time for on-site maintenance and/or SMSB usage.

Figure A's involved are: 100, 101, 108, 112, 114, 115, 123, 138, 149, 155, 166, 170, 171, 173, 174, 175, 198, 277, 278, 372, 711, 741, 3007, 3013, 3035, 3065, 3092, 3109, 4012, 4252, 4388, 4489, 4490, 4491, 4523, 7679, 7695, 7749, and others.

Recommendation:

Redesign with these Figure A's is recommended for shorter feet of greater diameter with better means of fastening to the electrical equipment cases, Where equipment, weight per case greatly exceeds 90 pounds, repackaging is required to provide adequate transport and handling features incorporating qualifications implied by GM 07-59-2617A and MIL-E-4970A Specifications.



MAINTAINABILITY REVIEW REPORT



WS-133 WEAPON SYSTEM

The Boeing Company
Aero-Space Division
Seattle Washington

MAINTAINABILITY GROUP

Organization 2-5261-30
Mail Stop 50-66
Telephone JU6-6263

PAGE: 1 of 1

M R R No. 13-1337

DATE: 23 January 1963

FIGURE 'A' NO. 1337

TITLE Distribution Box, J-1269/GSW-4

1.

- a) Distribution Box, J-1269/GSW-4, with left and right access panels removed, presents free access to all terminal boards, circuit breakers and relays, with the internal wiring held firmly by washer and nut devices - even to employment of sealant for positive locking engagement of nuts. Lacing and clamps for mechanical support are used, consistent with size in binding leads, heavy connectors, and cables.
- b) The Safe and Arm Module, PN 25-31189-1 when encapsulated weighs 130 pounds has hoist points for insertion of two eyebolts to assist on remove and replace in upper cabinet location of distribution box.
- c) External cables and plugs can connect to box receptacles without mutual interference.
- d) Throughout the Figure A 1337, components and conductors are packaged in a manner to provide ease and economy of maintenance.

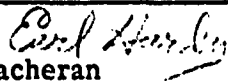
M Engineer:

L. Niemi

Approved by:

J. S. McEacheran

Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 2</u> M R R No. <u>14-1412</u> DATE: <u>January 21, 1963</u>
FIGURE 'A' NO. 1412 TITLE Signal Assembly, Voice Reporting		
1. To remove the plug-in circuit boards and filter unit requires an allen wrench of greater than normal length. <u>Recommendation</u> Changing the allen head bolts to slotted hex-head bolts would eliminate the requirement for a special tool. 2. Due to the location of some of the mounting base mounting bolts several of the plug-in circuit boards have to be removed before their mounting base can be removed. <u>Recommendation</u> Changing the location of the base mounting bolts would eliminate this problem. 3. Due to the location of the filter unit mounting bolts the plug-in circuit board mounting base must be removed. <u>Recommendation</u> Changing the location of the filter unit mounting bolts would eliminate this problem. 4. The following components have solder connections: (a) The filter unit; (b) The head set plug; (c) The two self test switches; (d) The interrogate switch; (e) The external test switch; (f) The memory reset switch; (g) The two active channel switches; (h) The two channel selector gang switches.		
M - Engineer:  R. Stearns	Approved by:  J. S. McEacheran	Approved by:

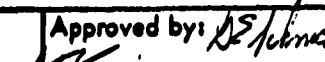
Recommendation

Eliminate soldering and provide plug-in, screw terminal or pig-tail connections where possible.

5. A special allen wrench, a standard allen wrench, two sizes of phillips screw drivers, and a common blade screw driver are required to perform maintenance.

Recommendation

By standardization of the types of bolts the requirement for different hand tools could be minimized.

M	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	M
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE 1 M R R No. 15-6950 DATE: 22 January 1963
FIGURE 'A' NO. 6950 TITLE HSM-80C Section 49 Skirt		
Preliminary design of the HSM-80C section skirt requires that the skirt be made in two halves and attached to the missile with the longitudinal split at 0° and 180°. Installation and removal of the skirt will require that maintenance personnel install and remove bolts at the forward interface and the two longitudinal splice joints. Insulation of the bolt heads also may be required during skirt installation, if thermal analysis shows this to be a requirement. Access to the work area at the locations where the skirt section is split is limited by the narrow space between the #1 and #3 nozzles, which are located at 0° and 180° respectively, and the adjacent skirt structure. The long arm reach required to install and remove the longitudinal splice joint fasteners in the forward area of the skirt is a contributing factor to the limited accessibility of this area. <u>Recommendation:</u> It is recommended that the section 49 skirt be split at 135° and 315° to gain a significant increase in the accessibility for installing and removing the longitudinal splice joint bolts.		
M Engineer  J. Pruner	Approved by:  J. S. McEacheran	



MAINTAINABILITY REVIEW REPORT



WS-133 WEAPON SYSTEM

The Boeing Company
Aero-Space Division
Seattle Washington

MAINTAINABILITY GROUP

Organization 2-5261-30

Mail Stop 50-66

Telephone JU6-6263

PAGE: 1

M R R No. 16-1380

DATE: January 23, 1963

FIGURE 'A' NO. 1380

TITLE Distribution Box, J-1312/GSW-4

1.

- a) Figure A 1380, Distribution Box, J-1312/GSW-4, as an end item is manufactured and assembled by ElSCO System Inc., 4516 Stoneway North, Seattle, Washington. The box contains terminal strips, circuit breakers and receptacles, where internal wiring is brought from breakers to strips to receptacles with crimped mechanical connections and supported, for mechanical strength.
- b) This Figure A in its present configuration, as per ECP 40 and TBC drawing 25-27307, appears to be satisfactory as to Maintainability and soldering.

M Engineer:

L. Niemi
L. Niemi

Approved by:

J. S. McEacheran
J. S. McEacheran

~~Approved by:~~

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: 1 M R R No. 17-3007 DATE: January 29, 1963
FIGURE 'A' NO. 3007 TITLE Test Set, Explosive Set Circuitry		
1. When the Test Sets' cover is open it is held to the case by two rubber sleeved chains. The case end of each chain is fastened by a philps head screw. During normal usage the cover will hang by these chains as the Launch Facility ordnance circuitry is checked. Resultant chain breakage will randomly occur necessitating chain replacement. The present placement of one screw conflicts with the location of selector switch S1 and S2 making it impossible to remove the screw with a philps head screwdriver. <u>Recommendation:</u> Provide a hinged cover for the Test Set. If cover redesign is not feasible replace the philps head screws holding the chains with slotted hex-head screws which can be removed by an open end wrench. 2. Selector switch S1, S2, S3, and S4 control knobs are affixed to the circular shaft of the switch by allen head screws. Continual use of these knobs will require periodic tightening of the screws to retain the knob in its proper location on the shaft. Should control knob replacement be necessary, it could be time consuming because the control knob could be placed in a position which doesn't correspond to switch position due to the switch shaft not being keyed. <u>Recommendation:</u> Provide a means of having the switch shafts and control knobs fit together in a singular manner.		
M Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>J. S. McEagheran</i> J. S. McEagheran	Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1</u> M R R No. <u>18-4018</u> DATE: <u>February 7, 1963</u>
FIGURE 'A' NO. 4018 TITLE Adapter Group, Test		
1. A total of eight fuses are mounted within assemblies 25-31605-1, 25-31604-1, and 25-31603-1. Four mounted on the 25-32950-4 heat sink assembly which is part of the 25-31605-1 assembly. Two are mounted on the 25-33020-1 heat sink assembly which is part of the 25-31603-1 assembly. The remaining two are located in the 25-31604-1 assembly, one is a spare. Six fuses, three active and three spare, are mounted on the front panel of 25-31604-1. <u>Recommendation:</u> Place all fuses and spares (one spare per active fuse) on the front panel of their respective chassis. Provide indicating fuses for rapid and positive recognition of equipment malfunction. See MIL-M-26512B Section 3.1.1. 2. Certain removable assemblies weighing over 45 pounds are not marked with their unit weight. An example is the Programmer Assembly 25-28170-1. <u>Recommendation:</u> Identify unit weight for assemblies weighing over 45 pounds. See MIL-STD-803 section 10.4.3.1. 3. Three sub-contractor manufactured assemblies have printed circuit assemblies (PCA's) which are electrically terminated by wire wrapped connections. The wire route is wire harness to terminal board, then terminal board to PCA. Examination of the Reference Signal Generator Chassis 1193071-502, Waveform Converter Chassis 1193072-502, and Electrical Impedance Simulator Chassis 1193073-502 results in the following observations: a.) The wire between the terminal board and PCA should have sufficient slack for at least three reterminations at the PCA end. This condition is not met.		
M Engineer: <i>A. Eenschel</i> A. Eenschel	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	Approved by:

- b.) Form C maintenance analysis calls for unwrapping the wire at each PCA pin, replace the faulty PCA, and wrap each wire to the PCA. This method decreases the reliability of the electrical connection because of the wire having had an extra wrap cycle.
- c.) Maintenance technicians may forget the PCA's are wire wrapped, and pull without first removing the wiring. The results will require replacement of PCA, terminal board, and wiring.
- d.) When the AN/GSM-61 and AN/GJM-15 are being used to check assemblies for faults, unnecessary downtime will result if the fault is traced to a wire wrapped PCA. This will be the repair and checkout time difference between a fault traced to an assembly containing wire wrapped PCA's and one to an assembly containing modules which are plug-in.

Recommendation:

Alternative I

Investigate feasibility of re-design to eliminate the use of wire wrap terminations. Provide etched circuit boards and modules with the plug connector in accordance with Boeing Standard C45BN-3A or equivalent, and the receptacle in accordance with Boeing Standard C45BN-1 or equivalent. See STL Document 6120-6882-DU-RDI.

Alternative II - Re-design not possible.

- a.) Revise Form C analysis to call out the following remove and replace techniques for wire wrapped PCA's.
 - Remove: 1.) Cut each wire as close as possible to the PCA pin. Tag as necessary for identification.
 - 2.) Remove PCA mounting hardware.
 - 3.) Remove PCA.
 - 4.) Strip each wire in preparation for wrapping to new PCA. If sufficient length is not available replace wire between terminal board and PCA.

Install:

- 1.) Install new PCA.
 - 2.) Install PCA mounting hardware.
 - 3.) Use a wire wrapping tool to connect wiring to PCA.
 - 4.) Route repaired assembly through test center.
- b.) Provide a warning placard within assemblies containing wire wrapped PCA's stating the PCA's are not plug-in type.
4. Access panels at the rear of the cabinet are fastened by Phillips screws.

Recommendation:

Provide hinged access panels. See MIL-STD-803 section 10.4.3.5.5.

5. Solder connections are used through out the unit.

Recommendation:

Use plug-in assemblies, crimp-on connectors, or components with soldered-on "pig-tail" lead wires to a plug-in or mechanical connectors. See STL Document 6120-7822-DU-RDI, Maintainability Criteria, dated 16 March 1962.

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: 1 of 5 M R R No. 19-4491 DATE: February 18, 1963
FIGURE 'A' NO. 4491 TITLE Start-Up, Launch Facility, OA/GSM-62		
1. The power cable from the power pack, used with the Start-Up Unit, has a connector with a fine thread nut and plug. <u>Recommendation:</u> The connector and plug should be of the coarse thread, quick release type used on other Minuteman cabinets. 2. The cable storage suitcase does not have a cable inventory and cable location placard. <u>Recommendation:</u> To minimize the loss and damage of cables a cable inventory and cable location placard should be fastened to the cover of the cable storage suitcase. 3. The Technical Order requires the G&C gyroscope start-up power be removed in less than sixty seconds after the gyroscopes are started. This is accomplished by separation of a multi-turn connector. Connector malfunction will result in equipment damage such as the power pack. <u>Recommendation:</u> An "ON-OFF" power control switch should be installed on the power pack. 4. The cover to the test set suitcase can be installed only one way but due to symmetry, has no readily identifiable method of indicating the correct way. <u>Recommendation:</u> The cover and the case should be marked so maintenance personnel can readily discern the correct installation position.		
M Engineer: <i>Ralph L. Stearns</i> Ralph L. Stearns	Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	Approved by:

5. The two suitcases, used to house the figure A equipment, are fragile and may not be capable of withstanding the rough field handling. These suitcases are the same as the one for Figure A 3109 which has had several failures, reference MAFB BLAR 87T, dated December 11, 1962.

Recommendation:

The suitcase should be changed to the Zero Modular Packaging System type per catalog E59 or similar.

6. The top chassis is connected to the lower module by a wire bundle thus preventing separation of the two items for the purpose of maintenance. Experience has shown that connecting two items together by a wire bundle will result in damage to both the chassis and the wire bundle.

Recommendation:

This can be corrected by separating the wire bundle with a connector or by attaching the upper chassis to the lower one by means of a hinge.

7. To remove the lower chassis from the suitcase the top unit must be held by one man, a second man must hold the suitcase in place, and a third man must lift the lower chassis out of the suitcase.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.5.2 "Where possible, cases shall be designed to lift off units rather than units lifted out of cases."

8. To assemble the two chassis and the suitcase, drift pins must be used to align the three units.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.7.5 "Guide pins or their equivalent shall be provided on units for alignment during mounting."

9. There is no easy way to discern the orientation of the two chassis and the suitcase.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.5.1 "The proper orientation of a unit within its case shall be made obvious, either through design of the case or by means of appropriate labels."

10. The spare fuses for the modules in the test set suitcase are mounted in the cable storage suitcase.

Recommendation:

The spare fuses should be mounted in the same suitcase, readily accessible, and adjacent to the working fuses.

11. To use either the self-test set or the break-out-box the maintenance man must remove them from the suitcase, by operating four hard to use fasteners.

Recommendation:

By mounting the connector receptacle on the tops of these modules this requirement would be eliminated.

12. Wire bundles located directly over terminal boards TB1, TB3, TB4, TB5, TB6, TB7 and TB8 make the terminals inaccessible.

Recommendation:

Relocate the wire bundles so the terminals are accessible.

13. During removal the lower chassis tends to twist because the handles are not located over the center of gravity.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.2.2 "Whenever possible, handles or grasp areas shall be located over the center of gravity of the unit so that when the unit is lifted it does not swing or tilt.

14. The label for transformer "T 1" is obscured by mounting board "A 1".

Recommendation:

Change the location of the transformer label.

15. It is difficult to locate the right positioning guide for the plug-in circuit boards.

Recommendation:

Label the correct positioning guides.

16. It is difficult to determine which plug-in circuit board goes into which receptacle.

Recommendation:

Label the circuit boards and the receptacles with reference designations.

17. The abbreviation of "pounds" on the suitcases is "lbs".

Recommendation:

The abbreviation "lb" should be used per MIL-STD-12B paragraph 1.3.4.

18. The name plates, on the test adapter and break-out-box chassis, are not visible when the modules are in their correct mountings.

Recommendation:

Per MIL-STD-130B paragraph 4.2 "Whenever practicable, the marking of the item shall be located in such a manner as to allow its being visible after installation. "

19. The circuit card retaining cover is held in place by phillips screws with flat washers under the heads.

Recommendation:

As the washers are not required and will be discarded by field personnel money can be saved by not using them.

20. Phillips head screws and bolts are used through out the test set. This type of head is susceptible to ruin while being removed.

Recommendation:

Use hex-head screws and bolts in place of phillips head.

21. The mountings for capacitors C2 and C3 are held in place by bolts and nuts. This requires the use of a holding tool and a turning tool to remove a part.

Recommendation:

When a nut is required use a captive type nut.

22. The Figure A does not contain any Maintainability Design Requirements. In accordance with AFBSD Exhibit 61-56, Maintainability Design Requirements must be included in the Figure A's for all OGE and MGE Minuteman equipment for which Boeing is responsible.

Recommendation:

When the Figure A is revised Maintainability Design Requirements should be added.

23. Line 4C of the Form C reads "blowers." There is only one blower.

Recommendation:

On the next revision of the Form C change line 4C to read "blower."

24. Line 4a of the Form C instructs the maintenance personnel to remove the test set case. The Form C does not instruct the maintenance personnel to put the test set back in the case.

Recommendation:

On the next revision of the Form C correct this condition.

25. The Technical Order does not note that for the start-up period the missile alignment light beam must not be broken.

Recommendation:

A caution note should be included in the T.O.

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1</u> of <u>4</u> MRR No. <u>20-302</u> DATE: <u>February 21, 1963</u>	
FIGURE 'A' NO. 3092		TITLE Test Set, Programmer Group, AN/GSM-57	
1. Fault isolation to a replaceable component and resulting repair is a long drawn out procedure. The AN/GSM-57 self-test provides a GO-NO-GO indication. A NO-GO will necessitate checking the Test Set by the AN/GJM-15 Test Center and AN/GSM-61 Test Adapter Group. After the fault is located the Test Set will be repaired while using the AN/GSM-82(V) Test Equipment, then the repaired Test Set will be self-tested again to ensure a GO condition exists. Therefore it is conceivable that four test setups will be required before the Test Set is returned to an operational status. <u>Recommendation:</u> Investigate the possibility of using one test configuration at the SMSB. Such a configuration would make use of the AN/GSM-82(V) Test Equipment, Standard Test Instruments, and the self-test provision of the Test Set. An additional break-out box would be required, however the manhours saved by eliminating the need for converting from one test situation to another would warrant its application. See MIL-M-26512B (USAF) for further <u>M</u> information on test provisions. 2. The suitcases and their feet will not withstand normal organizational usage. Reference MAFB BIAR 87T dated December 11, 1962. <u>Recommendation:</u> Zero Modular Packaging per catalog E59 or equivalent would provide the rugged test equipment suitcases needed for organizational usage. 3. The upper chassis of Fault Locator, 25-29127-5, is mounted on the lower chassis. Mounting alignment is such that the corner hex head screws are too close to the case (four places) making them difficult to remove.			
<u>M</u> Engineer: <i>A. Henschel</i> A. Henschel		Approved by: <i>J. S. McEacheran</i> J. S. McEacheran	

Recommendation:

Correct the close fit by ADCN action and use slotted hex head screws for this application.

4. Organizational usage of the AN/GSM-57 requires nine cables to be connected at the top rear of the Programmer Group requiring use of a stepladder.

Recommendation:

Investigate packaging the Programmer Group in the type of equipment rack which is used at the Launch Control Facility to allow faster test setup. If redesign of the Programmer Group occurs, consider using a transfer switch which could be used to isolate the Programmer Group from the rest of the launch circuitry during organizational maintenance. Also bring all test connectors needed for organizational maintenance to the drawer front. This would eliminate the need for removing the functional connectors and would reduce maintenance time. See STL Document 6120-6882-DU-RDI (Maintainability Criteria).

5. The test program for the AN/GSM-57 consists of punched program cards. There is no instruction on or near the card reader stating which way the program card should be inserted. Instructions are in T.O. 21-SM80A-2-3.

Recommendation:

Provide an instruction placard or the outline of a properly inserted program card on or near the card reader to eliminate any doubt as to which way the card should be placed.

6. The cable carrying case weighs 128 pounds with all cables, presently there is no weight designation on the case. The eighteen cable compartments are unmarked as to which cable they are for, allowing the technician to place each cable where he pleases.

Recommendation:

Mark the weight of the carrying case, reference MIL-STD-803 section 10.4.3.1. Mark each cable compartment for a specific cable. This will ensure that all cables are accounted for when the maintenance crew leaves the Launch Facility and will maintain the proper weight distribution in the case.

7. Test setups at the Launch Facility could be made quicker if a placard were provided in the top cover of the Fault Locator and the Distribution Box suitcases.

Recommendation:

Provide a cable hook-up placard in the Fault Locator suitcase cover illustrating the cable configuration for checkout of the Programmer Group. Place a placard in the Distribution Box suitcase cover showing the cable configuration for Test Set self-test.

8. Figure A Technical Requirements section should have a Maintainability and Operability paragraph.

Recommendation:

Conform with instructions of AFBSD Exhibit 61-56.

9. Model Specification, Test Set, Programmer Group (S-133-121-3-1-10), Boeing Document D2-9140, has no reference to Maintainability.

Recommendation:

Conform to MIL-M-26512B (USAF) section 3.2.6.

10. Part numbering of the AN/GSM-57 Program cards can be confusing. The cards for a certain test are color-coded, however the numbering system is such that a technician has to consult the applicable T.O. to determine which cards in the deck should be used. Missing cards and numbered cards not in numerical sequence are due to minor equipment changes requiring reprogramming of the Test Set.

Recommendation:

Number the cards in a test deck consecutively. When the program cards require revision, change the deck dash number and replace the revised cards with cards of the same number. A consecutively numbered deck will assure the technician of whether or not his deck is complete without having to stop and check every time the consecutive numbering sequence is broken.

11. Assembly 25-30032-5 (A27) requires removal of A30 and A31 before it can be removed. Removal would take considerable time due to the soldering of the wiring directly to the components on the module.

Recommendation:

If soldered connections have to be used, bring wiring from the wiring harness to a terminal board, then bring soldered pigtails from the component board to the terminal board. This type of connection for A27 would eliminate the need to solder the Test Set at the SMSB or to return the test set to a Depot if a component on A27 fails. "Physical arrangement of modules and/or components shall be such that all high failure rate items are easily accessible for replacement, and provide for replacement without removal of any non-failed module or equipment." Quoted from STL Document 6120-6882-DU-RDI, Maintainability Criteria.

12. The Fault Locator consists of two chassis. When maintenance work is being done, the Fault Locator is placed face down allowing the lower hinged chassis to swing outward exposing the internal circuitry and wiring. There is no stop to hold the lower chassis from rotating nearly 180° resulting in unnecessary strain being applied to the wiring.

Recommendation:

Provide an arm which will prevent the lower chassis from rotating more than 95°.

13. The blower for the cooling air supply is located in the upper chassis. If the Fault Locator is opened while power is on, no cooling air will be supplied to the 24 semiconductor modules located in the lower chassis.

Recommendation:

Provide an interlock switch to cut off power when the chassis are separated.

14. The Fault Locator weight designation is not marked per MIL-STD-12B. Example 141 lbs. should be 141 lb.

Recommendation:

Use MIL-STD-12B paragraph 1.3.4 and Boeing Document 13228, Manual of Writing Style as guides for all abbreviations and written information on equipment chassis.

 MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 5</u>
		M R R No. <u>21-4490</u> DATE: <u>February 26, 196</u>

FIGURE 'A' NO. 4490 TITLE Simulator Set, Electrical Functions, Missile-La
 AN/GSM-1

1. The Technical Requirements section of the Figure A does not contain a paragraph on Operability and Maintainability.

Recommendation:

Conform with AFBSD Exhibit 61-56 by supplying a paragraph on Operability and Maintainability in the Technical Requirements section of the Figure A when revised.

2. Technical Order 33D9-14-26-1, Operation and Maintenance, Simulator Set, Electrical Functions, Missile and Launch has several areas needing corrections and/or additions. These areas are:

- a) Section I Figure 1-2, Leading Particulars, has erroneous part numbers for three items of AN/GSM-62;

Recommendation:

Correct Figure 1-2 as follows:

- 1) The part number of Simulator SM-245 is 25-33733-1 not 25-33586-1;
 - 2) Part number of Distribution Box J-1291 is 25-33734-1 not 25-33586-1;
 - 3) Part number of carrying case CY-3634 is 25-34046-1 not 25-34036-1.
- b) Sections VI - Maintenance Instructions, VII-Troubleshooting, VIII-Calibration, and IX-Repair Instructions are listed as information to be supplied at a later date.

M Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:

Recommendation:

As the above instructions become available apply them to a working situation for validation prior to incorporation into the Technical Order.

- c) Section 5-12, the Recorder Operational Checkout procedure does not have a step for turning on Recorder power.

Recommendation:

Add a step between (a) and (b) stating "Place the power ON/OFF switch to the ON position, white pilot lamp shall illuminate."

- d) Section 1-18 calls out Signal Data Recorder Cable, 29-257102-1. No cable with this part number exists. The correct part number is 29-25702-1.

Recommendation:

Correct the part number of the Signal Data Recorder Cable on page 1-8 of the Technical Order to be 29-25702-1.

- 3. Simulator Set Cable Assembly Case CY-3680 and CY-3681, and Simulator Set Case - Test Adapter CY-3634 have stronger feet than the suitcases for Simulator SM-245, Recorder RO-186, and Distribution Box J-1291 which have riveted feet, Zero P/N 7-701. The latter are subject to breakage in the field, reference MAFB BIAR #87T. OED 208 calls for re-designed feet to be placed on suitcases when the old ones fail.

Recommendation:

Investigate using the stronger feet of CY-3634, CY-3680, and CY-3681 for all MGE and ACO equipment suitcases if OED 208 is not approved for action.

- 4. Dust covers for the Skirt Umbilical Junction Box and G&C Umbilical Junction Box receptacles have to be removed before panel 29-26830-1 of Distribution Box 25-33734-1 (J-1291) can be raised to gain access to the junction boxes. The maintenance technician's fingers rub against the rough nylon material lining the circumference of the holes in the panel, as the dust covers are removed.

Recommendation:

Provide a hinged panel with larger holes so the dust covers need not be removed until the technician is ready to connect cables to the junction box.

4. (Continued)

Fasten the panel to the Distribution Box with a minimum of captive quick-release fasteners and make the dust covers captive to their respective junction box. MIL-STD-803 sections 10.4.3.5.5, 10.4.3.5.8, and 10.4.3.8.1.1 state design requirements for this situation.

5. Wire harness is mounted directly over the twist lamp and switch wiring terminations in Simulator 25-33733-1 (SM-245) limiting accessibility for switch replacements.

Recommendation:

Route wire harness so access for switch removal and replacement is improved. Per MIL-STD-803 section 10.4.2.3.3, "All throw-away assemblies or parts are accessible without removal of other components."

6. Non-indicating fuses are used in the Simulator and Recorder.

Recommendation:

Use of indicating type fuses will give the maintenance technician the means to rapidly determine the cause of a fault indication as required per MIL-M-26512B (USAF). Indicating fuses are recommended by Boeing Document D2-4747-1, Maintainability Design Criteria for Minuteman Electronics Equipment, section 6.1.2.3.1 item 25.1.1.1.3.

7. Cases CY-3634, CY-3680, and CY-3681 all have the same weight marking of 100 LB, however each case with cables does not weigh the same.

Recommendation:

Mark the actual weight on each carrying case.

8. One handle on Simulator 25-33733-1 (SM-245) is mounted directly over four of the Phillips screws holding panel 25-34464-1.

Recommendation:

Per MIL-STD-803 section 10.4.2.3.1, "Components shall be placed so that there is sufficient space to use test equipment and other required tools without difficulty or hazard."

9. The routing of the wiring harness to the printed circuit cards in Recorder RO-186 is such that wires will be damaged when the Recorder is lifted in and out of its carrying case.

Recommendation:

Reroute the wiring harness or use a larger case for the Recorder. Per MIL-STD-803 section 10.4.3.5.3, "Cases shall be made enough larger than the units they cover that wires and other components are not likely to be damaged when the cases are put on or taken off."

10. Receptacles J6 and J6A of Recorder RO-186 have plastic dust covers which are easily lost, especially at the Launch Facility.

Recommendation:

Provide captive dust covers.

11. Components on assembly 301294-901 (TB-3) of Recorder Assembly 301292-901 are high failure rate items (diodes). Work on or removal of TB-3 requires other assemblies to be removed first.

Recommendation:

Per MIL-STD-803 section 10.4.3.10.2, "Whenever possible, units shall be so located that no other equipment must be removed to gain access or remove."

12. The Recorder suitcase top cover, part of 10-21340-1, is hinged at one side. When the case is opened, the cover can be removed from or left on the case during organizational use. If the cover is left on, its weight is sufficient to cause the hinges to tear away from the suitcase. Removing the cover will alleviate the above problem, however the hinge pins will be knocked out if perfect alignment of the cover hinge is not made with the case hinge pin during cover replacement.

Recommendation:

Provide a removable arm stop which will prevent the top cover from placing undue loading on the hinges when the Recorder suitcase is open. Per MIL-STD-803 section 10.4.3.5.4, "Where feasible, guides, tracks, and stops will be provided to facilitate handling and to prevent damage to units and components."

13. Simulator SM-245 is fastened to its carrying case by 32 Phillips screws and non-captive self-locking nuts. Panel 25-34464-1 is fastened to Simulator SM-245 by 22 Phillips screws. Distribution Box 25-33734-1 has 22 Phillips screws fastening it to the case. Washers are used under each of the Phillips screws.

Recommendation:

Investigate reducing the number of fasteners and eliminating the need for washers. Also per MIL-STD-803 section 10.5.3.1.4, "Captive fasteners shall be used where possible."

14. Simulator Assembly 25-33733-1 (SM-245), Recorder 25-35862-1 (RO-186), and Distribution Box 25-33737-1 (J-1291) can be placed in their carrying cases 180° from the proper position. The maintenance technician must also align a RFI gasket with a drift pin or other means prior to fastening the Recorder to its case.

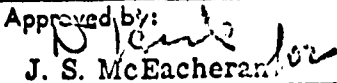
Recommendation:

Per MIL-STD-803 section 10.4.3.7.5, "Guide pins or their equivalent shall be provided on units for alignment during mounting."

15. The top covers for suitcases CY-3634, CY-3680, CY-3681 are interchangeable and can be placed on the suitcase in four different positions. Due to the offset of the tongue and latch fasteners only one position will allow the fasteners to mate. The top cover for Distribution Box J-1291 can fit two ways, only one will allow latching the fasteners. Simulator SM-245 has a top and bottom cover, each can fit two ways, one will allow mating of fasteners.

Recommendation:

Per MIL-STD-803 section 10.4.3.5.1, "The proper orientation of a unit within its case shall be made obvious, either through design of the case or by means of appropriate labels."

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 2</u> MRR No. <u>22-1373/1374</u> DATE: <u>MAR 4, 1963</u>
FIGURE 'A' NO. 1373/1374 TITLE Electrical Surge Arrestor Set, LCF and LF		
1. Figure A 1373 and 1374, Electrical Surge Arrestor (ESA) Sets and the arrestor units therein provide tie-in for tests at organizational level maintenance as: a) Checkout of LCF intrasite cables, also LCF interconnecting box cables to ESA; b) Checkout of intersite cables at LCF ESA; c) Monitoring of VRSA messages at LCF ESA, Figure A 1373 and at LF ESA, Figure A 1374, for detection of LCF or LF OGE drawer faults; d) Continuity and insulation readings with input and output cables disconnected. The employment of the arrestor units to conduct tests establish usefulness for accessible test points. <u>Recommendation:</u> Provide test points with a quick disconnect fastener to prevent the test leads from falling out when not held by the technician. Probing at the organizational level is in direct violation as dictated in BSD letter BSQRT/Maj. Reeb/2008, Subject: Electronic Malfunction Isolation, June 15, 1962. 2. The present configuration requires removal of NAS 679A3W self-locking hex nuts from the BAC-T40D2 feed through terminals for fault isolation of the arrestor unit and cable tests aforementioned. Drawings, Form C's and Technical Orders note the requirements of 12 inch-pounds torque limitation and T.O. 21-SM80A-2-20 caution note calls for use of a slip-type torque wrench set at 12 inch-pounds for replacement of NAS 679A3W nuts. Failure reports continued to depict over torquing with threaded ends of BAC-T40D2 broken off, as per FR068598 dated 12 January 1963.		
M Engineer:  L. Niemi	Approved by:  J. S. McEachern	Approved by:

Recommendation:

Place caution note on part number 25-2014 series channel assembly with fluorescent silk screen materials per MIL-L-25142 or 3M scotchlite tape:torque limit 12 inch - pounds when installing nuts on arrestor unit terminals.

3. Part number 25-29014 series channel assembly when unbolted swings on an hinge mounting for sixty degree tapered opening avenue of access five inches wide. The work space at the arrestor unit mounted first from the hinge on the channel assembly offers a minimum of 2-1/4 by 5 inches access for activity of one hand tasks. These assemblies mounted on the upper bank of the Figure A 1373 represent awkward and difficult tasks, especially when performed on top of a work ladder in the enclosure room. Criticism also applies to Figure A 1374. Use of six inch open end wrench in crowded work spaces will permit over torque on lock nuts of arrestor unit feed through terminals.

Recommendation:

Redesign part number 25-29326-1;relocate clamps and cables to allow channel to open greater than sixty degrees for testing and work access. MIL-STD-883C section 10.4.3.g, "openings for adjusting and handling units shall be ample to permit the required activity and where possible to permit adequate view of the components being manipulated."

 MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-00 Mail Stop 50-66 Telephone JUC-6253	PAGE: <u>1 of 4</u> MRR No. <u>23-3109 Rev. A</u> DATE: <u>March 5, 1963</u>

FIGURE 'A' NO. 3109 TITLE Test Set, Alarm Set, AN/GSM-59

The following Maintainability problem areas have been reported since the issuance of MRR 11-3109 dated 1/8/63. Maintainability Evaluation/Observation Reports 3109-2 dated 1/17/63 and 3109-3 dated 3/2/63 provide sufficient information for MRR 23-3109 Rev. A.

1. Fault Locator 25-26829 and Test Set, Antenna Calibration 25-35613 can be placed in their carrying cases 180° from the proper location. Mating the chassis to the case can not be accomplished unless proper placement is made. When proper placement of the chassis is made, drift pins or equivalent are required to align the case and chassis for insertion of fastening screws.

Recommendation:

Provide alignment pins so the maintenance technician can easily determine the proper position of the chassis within its suitcase. Per MIL-STD-883C section 10.4.3.5.1, "The proper orientation of a unit within its case shall be made obvious, either through design of the case or by means of appropriate labels." Also section 10.4.3.7.5 states, "Guide pins or their equivalent shall be provided on units for alignment during mounting."

2.
 - a) Failure of any of the diodes or transistors on Electronic Component Mounting Bracket 29-26783 (A8) requires removal of four Phillips screws which fasten the bracket to the Fault Locator frame. The location of transformers T1 and T2 necessitates use of a special length Phillips screw driver to accomplish screw removal.
 - b) The lower clamp, BACB20AF3, on capacitor C2 in the Fault Locator is positioned in such a manner as to make removal of the retaining screw, NAS 603-10, impossible without the use of a special tool.

Recommendation:

Eliminate the requirements for non-standard tools. Per MIL-STD-883C section 10.4.3.7.3, "Field removable assemblies and units shall be replaceable with nothing more than common hand tools."

M Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>J. S. McEachern</i> J. S. McEachern	Approved by:

3. Units weighing over 45 pounds are not marked as such. Example: The Fault Locator Test Set weighs approximately 85 pounds.

Recommendation:

Mark each assembly or unit weighing over 45 pounds with the appropriate weight designation on three exterior surfaces. See MIL-STD-803 section 10.4.3.1 and MIL-T-21200C section 3.2.9.

4. The meter on the Fault Locator front panel has two scales, identified on the meter face as A and B. The test selector has switch positions which refer to either a white or black dot with the notation above the switch stating O Read Inner Scale and O Read Outer Scale.

Recommendation:

Refer each Test Selector switch position to A or B to correspond with the meter marking.

5. The abbreviation "R/T" is used for one position of the Function Selector of the Fault Locator and "RCVR-XMTR" is used for a position of the Test Selector. The abbreviation "NS" is used on the Test Set Group, Antenna.

Recommendation:

Use standard authorized abbreviations. MIL-STD-130B calls for MIL-STD-12B to be used for abbreviations. Use the abbreviation "RCVR-XMTR" for Receiver-Transmitter not "R/T". Per MIL-STD-12B "NS" could be National Special (thread), Near side, or Nickel steel. Spell out "Nano-second" on the panel rather than use an ambiguous "NS".

6. The Phase Shifter Adjustment Control, part of the Antenna Test Set Group, does not operate freely and smoothly without binding. There is no label indicating the direction of increasing phase shift.

Recommendation:

Eliminate binding and label the control. Refer to MIL-E-4153 section 3.2.5.2. "Mechanical operations: play and backlash shall be held to the minimum and shall not cause poor contact or inaccurate setting. Controls shall operate freely and smoothly without binding, scraping, or cutting; controls shall be lubricated when lubrication does not interfere with operation. Continuous positioning, circular pointer type knobs shall be used for discrete positioning operations." If redesign does not occur, indicate the direction of increasing phase shift near the Phase Shifter.

7. The cable receptacles on the Fault Locator do not have captive dust covers.

Recommendation:

Provide captive dust covers for all receptacles to prevent damage of connector threads and pins.

8. The Function Selector Switch on the Fault Locator has its stop-located two steps beyond the last labeled function.

Recommendation:

Label the two spare positions as "spare". Per MIL-STD-803 section 9.6.5.5.3, Provide stops at the beginning and end of the range of control positions if the switch should not be operated beyond the end position or specified limits."

9. Accessibility to the terminals of terminal boards TB1, TB2, TB3, TB4, TB5, and TB6 is limited because of wire bundles directly over the terminals.

Recommendation:

Re-route the wire bundles to improve access to wiring at the terminal boards.

10. The cable storage area in the Antenna Calibration Set cover is not large enough for the cables it is to contain.

Recommendation:

Provide adequate cable storage space by re-design of case if necessary.

11. The Antenna Adapter, part of Antenna Test Set TS-1729/GSM-59 is stored in the cover of the Test Set. Two fasteners 26-15191 hold the retaining panel 29-27117 to the cover, both are multiple turn fasteners and they are difficult to unfasten and fasten.

Recommendation:

Provide captive quick release type fasteners.

12. Cable inventories or location placards are not provided in any of the Cable Storage areas of the AN/GSM-59. Cables can inadvertently be lost or misplaced if there is not a means of ensuring all are replaced in their storage space.

Recommendation:

Provide a cable inventory placard in each cable storage space.

13. The selector switches on the Fault Locator front panel are fastened by means of high torque screws. Removal of these screws requires a special screw driver.

Recommendation:

Reduce the variety of screws and tool requirements. Per MIL-STD-803 section 10.4.3.7.2, "Whenever possible, identical screw and bolt heads shall be used. This is to enable various panels and components to be removed with one type of tool." Per MIL-E-4153 section 3.2.31.1, "Type and variety of tools shall be kept to the absolute minimum."



MAINTAINABILITY REVIEW REPORT

WS-133 WEAPON SYSTEM



The Boeing Company
Aero-Space Division
Seattle Washington

MAINTAINABILITY GROUP

Organization 2-5261-30
Mail Stop 50-66
Telephone JU6-6263

PAGE: 1

M R R No. 24-3013

DATE: March 12, 1963

FIGURE 'A' NO. 3013

TITLE Test Set, Consoles; Communication - Launch Con

AN/GSM-58

1. Printed Circuit Card Puller 25-27424-1 can not be used to remove and replace Printed Circuit Assemblies 25-28864, 25-28865, 25-31459, and 25-28867. Form C Maintenance Analysis for the AN/GSM-58 Test Set and T.O. 33D9-17-26-1, Communication -- Launch Control Consoles Test Set Operation and Maintenance, call for use of the Card Puller.

Recommendation:

Revise T.O. 33D9-17-26-1 and the Form C Maintenance Analysis to delete the callout for use of the Printed Circuit Card Puller on the AN/GSM-58 Printed Circuit Assemblies. The revised maintenance steps can call out removal and replacement of the Printed Circuit Assemblies in question by hand.

2. The weight designation for the Test Set is marked on the top cover only.

Recommendation:

Mark the unit weight on three exterior surfaces of the case. See MIL-STD-21200C section 3.2.9.

3. The Test Set cable receptacles have dust covers which are the plastic non-captive type.

Recommendation:

Provide captive dust covers.

4. Fault Locator 25-26823-7 can be placed in its case 180° from the proper position.

Recommendation:

Provide guide pins to make it obvious how the unit fits into its case. See MIL-STD-803 section 10.4.3.5.1.

M Engineer:

A. Henschel

Approved by:

J. S. McEachern

Approved by:

5. The cover for Test Set can be placed 180° from its proper position. The tongue and latch fasteners will mate only when the cover is on properly.

Recommendation:

Provide an alignment marker on the case. See MIL-STD-803 section 10.4.3.5.1.

6. Test Cables 29-21627-2, 29-21628-2, 29-21629-2, 29-21630-2, 29-23727-2, and 29-23921 are stored in the cover of the Test Set. A hinged partition with an inner lining of sponge rubber retains the cables within the cover. Difficulty is encountered in closing the partition because of the 2-inch layer of rubber.

Recommendation:

Reduce the thickness of sponge rubber to 1/2 inch to allow proper closing of the partition when all cables are within the storage space.

7. The Fault Locator is fastened to its case by 22 non-captive Phillip's screws.

Recommendation:

Provide captive fasteners. See MIL-T-21200C sections 3.1.11 and 3.1.2.4.

8. There is no cable inventory placard for the cable storage space. It is important for the maintenance technician to account for all cables when his job is finished at the Launch Facility or Launch Control Facility.

Recommendation:

Provide a cable inventory placard for the Test Set.

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM																							
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 2</u> M R R No. <u>25-4388</u> DATE: <u>March 21, 1963</u>																						
FIGURE 'A' NO. 4388 TITLE Test Set, Telephone AN/GTM-3																								
The observations listed are a result of a T.O. V & V conducted at MAFB March 12, 1963. Paragraphs 6-14, 6-23, and Figure 6-7 of T.O. 21-SM80A-2-5 were being verified for SATAF T.O.C.U. 1. The portable carrying case for the AN/GTM-3 Test Set contains the following items: <table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">1 Signal Generator, SG-478</td> <td style="width: 40%; text-align: right;">1272136-501</td> </tr> <tr> <td>2 Test Adapters, MX-4114</td> <td style="text-align: right;">1274183-501</td> </tr> <tr> <td>1 Test Adapter, MX-4115</td> <td style="text-align: right;">1270172-2</td> </tr> <tr> <td>1 Electrical Headset, H-219</td> <td style="text-align: right;">1270157-2</td> </tr> <tr> <td>1 Multimeter, AN/PSM-6</td> <td></td> </tr> <tr> <td>2 Mercury Batteries (1 active, 1 spare)</td> <td style="text-align: right;">1270156-1</td> </tr> <tr> <td>6 Test Leads</td> <td style="text-align: right;">1270154-9</td> </tr> <tr> <td>4 Test Leads</td> <td style="text-align: right;">1270154-11</td> </tr> <tr> <td>4 Test Leads</td> <td style="text-align: right;">1270154-3</td> </tr> <tr> <td>3 Test Leads</td> <td style="text-align: right;">1270154-18</td> </tr> <tr> <td>3 Test Leads</td> <td style="text-align: right;">1270154-24</td> </tr> </table> A total of 28 items are contained within the carrying case however there is no label or placard on the case giving a list of the contents. <u>Recommendation:</u> Provide a label or placard on the partition of the carrying case cover listing the contents of the case. Per MIL-T-21200C, Military Specification - Test Equipment for use with Electronic and Fire Control Systems section 3.2.9.7, "Labels showing wiring and schematic diagrams, lubricating and operating instructions, safety notices, list of tools, list of contents, and similar information shall be provided where space permits. Labels shall be legible and shall be designed to remain so for the service life of the equipment on which they are mounted." 2. The use of a termination resistor is required for calibration of the Signal			1 Signal Generator, SG-478	1272136-501	2 Test Adapters, MX-4114	1274183-501	1 Test Adapter, MX-4115	1270172-2	1 Electrical Headset, H-219	1270157-2	1 Multimeter, AN/PSM-6		2 Mercury Batteries (1 active, 1 spare)	1270156-1	6 Test Leads	1270154-9	4 Test Leads	1270154-11	4 Test Leads	1270154-3	3 Test Leads	1270154-18	3 Test Leads	1270154-24
1 Signal Generator, SG-478	1272136-501																							
2 Test Adapters, MX-4114	1274183-501																							
1 Test Adapter, MX-4115	1270172-2																							
1 Electrical Headset, H-219	1270157-2																							
1 Multimeter, AN/PSM-6																								
2 Mercury Batteries (1 active, 1 spare)	1270156-1																							
6 Test Leads	1270154-9																							
4 Test Leads	1270154-11																							
4 Test Leads	1270154-3																							
3 Test Leads	1270154-18																							
3 Test Leads	1270154-24																							
<table style="width: 100%; border: none;"> <tr> <td style="width: 33%; border: none;"> M. Engineer: <i>A. Henschel</i> A. Henschel </td> <td style="width: 33%; border: none;"> Approved by: <i>[Signature]</i> for D. Heck </td> <td style="width: 33%; border: none;"> Approved by: </td> </tr> </table>			M. Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>[Signature]</i> for D. Heck	Approved by:																			
M. Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>[Signature]</i> for D. Heck	Approved by:																						

2. (Continued)

Generator SG-478; however, none is available with the test set necessitating use of work around procedures.

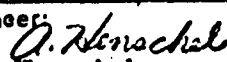
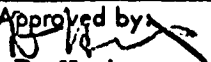
Recommendation:

Provide the necessary termination resistor(s) as part of the Test Set.

3. The test points on the Test Adapters are not compatible with the banana jacks of the test leads for commercial test equipment such as the AN/PSM-6.

Recommendation:

Provide test points on the Test Adapters which are compatible with the test leads of the commercial equipment used with this Test Set. Per MIL-STD-803 section 3.1 "Insofar as possible, selection of components, marking, coding, labeling, and arrangement schemes (equipment layout) shall be standard for all system equipment. Where equipment units are manufactured by different contractors, uniformity shall be accomplished by agreement with the procuring activity."

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 3</u> MRR No. <u>26-4152</u> DATE: <u>April 16, 1963</u>
FIGURE 'A' NO. 4152 TITLE Test Equipment, Electronic Facility - Base Maintenance AN/GSM-82 (v).		
1. A consistent identification system is not being used for the front panel, fuses of the various adapters and test sets comprising the AN/GSM-82(v). Listed below are comments pertaining to some of the units: a) Test Adapter MX-4692 has three active fuses (8A, 1/4A, 1/4A) in the power section of the adapter, it is not obvious which power circuits they are protecting. <u>Recommendation:</u> The fuses should be labeled as follows: - The 8A fuse should be designated as 28VDC, 8A. - Designate one of the 1/4 A fuses as Relay K9, 1/4A. - Designate the other 1/4A fuse as 115 VAC, 1/4A. b) Test Adapter MX-4694 has four fuses on the front panel, each does not have an ampere rating label. <u>Recommendation:</u> Provide additional labels designating F1 as being 1AMP and F2 as being 3/8AMP, also label the ampere rating of each spare fuse. c) Test Adapter MX-4697 has four active fuses in the power section labeled only with their ampere rating, it is not obvious what power circuit they are protecting. <u>Recommendation:</u> Label the fuses to give the following information: 5A fuse should be designated 28VDC, 5A.		
M Engineer:  A. Henschel	Approved by:  D. Heck	Approved by:

c) (Continued)

2. 1/4A fuse should be designated Relay K1, 1/4A.
3. 1/2A fuse should be designated 100 VDC, 1/2A.
4. 1/16A fuse should be designated Relay K2, 1/16A.

- d) Test Adapter MX-4693 has the two active fuses in the power section labeled with ampere rating only, it is not obvious which power circuit each is protecting.

Recommendation:

Label the 10AMP fuse as being 28VDC, 10AMP, and the 1/4 AMP fuse as Relay K1, 1/4AMP.

- e) Dummy Decoder Test Set TS-1796 has two fuses F1 and F2 which are not labeled with their function and ampere rating.

Recommendation:

Label F1 for +28VDC, 1AMP and F2 as the SPARE 1 AMP.

- f) Programmer Group Test Set - Power Supply TS-1795 has three fuses (F1, F2, and F3) which are labeled only with their circuit designation and ampere rating.

Recommendation:

Label F1 for ϕA , 115VAC, F2 for ϕB , 115VAC, and F3 for ϕC , 115 VAC, in addition to the ampere rating.

- g) Tester - Communications Test Set TS -1789 2AMP fuse has no function label.

Recommendation:

Label the function of the 2AMP fuse as being 28VDC, 2AMP.

- h) DC Power Filter Test Set TS-1793 has four fuses (2 active, 2 spare) with no ampere rating labels.

Recommendation:

Label the 150VDC fuse as being 150VDC, 1 AMP and the 28VDC fuse as being 28VDC, 8AMP. Also label the ampere rating of each spare.

- 1) Electrical Dummy Load DA-312 has three active fuses which are not labeled as to their function.

Recommendation:

Power circuit being protected is the three phase 115V, 400 CPS. Label each fuse for the phase it is protecting in addition to the ampere rating.

2. Cable W-18, Boeing P/N 29-26178-1, has terminals E1 and E2 (BACT12AC-55) which are not large enough for the Avtron T242B Electrical Load Bank terminals.

Recommendation:

Provide larger terminals for the W-18 cable.

3. Units weighing over 45 lb are not labeled with their weight designation.

Recommendation:

Label the weight on units weighing over 45 pounds. Per MIL-STD-803 section 10.4.3.1.1, "All units weighing over 45 pounds or more shall be prominently labeled with their weight."

4. Several units comprising the AN/GSM-82(v) have indicator lights which do not have a "self test" or "press to test" capability. These units are:
 - a) Programmer Group Test Set -- Power Supply, TS-1795;
 - b) Programmer Group Test Set -- Voltage Regulators, TS-1794;
 - c) Voice Reporting Test Set Tester, TS-1823.

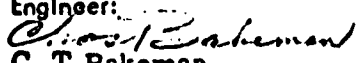
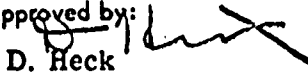
Recommendation:

Provide a lamp test capability for the above indicators. Per MIL-STD-803 section 6.3.4, if it is not possible to provide a master light test control, each indicator should have a "press to test" capability.

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1</u> M R R No. <u>27-4167</u> DATE: <u>April 17, 1963</u>
FIGURE 'A' NO. 4167 TITLE Electrical Load Bank		
The following maintainability comments were reported by the M engineer at VAFB during the Verification and Validation of paragraph 11 of T.O. 31X3-12-8-2, Programmer Group Field Maintenance. 1. The Avtron Model T242B Electrical Load Bank weighs over 70 pounds, however the unit has no weight labels. <u>Recommendation:</u> Provide weight labels for the Electrical Load Bank. MIL-STD-803 section 10.4.3.1.1 states, "All units weighing 45 pounds or more shall be prominently labeled with their weight." 2. The Load Bank is adjusted by using a Multimeter (AN/PSM-6) and test leads (see paragraph 11-19d of T.O. 31X3-12-8-2) however the terminals of the Load Bank have no provision for insertion of test leads. This requires the technician to press the test leads against the Load Bank terminals while a second technician manually makes the load adjustment. Disadvantages of this situation are: a) The requirement for two technicians for a simple load adjustment. b) Possible adjustment error due to poor electrical contact between the test leads and Load Bank terminals. <u>Recommendation:</u> Drill holes in the ends of the Load Bank terminals to accomodate the banana jacks of the AN/PSM-6 test leads. MIL-STD-803 section 10.6.1.5 states, "Primary test points used in adjusting the unit shall be located close to the controls and displays also used in the adjustment."		
M Engineer: <i>A. Henschel</i> A. Henschel	Approved by: <i>D. Heck</i> D. Heck	Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: 1 M R R No. 28-1283-1 DATE: 4/24/63	
FIGURE 'A' NO. 1383		TITLE Motor-Generator Set; Launch Facility	
1. The control assembly access plate is secured by 41 hex-headed bolts. Removal of the bolts for maintenance service and/or checkout operations involves extensive plate removal time. There is no indication in the Figure A or elsewhere that this method of securing the panel is necessary for structural or security reasons. Section 10.4.3.5.5 of MIL-STD-803 states "Where space permits, hinged covers should be used to reduce the number of fasteners required." <u>Recommendation:</u> It is recommended that the bolt-on access covers on the control assembly be changed to hinged door-type covers at the first opportunity of design or supplier change.			
M Engineer: <i>C. T. Bakeman</i> C. T. Bakeman		Approved by: <i>D. Heck</i> D. Heck	Approved by:

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1</u> MRR No. <u>29-1367</u> Rev. A DATE: _____
FIGURE 'A' NO. 1367 TITLE Motor Generator Set; Launch Control Facility		
The following maintainability problems and corrective actions are recommended for combination with other changes during "up-dating" of delivered WS-133A. 1. Several occasions have been experienced during A & C/O and initial operations of the M.G. set where lubrication deficiency initiated destructive bearing wear. Supplemental lubrication, with the M.G. Set in place, is very difficult due to close quarters and inaccessible lub fittings. <u>Recommendation:</u> Provide extensions to the existing fittings with a tube and lubrication fitting located to be accessible from the LCF floor on removal of the floor plate. Incorporation on delivered units can be accomplished by kit installation during other changes or during maintenance activity. 2. In place maintenance of the control panel is almost impossible due to the location of the cover plates and close quarters in the pit. As a result, the T.O. calls for removal of the M.G. Set for most of the fault isolation steps. This involves as much as a ten hour downtime during which the LCF is in-operative. <u>Recommendation:</u> Mount the M.G. control assembly in a horizontal position on top of the motor generator assembly as previously recommended and provide for hinged cover plates on the control assembly. Redesign so that the 60 cycle regulator, 400 cycle regulator and other fault potential items may be removed and replaced by plug-in application, or by terminal connections and bolt on fastenings. Physics Technology advises that satisfactory shielding can be obtained by a beryllium-copper foil shield on the piano type hinges and by a line contact with 20#/sq. in. applied by the plate catches.		
M Engineer: <i>T. C. Bakeman</i> T. C. Bakeman	Approved by: <i>D. Heck</i> D. Heck	Approved by: _____

	MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM	
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 2</u> M R R No. <u>30-MGE-1</u> DATE: <u>MAY 13, 1963</u>
FIGURE 'A' NO. M.G.E. TITLE Storage-Identification of Removable Items		
Reference: (a) Memo 2-6933-00-100, B. W. Bates to J. D. Rough, April 29, 1963 Sub: Adapter Identification and storage Considerations Fig. A's 4319 & 4636; (b) MIL-T-21200C (ASG) par. 3.2.9.7; (c) D2-14256 Minuteman Maintainability Guide for Design Criteria par. 7.1.1.3 (5); (d) Coordination Sheet 2-7841-3-315, Dated Jan. 8, 1963; Subj.; Maintenance Problems Due to mixing of components - - - (e) ECP 115 R1 Revision C on Fig. A 4319 and 4636. 1. This maintainability report summarizes reports made on individual MGE Fig. A's and recommends an "across the board" action to provide adequate storage identification for removable items in all M.G.E. equipment having such items. On eleven M.G.E. Figure A items, previous MRR's have contained comments on lack of removable item storage-identification which impairs checkout and maintenance operations. Reference (d) coord sheet recommends that all loose components be identified by label and that a placard or listing of all such components be provided on the M.G.E. unit and/or storage case. Reference (a) memo points up this need on two M.G.E. fig. A's and recommends a system, attachment B to reference (a), that is suitable for general use. Reference (b) MIL SPEC, and reference (c) Boeing document call for identification "of storage space" and "labels" showing "lists of tools and contents" -- "where space permits." Field experience reports serious problems from intermixing of cables and components between MGE units, and that loose items are being misplaced at test locations. This involves extended downtime on operational equipment, increased maintenance and spares costs, and continual degradation of M.G.E. capabilities. A suitable placard on each M.G.E. unit, listing identified portable items and their proper storage space, provides an automatic inventory.		
M Engineer:  C. T. Bakeman	Approved by:  D. Heck	Approved by:

1. (Continued)

of required items and assures orderly availability of the items when needed at site.

Recommendation:

It is recommended that the M.G.E. design Unit undertake a check of all M.G.E. units having loose removable items and that a placard identification as outlined in attachment B to reference (a) be provided for the M.G.E. units not now so equipped. This placard, to be located on the carrying case, should list all loose items, identify each item and its proper storage space.

New or revised M.G.E. units should be similarly treated as a standard practice. This should be clearly established in the design action on reference (e) ECP 115 R1 for Fig. A 4319 and Fig. A 4636.

	MAINTAINABILITY REVIEW REPORT VS-100 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1</u> M R R No. <u>31-4319</u> DATE: <u>May 13, 1963</u>	
	FIGURE 'A' NO. 4319 TITLE Adapter Set -- Connector		
The figure A 4319 equipment in its present state consists of two items, the Connector Adapter Group to be used at the SMSB and the Operational Maintenance Adapter Set to be used at the LF and LCF. Present instructions for use of this equipment, in checking OGE and MGE at the organizational and field maintenance levels, are inadequate and even non-existent for certain Figure A equipments. For example: T.O. 21-SM80A-2-11, Aero-Space Ground Equipment Power and Miscellaneous Systems, section 2-30 calls out a continuity checkout of the Main Distribution Box at the LF (Figure A 1337). The Adapter Set is contained within four portable suitcases and consists of many adapters, however the T.O. does not call out which adapter to use, where to find it, and how to use it. T.O. 21-SM80A-2-3, Control and Monitoring System, section 2-20 calls for <u>direct probing</u> of connectors on the Launch Control Console (Figure A 1243) and its associated cabling (Figure A 1246) without any reference to use of the Adapter Set. The lack of maintenance instructions for use of the Connector Adapter Set renders it unsatisfactory from a maintenance viewpoint, yet ECP 115 R1 is proposing additional adapters for the Operational Maintenance Adapter Set. Also proposed are additional connectors for the Connector Adapter Group and redesignation of this item as Figure A 4636. The real need is for proper instructions on how to use the existing equipment. Providing additional adapters will not solve the probing problem unless adequate instructions are provided. <u>Recommendation:</u> Provide proper instructions for the use of the Figure A 4319 test connectors in all appropriate Technical Orders.			
M Engineer: <i>A. Henschel</i> A. Henschel		Approved by: <i>D. Heck</i> D. Heck	

MAINTAINABILITY REVIEW REPORT WS-133 WEAPON SYSTEM		
The Boeing Company Aero-Space Division Seattle Washington	MAINTAINABILITY GROUP Organization 2-5261-30 Mail Stop 50-66 Telephone JU6-6263	PAGE: <u>1 of 4</u> M R R No. <u>32-1201</u> DATE: <u>MAY 21 1963</u>
FIGURE 'A' NO. 1201 TITLE Programmer Group		
1. Figure A 1201, Programmer Group has six replaceable drawer assemblies. Each of the drawers weighs over forty-five pounds and is unmarked as to weight. RECOMMENDATION: All units weighing over 45 pounds or more shall be prominently labeled with their weight (MIL-STD-803 section 10.4.3.1.1). 2. On the figure A 1201 wire tray assembly, replacement of a contact pin on a connector-plug will place the launch facility out of commission for five hours or more. This downtime is due to inaccessibility of connectors, wires, and cables combined with insufficient slack in the wire bundle. RECOMMENDATION: Provide for repair of damaged connectors without the necessity for removing the wire tray assembly. This can be accomplished by providing slack in the wire bundle to permit replacement of connectors. (BAC 5116 section 5.3 lb. Slack in Wiring, "Allow for reterminating at least two times, where practicable"). 3. The Figure A 1201, utilizes Pyle-National (BAC-C-45 series) connectors to bring the intrasite cabling to the top rear of a standard Minuteman rack. The required space for access to the connectors was waived at the Critical Design Review in April 1961 on the basis that Boeing would provide a suitable tool to correct this condition. A proposed change to Figure A 4386, Strap Pipe Wrench, never reached ECP status. The proposal was to provide a hardware change with substitution of a set of Pyle-National special wrenches for the present wrench. The revised Figure A 4386 provided wrenches (split collect type), adapters for connectors with enlarged back shells, torque wrench with spanner adapters, and a strap wrench. The revised figure A 4386 would have applied to all connectors including 45 and 90 degree types.		
M Engineer E. T. Niemi	Approved by: D. Heck	Approved by:

3. (Continued)

Torquing requirements of the Pyle-National connectors have been established in cabling installation drawings (example 24-2230, Malmstrom AF Base) and with Boeing Process Specifications 5116 and 5121. The torque setting insures complete engagement of the pins to overcome contact flutter, a source of electrical noise on low frequency vibrations, completion of Electro-Interference (E-I) ring contact between the mating plug and the receptacle, and closure of the environment seal. If proper torquing is a requirement for manufacturing and A & CO, then the Air Force has a requirement for a capability to properly torque the connectors after repair.

RECOMMENDATION:

The change proposal for Figure A 4386 should be reinstated or, a visual display should be utilized to provide a check reading of torque; for inspection purposes, all connectors should be designed so that a color line appears or disappears when connection is complete. Color should be permanent and of high visibility, i.e., fluorescent orange. Design of all connectors within a system should be consistent in the color selected, and method of indicating full connection.

4. As per Boeing drawing 25-22782, the Power Supply Regulator Assembly Drawer (25-22042) has silk screened on top cover: "CAUTION": "This drawer contains matched sets of printed circuit cards. The assemblies boxed together denote which cards must be installed and replaced as matched sets." Following this, on the cover, are listed each matched set part number, module assembly drawing number, and module reference designation. ECP 358 redesign was to include elimination of these matched sets. This ECP was disapproved by BSD and has been cancelled. Hence the regulator drawer assembly requires shipment to depot, when trouble cannot be corrected by replacement of printed circuit card assemblies or drawer wiring repairs; authority for action is Field Maintenance, Programmer Group, T.O. 31X3-12-8-2, revised 8 April 1963. Conversion of individual printed circuit assemblies (PCA) by module assembly drawing number into matched sets, is provided with Boeing drawing 25-29402.

Individual unmatched cards have been ordered and delivered as Air Force Spares without functional test.

RECOMMENDATION:

- (a) Resolve the problem at field level maintenance by providing the adjustment and functional test for replacing one half of a PCA matched set

4. (a) (Continued)

on the following: Adjust module assembly drawing numbers, a) 25-29315-10, b) 25-29320-7, c) 25-29337-10, d) 25-29342-9, to match module assembly drawing numbers, a) 25-23421-8, b) 25-23423-8, c) 25-23431-8, d) 25-23423 and 25-23433-8 respectively. The Functional Test Liaison Group, 2-6512 are to provide tests to eliminate oscillation problems possible if unmatched PCA are put together in a set.

(b) The Minuteman Service Publications Unit should incorporate in T.O. 31X3-12-8-2 coverage for field level matching necessary to comply with "CAUTION" notation of Boeing drawing 25-22782.

5. Problems on the decoder safe assembly door (25-25042), timer sequence drawer (25-22037): Malmstrom FSRR-341SMW-3R, dated 19 November 1962, -10R, dated 3 December 1962 and -15R, dated 3 December 1962 reported conditions wherein overtravel damage (falling into the drawer face below) or jamming (by this lower drawer) may have occurred to the door assembly. Misuse of tools appears to have damaged the combination lock mechanism, door pin spring handle, door lock bolt, and sprocket or hinge assemblies.

RECOMMENDATION:

- (a) Redesign Decoder Safe Door Assembly (25-25042) to hang, in the unlocked position, free of any contact with the Launch Sequence Programmer drawer (25-22038). Provide a spring return from an overtravel position which occurs on manual holding to load and remove decoder or decoder relay for the decoder vault, when the safe door is in the open position.
- (b) An immediate solution is to provide a rubber bumper for the safe door to reduce damage and impact stress to door, dial and lock mechanism.
6. To install the launch enable switch K1 in the Launch Sequence Programmer drawer (25-22038), the drawer wiring harness has to be displaced, connections to wires determined, and access gained to solder these wires to switch terminals. Some seventy-two wires are to be soldered. Twenty manhours are required to install and twenty-two manhours to replace this switch.

Shipment to the depot of a defective switch is required by instructions in the Field Maintenance, Programmer Group, T.O. 31X3-12-8-2. ECP 358, now cancelled, was to facilitate installation of this switch by elimination of soldering.

RECOMMENDATION:

Replace the Launch Enable Switch Assembly, Boeing Model Specification 10-20802, with new design. Switch enclosure should be removable for ease

RECOMMENDATION: (continued)

of lead installation and testing. Replace solder terminals with pigtails to release internal congestion, simplify replacement of switch, and provide change from hermetic seal to environmental seal. This is a recommendation for renewal of ECP 358 features for the launch enable switch, Vendor Part Number MH6084EMSF4.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1201-1/3092-1 Date January 18, 1963 Page 1 of 9
 Prepared by John L. Wright 2-5261 M/S 50-66 phone JU 6-6263
 Figure A No. 1201/3092 Nomen Programmer Group/Programmer Group Test Set
 Dwg. No. 25-22036-87/25-26725-1 Serial No. Not Recorded
 Observed Event Demo 1-18 Location Malmstrom AFB Date November 7, 1962
 Title or Description Fault Isolation of Programmer Group
 T.O. Procedures T.O. 21-SM80A-2-3: Par. 2-52 through 2-60

MAINTAINABILITY CHECKLIST				
1	Fault Isolation	3	14	Lines and Cables
2	Standardization	N/O	15	Fasteners
3	Interchangeability	N/O	16	Covers, Cases, Shields
4	Packaging, Mounting	4	17	Disposable Modules
5	Accessibility	3	18	Test Equipment
6	Work Space	4	19	Servicing, Handling, Equip.
7	Testing, Servicing	3	20	Tools
8	Displays	4	21	Platforms, Stands, Shelters
9	Handles	4	22	Technical Order
10	Labels, Marking	3	23	Figure A
11	Controls	4	24	Form B/C
12	Work Aids	N/A	25	Specifications
13	Connectors, Connections	2	26	Personnel Requirements

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

ATTACHMENT: "Minutes of Post-Demonstration Critique of Class I Demonstration 1-1f
 8 November. 1962

Item 1. Fault Isolation

General Fault Isolation capability is apparently quite good, except during final end-to-end checkout. If a malfunction indication occurs during end-to-end checkout (paragraph 2-60 of T.O. 21-SM80A-2-3), repetition of the entire programmer group checkout procedure is required. It would be much less time-consuming if the end-to-end checkout procedure contained instructions directing the technician to repeat only specific drawer checks for any given malfunction indication. (NOTE: This problem so impressed the Air Force Technical Approval Team that it was made a matter of record. Refer to paragraph 3 of the attached Post-Demonstration Critique Minutes.)

RECOMMENDATION:

The Programmer Group end-to-end checkout procedure should be revised to include instructions directing the technician to repeat only specific drawer checks for any given malfunction indication.

Item 5. Accessibility

Programmer Group connectors, to which test set cables must be connected, are located at the top rear of the rack. They are therefore not readily accessible without a stepladder. Moving the stepladder in and out of position is time-consuming and clumsy, and might conceivably lead to damage of the test set. The ladder cannot be left in position, because it obscures the equipment and is simply in the way.

RECOMMENDATION:

One possible way of eliminating the ladder problem would be redesign of Figure A 1201 to provide completely accessible test connectors, possibly also eliminating the necessity for breaking some of the connections at the top rear of the rack.

Item 7. Testing and Servicing

One of the paramount Maintainability criteria specified for Minuteman in STL Document 6120-6882-DU-RDI (and restated in M Memo 62-1) requires that test points for fault isolation at the operational site be brought to standard connectors on drawer fronts. The implication is that test connections are to be readily accessible. Programmer Group drawers have indeed been provided with individual test connectors, but many additional connections are required at the top rear of the rack during checkout. The poor accessibility of these connections is discussed under Item 5.

RECOMMENDATION:

The test connectors recommended under Item 5 should be located on the face

RECOMMENDATION: (Continued)

of a new drawer A5, which would replace the present blank panel between drawers A4 and A6.

Item 10. Labels and Marking

- a. In preparation for the demonstration, a Boeing technician inserted a faulty circuit board in one of the Programmer Group drawers. He had to try several times before he was able to insert it so that it would mate properly with its connector. The difficulty was caused by the fact that it is very hard to select simultaneously the proper slots into which both ends of the card should slide. It is quite easy to start the card in non-opposing slots, resulting in crooked card installation and possibly causing connector or card damage.

RECOMMENDATION:

All slots in which cards are installed should be plainly marked to differentiate them from unused slots. Opposing slots should both be marked, to preclude misalignment of boards during insertion.

- b. Plastic program cards are used to operate the 3092 test set. Though the T.O. contains instructions specifying proper insertion of the cards in the card reader, it would be quite possible for a technician to insert them wrong-end-first.

RECOMMENDATION:

Test set program cards should have a positive printed indication of the proper end to be inserted into the card reader.

Item 13. Connectors and Connections

- a. Because of the fact that the 3092 Test Set was apparently designed to connect to several already - existing operational connectors of Fig. A 1201, there are 19 cable connections to be made before any checkout can be accomplished. Naturally, this is very time-consuming, especially since the technician must make over half of them in an area of limited accessibility, while standing on a stepladder. (NOTE: This problem, too, was made a matter of record by the Air Force Technical Approval Team. Refer to paragraph 4 of the attached Post-Demonstration Critique Minutes, which is a dignified summary of the much more vehement off-the-record comments made by several of the critique attendees).

RECOMMENDATION:

The multitude of connections required could be greatly reduced through incorporation of the test connectors recommended under Items 5 and 7. Large

RECOMMENDATION: (Continued)

multi-pin test connectors should be used, combining many circuits which under present conditions can be completed only by separate connections to many existing operational connectors.

- b. It undoubtedly will remain necessary to disconnect at least some of the connections at the top rear of the Programmer Group, to isolate the equipment from external circuits during checkout. But it may be possible that some of the operational connections could remain intact without affecting the checkout operation.

RECOMMENDATION:

Only those operational programmer group connections which would affect the checkout operation should be disconnected. As many connections as possible should remain undisturbed.

Item 14. Lines and Cables

The programmer group checkout procedure requires self-test of the 3092 Test Set before actual checkout of the programmer group. Special self-test connections of the 19 test set cables are required; this occupies over half of the time required for self-test performance. Of the 19 cables, 16 are then disconnected (from the special self-test distribution box) and reconnected elsewhere. By the time this is accomplished, the area around the programmer group resembles the aftermath of an explosion in a spaghetti factory, no how methodically the reconnections were done. The programmer group is draped with cables of many different sizes; the smallest cables incongruously are terminated in the largest connectors, to mate with the operational programmer group connectors. Through it is not noted specifically in the attached Minutes, the Technical Approval Team Chairman stated during the critique that there "must be over 1000 dollars tied up just in cables and connectors for the 3109 Test Set."

RECOMMENDATION:

Incorporation of the programmer group test connectors recommended under Items 5, 7, and 13a, coupled with redesign of the 3092 Test Set as recommended under Item 18, would greatly reduce the confusion and loss of time which are inherent in checkout of the programmer group under present conditions.

Item 15. Fasteners

A Boeing technician removed the cover of a programmer group drawer to insert a faulty circuit board. The cover was held by 26 non-captive screws.

RECOMMENDATION: (Continued)

multi-pin test connectors should be used, combining many circuits which under present conditions can be completed only by separate connections to many existing operational connectors.

- b. It undoubtedly will remain necessary to disconnect at least some of the connections at the top rear of the Programmer Group, to isolate the equipment from external circuits during checkout. But it may be possible that some of the operational connections could remain intact without affecting the checkout operation.

RECOMMENDATION:

Only those operational programmer group connections which would affect the checkout operation should be disconnected. As many connections as possible should remain undisturbed.

Item 14. Lines and Cables

The programmer group checkout procedure requires self-test of the 3092 Test Set before actual checkout of the programmer group. Special self-test connections of the 19 test set cables are required; this occupies over half of the time required for self-test performance. Of the 19 cables, 16 are then disconnected (from the special self-test distribution box) and reconnected elsewhere. By the time this is accomplished, the area around the programmer group resembles the aftermath of an explosion in a spaghetti factory, no how methodically the reconnections were done. The programmer group is draped with cables of many different sizes; the smallest cables incongruously are terminated in the largest connectors, to mate with the operational programmer group connectors. Through it is not noted specifically in the attached Minutes, the Technical Approval Team Chairman stated during the critique that there "must be over 1000 dollars tied up just in cables and connectors for the 3109 Test Set."

RECOMMENDATION:

Incorporation of the programmer group test connectors recommended under Items 5, 7, and 13a, coupled with redesign of the 3092 Test Set as recommended under Item 18, would greatly reduce the confusion and loss of time which are inherent in checkout of the programmer group under present conditions.

Item 15. Fasteners

A Boeing technician removed the cover of a programmer group drawer to insert a faulty circuit board. The cover was held by 26 non-captive screws.

RECOMMENDATION:

Fewer screws should be used to hold programmer group drawer covers. Captive screws would be much more desirable than non-captive screws, to facilitate handling.

Item 18. Test Equipment

- a. As mentioned under Item 14, special self-test connections of the 19 test set cables, 16 of them to a separate "suitcase" distribution box which is considered part of the test set, are required. The distribution box serves no other purpose than to interconnect the cables during the self-test procedure. The time presently required just for making all the self-test connections is over half an hour. (The whole self-test, including hookup, takes less than an hour.)

Incorporation of the programmer group test connectors recommended under Items 5, 7, 13a, and 14 would require redesign of the 3092 Test Set Fault Locator, to provide compatible test cabling. The redesigned fault locator would have a significantly reduced number of test cable connectors. In fact the reduction would be so significant that it should be possible to incorporate the self-test interconnection function now performed by the distribution box into the fault locator itself. The self-test interconnection connectors could be placed on the fault locator in the space to be vacated through reduction of the present number of test connectors. The test set would then comprise only two "suitcases" instead of three, since the distribution box would be eliminated.

Reduction in the number of test cables would alleviate the problems which are naturally inherent in storage and handling of so many cables for one purpose. It would also achieve a time saving of well over 10 per cent in the total programmer group checkout operation.

RECOMMENDATION:

The advantages to be realized through redesign of the 3092 test set (and the 1201 programmer group, of course) are great enough that such redesign is strongly recommended.

- b. An even more significant time saving could be realized if the Test Set redesign were to include incorporation of a semi-automatic program card reader. Perhaps as many as 200 cards must be used during the entire checkout operation. Manual insertion of that many cards, one by one, is naturally very time-consuming and tedious.

RECOMMENDATION:

Redesign effort should include at least consideration of the possibility that a suitable semi-automatic card reader might be incorporated in the test set.

NOTE

Recommendations under a and b, above might not necessarily be valid if the present Programmer Group maintenance philosophy were abandoned. If a philosophy of wholesale drawer replacement without on-site checkout were adopted, actual usage of the 3092 Test Set might not be frequent enough to allow a significant overall time saving through incorporation of the recommended improvements.

- c. "The card reader handle must not be left in the up position for more than three minutes during the following tests. Launch Enable Switch may burn up if card reader is engaged more than 3 minutes. This caution does not apply to card number -216."

This caution note is inserted after paragraph 2-60 step a. of T.O. 21SM80A-2-3. It is hardly adequate as the sole protection against burning up the Launch Enable Switch. The technician certainly cannot be expected to start a stop-watch each time he lifts the handle, because he isn't told to do so. And, since he is primarily concerned with performing the step-by-step checkout procedure, it will be very easy for him to forget the caution note before he gets very far into that procedure.

RECOMMENDATION:

Automatic protection of the Launch Enable Switch should be built into the 3092 Test Set. A timer should start each time the handle is lifted, and automatically either sound a warning or disconnect the circuit after three minutes.

- d. Part numbering of program cards is very confusing. Card decks and individual cards are identified by dash numbers of the same drawings. As a typical (but hypothetical) example of the confusion that can result, assume that deck no. 25-26646-1 contains cards no. 25-26646-137 through no. 25-26646-164. If the technician is informed that the -1 deck contains cards -137 through -164 he can grasp and remember this fairly well. He will even be able to sort the cards properly if the -1 deck inadvertently gets mixed with a -13 deck consisting of cards -108 through -135. But what happens to the cards when there is a minor equipment change?

Suppose that equipment rework necessitates changes in cards -138, -147, -149, -151, -152, and -161. These dash-numbers must be dropped and six new cards, -165 through -170, must be added. Of course this changes the deck dash-number to -2. And what cards does it contain? The ease of remembering is suddenly gone, because the deck is no longer an easily remembered unbroken sequence of card dash-numbers. Now how can the technician at the Launch Facility sort mixed decks, or even be sure his unsorted deck is really complete? For that matter, since individual cards are marked only with the card dash-number and nowhere indicate the deck dash-number or equipment part numbers to which they apply, how can he even be sure that deck is actually the proper one for the equipment he is checking?

NOTE

The above example is really more factual than hypothetical. It is based upon the situation which actually exists for the card deck specified in paragraph 2-59 steps a through i of T.O. 21-SM80A-2-3. The only thing hypothetical is the initial deck configuration.

RECOMMENDATION:

The best way to minimize confusion among the maintenance personnel would be to adopt a card deck numbering system in which each deck is composed of serially-numbered cards (beginning in each case with 1, 2, 3, etc.), all bearing the deck part number. Equipment changes should be accommodated by decks with new dash-numbers to the basic deck part number, but each new deck should again have cards numbered 1 and on. Then if the technician's deck is incomplete or contains cards belonging in another deck he will know it immediately.

Item 22. Technical Order 21-SM80A-2-3 (changed 6 January 1963)

- a. Paragraphs 2-56 through 2-60 are inconsistent in their methods of identifying test set program card decks. The identification used is:

Paragraph 2-56 step a - "25-30947-125 through 25-30947-147"

Paragraph 2-58 step a - "25-31059-106 through 25-31059-110"

Figure 2-34 - "Deck Number"
"25-26643-140"
"25-26644-1"
"25-26644-165"
"25-26645-1"

Paragraph 2-59 step a - "deck no. 25-26646"

Paragraph 2-60 step a - "25-26642-165 through 25-26642-232"

Note that in some cases reference is made to a series of cards, and in others a deck number is specified. No information is given to indicate how many or what cards constitute a given deck (until farther along in subsequent steps; and then the technician is simply told, for example, to use "card numbers -139 through -171 except for numbers -147, -149, -151, -152, and -161," without any indication of the deck number). No information is given to indicate that a given series of cards may intentionally have missing cards (until, again, farther along in subsequent steps). The inconsistency and incompleteness of information

are very apt to confuse the technicians, and in fact did confuse the Boeing technicians who conducted the demonstration covered by this report.

RECOMMENDATION:

Each card deck and its contents should be completely identified in the first time it is specified. Example: "Remove program deck 25-26646-2 (cards 25-26646-137 through -171, except for missing cards -138, -147, -149, -151, -152, and -161) from card container for..." (All of the statements tabulated above should be revised.)

- b. Paragraph 2-56 step a initiates use of program cards "25-30947-125 through 25-30947-147." Then, during use of these cards, paragraph 2-56 steps v-1 and ax-1 require use of cards -148 and -149, respectively. From the associated text it is obvious that steps v-1 and ax-1 were inserted as alternates for paragraphs steps v and ax, to be used when a 25-26725-2 test set is used in place of the original 25-26725-1 test set. Apparently paragraph 2-56 step a was overlooked when the change was inserted.

RECOMMENDATION:

Paragraph 2-56 step a should be changed to include the -148 and -149 cards. To accomplish both this and the recommendation made under a. above, the following revised wording is suggested to replace paragraph 2-56 step a:

"NOTE"

"Omit step a when using test set 25-26725-2. Omit step a-1 when using test set 25-26725-1.

"a. Remove program card deck 25-30947-2 (cards 25-30947-125 through -147) from card container. Insert deck in UNTESTED CARDS slot of Fault Locator (figure 2-26).

"a-1. Remove program card deck 25-30947-3 (cards 25-30947-125 through -149, except for missing cards -128 and -139) from card container. Insert deck in UNTESTED CARDS slot of Fault Locator (figure 2-26)."

- c. Paragraph 2-56 step b specifies that, among other required indications, a red light "should start to flash at 4 cps." The immediate reaction of a technician reading the requirement is to attempt a count, to verify that the rate is indeed 4 cps, as specified. Naturally, it is impossible to count that fast, and twice as impossible to count the 8 cps specified in the note of step 2-56 ay (3).

RECOMMENDATION:

Visual verification of 4 cps and 8 cps flash rates is impossible. The 4 cps and 8 cps rates should therefore be replaced by general descriptive terms (such as "rapidly" and "very rapidly", respectively). Steps requiring such generalization are 2-56 b, 2-56 ay (3) NOTE, 2-56 ay (5), and 2-57b.

- d. Identical notes inserted before steps 2-56 d, 2-58 c, 2-59 f, and 2-60 c specify the proper orientation of program cards for insertion in the card reader. The note states that "cards must be inserted with printed side up and the cut end toward the operator inserting the card." Since the operator is free to move anywhere he pleases around the fault locator "suitcase," this is not a very precise instruction.

RECOMMENDATION:

Program card insertion instructions given in the notes preceding steps 2-56 d, 2-58 c, 2-59 f, and 2-60 c should be changed to use a fixed object, rather than the operator, as the point of reference. For example, it would be much more clear to state "Cards must be inserted with printed side up, and cut end away from the card reader," or "cards must be inserted uncut-end-first, with printed side up."

- e. Paragraph 2-59 tells the technician to look up a card deck number in figure 2-34, and then to "Use this deck after performing steps a through j." Steps a through j then use an entirely different deck. Reference to figure 2-34 in paragraph 2-59 is premature, and only causes confusion in the technicians' minds.

RECOMMENDATION:

The second and third sentences of paragraph 2-59, referring to figure 2-34, should be deleted. Step 2-59 k should then be revised to direct the technician to figure 2-34, for selection of the proper card deck to be used in steps l and on.

- f. Steps 2-59 i and 2-60 e do not disclose whether the cards specified following the words "except for" are intentionally missing or are present but will not be used. This might be confusing to the technician.

RECOMMENDATION:

Steps 2-59 i and 2-60 e should be revised to indicate specifically that certain cards are missing. This can be accomplished easily by revising the wording to read "... except for missing cards..." etc.

HEADQUARTERS
SITE ACTIVATION TASK FORCE
BALLISTIC SYSTEMS DIVISION (AFSC)
Malmstrom AFB, Montana

TO: Members

DATE: 8 November 1962

SUBJECT: Minutes of Post-Demonstration Critique of Class I Demonstration
1-18

FROM: Lt Col Hahnemann

-
1. The demonstration was conducted at Site B-5 on 7 November in accordance with T.O. 21SM80A-2-3, 15 September 1962 and 21SM80A-2-3C, 27 September 1962. The TAT agreed that the demonstration was conducted in a satisfactory manner and authorized the Chairman to so notify The Boeing Company.
 2. The TAT made the following recommendations for Demonstration 1-18:
 - a. BSD Exhibit 61-32 presently states operating crews are to have no knowledge of location of fault. This is unimportant. Since the demonstration is proving the adequacy of the T.O. and equipment, proper operation of equipment locating the fault satisfies the purpose of the demonstration.
 - b. It is recommended that VRSA be in an operating condition prior to beginning the three related demonstrations, 1-18, 1-19, 1-20.
 - c. The M&IR should reflect the VRSA be queried just prior to the fault, during the fault and after the fault removed.
 3. There definitely is lack of correlation of T.O. and M&IR and card in regard to identification of cards where the fault may be. Major Fulton of TAT will contact Mr. Volke of The Boeing Company Engineering to inform him of the problem and make the recommendation for what action should be taken to resolve these problem areas.
 4. The procedure for self-test of test equipment is over-complicated and time-consuming because of the necessity for connecting and removing a total of 19 cables.
 5. The Boeing Company crew which performed the demonstration is to be commended for the manner in which the demonstration was conducted. This demonstration crew was under the direction of Michael Halsey, TBC.
 6. AFTO 22's generated against this demonstration will be attached to these minutes.

D2-14934-6
Page 158

ATTACHMENT TO REPORT NO. EO-1201-1/3042-1

7. Attendees:

Mr. W. P. Barney	TBC
Mr. F. E. Whittemore	TBC QC
Mr. Q. M. Halsey	TBC
Mr. S. G. Wisniewski	TBC
Mr. John L. Wright	TBC
Mr. G. S. Allen	SATAF/STL
Mr. John A. Labrie	TBC
Major W. L. Fulton	SATAF Engr
Captain Ellis Curtis	SATAF Engr
Lt Col Elton	SAC (341st)
Lt Col R. H. Hahnemann, Chairman	SATAF Engr

Robert H. Hahnemann
ROBERT H. HAHNEMANN, Lt Col, Chairman

A. M. Elton
A. M. ELTON, Lt Col (SAC) 341st

Francis M. Shine
FRANCIS M. SHINE, Captain, OOAMA

Ralph D. Claxton
RALPH D. CLAXTON, AFQC

MAINTAINABILITY EXAMINATION/OBSERVATION REPORT

Report No. EO-1201-2/4487-1 Date April 3, 1963 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 201/4487 Nomen Programmer Group/Command Signals Simulator
 Dwg. No. 25-22036-89/8324450-501 Serial No. 6 / 5
 Observed Event T.O. T&V Location VAFB Date 2.18.63 thru 3.28.63
 Title or Description Drawer Checkout
 T.O. Procedures 31X3-12-8-2 Sections VII through XII (31 January 1963 revision)

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	2	14	Lines and Cables	
2	Standardization	4	15	Fasteners	
3	Interchangeability	4	16	Covers, Cases, Shields	
4	Packaging, Mounting	4	17	Disposable Modules	
5	Accessibility	2	18	Test Equipment	
6	Work Space	4	19	Servicing, Handling, Equip.	N/
7	Testing, Servicing	4	20	Tools	2
8	Displays	4	21	Platforms, Stands, Shelters	N/
9	Handles	4	22	Technical Order	3
10	Labels, Marking	2	23	Figure A	3
11	Controls	4	24	Form B/C	N/
12	Work Aids	4	25	Specifications	N/
13	Connectors, Connections	4	26	Personnel Requirements	N/

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower

Item 1 Cable tray fault-isolation and repair considerations for the Minuteman Standard Rack configuration have been dealt with in items 1 and 5 of EO-1284-1.

Item 5 The grouping of external electrical connectors at the top of the equipment rack has been dealt with in EO-1265-1 and EO-1201-1. The problem is quite pronounced in the case of the Programmer Group because of the large number of connections to be made in organizational level checkout. A hook-up technique favored by at least one Test Operator at VAFB is to make connections while lying on top of the air-conditioning trunking and overhead cable trays.

Recommendation.

Although it is recognized that a considerable effort would be involved, it is recommended that the rack should be redesigned to improve accessibility, and wiring-tray repairability.

Item 10 a. All the drawers of the Programmer Group weigh more than 45 lbs, the Power Supply weight being more than 120 lbs, but the units are not marked.

Recommendation.

Weight labels should be affixed.

b. The system of numbering of Printed Card Assembly locations (e.g. 403A1 A8) appears to have become confused. It is believed that the system was originally intended to define a card or component location, to facilitate rapid identification of an element among many similar elements; thus, the technician would know that the A3 card was the third one back, etc. Reference to figure 8-2 to T.O. 31X3-12-8-2 will quickly show the extent to which the system has been altered. Apparently the identification of a card by its part number has been abandoned and the card location system has been substituted in its place. This could result in confusion if a card becomes accidentally misplaced, and would at least result in the necessity to label a card with two identification numbers, the part number and the "A number".

Recommendation.

Specific card types should be identified by part number only, and locations should be identified by "A number" only. The part number should be visible when the card is in position, and the "A number" should be marked at both ends of the locations slot. Card locations should also be numbered serially from front to back.

Other components, particularly PCA connectors, should also be identified systematically in the same way; Figure 8-3 of T.O. 31X3-12-8-2 shows that PCA connectors are much less confused than the PCA's, and is a good example of the system as it was originally intended to function.

- Item 18 Difficulty has been encountered upon attempting to insert the Figure A 4487 Command Signals Simulator (SM-315/GYK-2) into the Decoder Vault of the Sequential Timer Drawer, due to the fact that the cover-retaining screws along the side of the unit are not countersunk, and will not enter the guide-slot. On the unit observed, all the retaining screws along the side-flanges had been removed in order to effect insertion.

Recommendation.

The screws used along the side-flanges should be countersunk.

- Item 20 The Tool Kit, Code Change, Command Signal Decoder TL-687/GYK-2 has been found at VAFB to suffer from the following mechanical deficiencies.

- a. The right-angle-drive wrench, (part no. 1790324-1) drive-spring is easily broken.
- b. The Code-Setting tool (part no. 1790323) pointed tip is too weak.
- c. Code post lock pins (part no. 1790325) have very fragile "heads" which break off easily.

Recommendation.

The tool kit items mentioned should be strengthened, either by increasing material thickness or by using stronger metals, so as to render the kit less liable to breakage in Field use.

- Item 22 The top left-hand PCA connector in Figure 10-4 of T.O. 31X3-12-8-2 is not identified. Study of the wiring diagram of the Launcher-Missile Status Monitor Drawer indicates that it may be J 10.

Recommendation.

The figure should be revised to show the identification of the jack.

- Item 23 The Figure A does not contain Maintainability Design Requirements.

Recommendation.

Maintainability Design Requirements should be incorporated at the next revision.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-1209-1 Date May 23, 1963 Page 1 of 5

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6598

Figure A No. 1209, 1230 Title LF - Miscellaneous Systems
1241, 1330

Part No. _____ Serial No. _____

Demonstration Event Unscheduled Location Ellsworth AFB Date April 24 & May 7,

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/A	14	Lines and Cables	N/A
2	Standardization		15	Fasteners	
3	Interchangeability		16	Covers, Cases, and Shields	
4	Packaging and Mounting		17	Disposable Modules	
5	Accessibility		18	Test Equipment	
6	Work Space		19	Servicing and Handling Equipment	
7	Testing and Servicing		20	Tools	
8	Displays		21	Platforms, Stands, and Shelters	
9	Handles		22	Technical Order	
10	Labels and Marking		23	Figure 'A'	
11	Controls		24	Form B/C	
12	Work Aids		25	Specifications	
13	Connectors and Connections	N/A	26	Personnel Requirements	N/A

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: These items noted while evaluating Fig. A 1211.

Several maintainability problems were identified during inspection of the LF Support Building.

1. **HYDRAULIC PUMP - BLAST VALVES**

Problem: Labeling - Marking

A hydraulic unit manufactured by Rucker, Model A 1202-D58, SN 061-61104, has a dial gage and a sight gage. The dial gage is not labeled as to function, the calibration units marked on the gage face are not identified, and the meaning of the multicolored (red and black) dial pointers is not clear. The sight gage is not labeled as to function, its only calibration mark is the word HI that appears at the top of the gage. The manufacturer's name appears in bold letters on the face of the gage.

Recommendations

1. Label both gages as to function.
2. Mark meaning of calibration units on face of dial gage.
3. Provide calibration marking for sight gage.
4. Remove manufacturer's name from sight gage.
5. Range code both gages in accordance with MIL-STD-803.

2. **SECURITY SYSTEM, LFSB**

Problem: Accessibility - Labeling

Two terminal strips of the LF security system are located in the launcher support building. These terminals are housed side by side in two steel boxes. Each lid is fastened by 24 standard metal screws. As the lids are only about a foot square and no RFI shielding is used, the large number of fasteners holding the terminal box lids in place does not seem necessary. The terminal box was unlabeled. Because so many fasteners are used the lids are left loose. One set of lids was noticed hanging by two screws.

Recommendations:

1. Since removing 24 screws encumbers the technicians' task, reduce the number of these fasteners to the minimum commensurate with RFI protection required.

2. (Continued)

2. Label the boxes as to function.

3. DIESEL FUEL LINE VALVES

Problem: Labeling - Marking

The diesel fuel lines in the support building are equipped with 5 home-stead valves. Valves handles are removable and the open-closed positions are unidentified. Further, the handle insertion points are not marked on the valve stems and handle. Operating the valves in this system is virtually a trial and error procedure.

Recommendation:

1. Mark the handle and valve stems to show where the handles should be fixed to the valve.
2. Label the open-close position or the open turning direction for each valve.
3. Identify each valve by the reference used in the technical order.

4. SUMP PUMP CONTROLS

Problem: Labeling

The sump pump controls in the LF Support Building are unlabeled except for power and control labels on conduit. Located on the support building wall facing the Chiller Unit, the controls include two rotary switches, two toggle switches, and terminal boxes. The toggle switches may be manual motor starter switches, an undesirable feature of many Wing II LF Support Building circuits (See E/O 1211) but this hypothesis cannot be verified at this writing.

Recommendation:

1. Label the controls as to function.
2. Check the circuit diagram of the Wing II sump pump controls for clarification of the use of toggle switches.

5. LIGHTING SYSTEM

Problem: Interference

There is physical interference of ethylene glycol line with a light fixture. The ethylene glycol solution pipe interferes with the suspension of the LF Support Building light fixture.

Recommendation:

The light fixture should be moved to eliminate the interference.

6. DIESEL FUEL SYSTEM

Problem: Labeling and Marking

Located near the diesel fuel tank in the LF Support Building is a glass tube that appears to be a gage. Its function is not clear. The tube has no increment markings or unit labels (gals.). Beneath the diesel tank, fastened to the support building wall is a dial gage identified only as Liquidmeter, Senior Model. The gage face is marked in increments ranging from 0 to 2400. The function of this gage is not identified, the units measured are not identified and the gage is not range coded to indicate adequate and inadequate reserve.

Recommendation:

1. Label the gages to indicate their functions.
2. If the glass tube is intended to measure units of fluid, calibration marks should be placed on the glass.
3. The increments marked on the liquid meter should be identified by label.
4. The dial gage should be range coded.

In the Launcher the following items were noted.

7. SHOCK ATTENUATION SYSTEM

Problem: Labeling/Controls

A shock contactor manufactured by Arrow Hart is located in the lower equipment room. On the front panel two red buttons are marked STOP. Curiously, just above each button is a marking that reads OPEN. On the right side of the box, hidden from view by the edges of the flanged panel, is a control knob. A label marked CLOSE is located above the knob. How the control is to be used could not be determined by looking at it or its marking.

Recommendation:

1. Label the controls as to function.
2. Relocate the CLOSE control knob to the panel front or remove the right side of the panel front so the control is not hidden.
3. Clarify the meanings of the control operating instructions. For example if the red button does open something, indicate what it opens. And if you press the button to operate it, then it should be marked press. Why is the button colored red? Why is it marked STOP?

8. WATER CONTROL SYSTEM

Problem: Labeling

The LF sump pump fuse box is not labeled. This box has two controls mounted on it; an automatic/manual selector switch on the left side and a reset button on the right side. There is no label to indicate what this equipment controls.

Recommendation:

Label this box as to function.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 1211-1 Date May 14, 1963 Page 1 of 7

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6598

Figure A No. 1211 Title Environmental Control System, LF

Part No. _____ Serial No. _____

Demonstration Event Unscheduled Location Ellsworth AFB Date April 25, - 27

T.O. Procedures 21-SM80A-2-7

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/R	14	Lines and Cables	2
2	Standardization	N/R	15	Fasteners	2
3	Interchangeability	N/R	16	Covers, Cases, and Shields	N/R
4	Packaging and Mounting	4	17	Disposable Modules	N/R
5	Accessibility	3	18	Test Equipment	N/R
6	Work Space	1	19	Servicing and Handling Equipment	N/R
7	Testing and Servicing	N/R	20	Tools	N/R
8	Displays(See Item 10)	3	21	Platforms, Stands, and Shelters	N/R
9	Handles	N/R	22	Technical Order	N/R
10	Labels and Marking	4	23	Figure 'A'	N/R
11	Controls	N/R	24	Form B/C	N/R
12	Work Aids	N/R	25	Specifications	N/R
13	Connectors and Connections	1	26	Personnel Requirements	N/R

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: Portions of the system were observed during organizational
adjustment by a contractor technician. Static evaluation was performed in
the support building.

4. Packaging and Mounting

- 4.1 Problem:** Mounted inside the lower left hand corner of the LF Air Conditioning Control Panel are four Sprague filters. To remove any one of these filters a wire must be disconnected from each filter, four nuts must be removed from a welded channel bracket that holds the filters in place and the bracket must be removed.

It could not be determined by inspection whether studs or bolts have been used to secure the channel to the cabinet floor. If bolts have been used they may be difficult to reinstall when the channel bracket is replaced, also the nuts cannot be loosened or tightened if the bolt turns.

A T.O. warning note directs personnel to ground the filters before attempting to remove them but a warning label is not used on the equipment.

Recommendations:

- 1. Redesign the channel to permit independent removal of each filter.**
- 2. Determine if bolts or studs hold the channel to the cabinet floor.**
- 3. A warning label should be displayed on the filter holding bracket. The warning should instruct personnel to ground the filter before attempting maintenance.**

4.2 Problem

The air conditioning control panel cabinet contains a 30 amp fuse. No spare fuse is located inside the cabinet, nor is a spare fuse holder present.

Recommendation

The cabinet should be equipped with a fuse holder, spare fuse, and a label designating the fuse value and function.

4.3 Problem

According to T.O. 21SM80A-2-7, Par. 5-98, removal and installation of the condensor fan assembly, of the chiller unit requires the entire chiller unit be removed from the LF Support Building where by use of a crane, it is placed on a flat bed truck. The condenser fan assembly is removed by sliding it out the rear of the chiller unit frame while the chiller rests on the flat bed truck. It does not seem practical to replace the fan assembly under unsheltered conditions and it is expensive maintenance considering the requirement for a crane, flat bed truck, and a maintenance van. If a slight modification is made, the fan assembly

4.3 (Continued)

could be lifted from the chiller in the support building with the maintenance van hoist.

Recommendation

A study should be made to determine effects of modifying the chiller unit frame by making two angle iron braces at the top of the frame removable. Attach hoisting eyes to the condensor fan assembly. The fan assembly is dynamically balanced and cannot be removed in pieces. The weight of the assembly should be marked on the fan housing facing the motor.

4.4 Problem

The launch tube heater S-3 is installed with the heater unit H-2 coils exposed. (See fig. 5-34 and 3-14, T.O. 21SM80A 2-7). The heater is located in the equipment room where personnel could inadvertently touch the exposed coils. The judgement that burns may result from contact with the heater element is verified by the warning on page X of the safety section of the 2-7 manual.

Recommendation

Cover the exposed coils with a fixed-louvered plate or wire screen.

4.5 Problem

The air duct extending from the condensor fan assembly of the Chiller Unit brine package has sharp edges. As the duct is located approximately 5 ft. from the floor the sharp edges could be a source of head injury.

Recommendation

Install protective welts over these duct edges. It is recognized that hard hats are required to be worn in this area but maintenance technicians frequently remove this headgear when working in the warm environment of the support building.

5. Accessibility

5.1 Problem

The air instrument components, illustrated by Fig. 3-12, T.O. 21-SM80A-2-7 are located adjacent the chiller unit discharge duct in the LF support building. The valves and gages mounted above the moisture accumulator T-4 are so high above floor level that they cannot be used without a step ladder. In Wing II LF Support building these displays and controls are located a considerably greater distance from the moisture accumulator than is shown in Fig. 3-12. The T-4 accumulator is unmarked.

Recommendation

Gages PG-32, PG-33 and associated lines and valves should be re-located within reach of a maintenance technician without need of a stand or ladder. The accumulator T-4 should be labeled as to function, contents, capacity and weight.

10. Labeling and Marking

Probably the most remarkably poor maintainability feature of the LF environmental control system is the absence of markings and labels. At Wing II LF's, B4 & D11 the following deficiencies were noted.

10.1 Problem

The expansion tank T-1, an ethylene glycol solution reservoir, has no markings to indicate its function, contents, capacity or filling point. The fluid level is determinable only by the dip stick method and then the stick is not supplied, rather the technician must carry a 12" rule. (Par. 5-77). Although the T.O. warns that blindness may result from getting ethylene glycol in the eyes there is no warning label on this tank.

The accessibility of the tank compounds this hazard. Mounted on the wall of the LF support building about eight feet from the floor, the tank can be filled only when standing on a ladder. No container is specified for holding the spare brine solution while filling the tank.

Recommendations

1. Provide markings to show function, contents, capacity and filling point of the expansion tank.
2. A label to warn against getting this solution in eyes should be mounted on the tank. It is recognized that people commonly handle this solution in auto cooling system maintenance without injury but in this case special care is indicated since this fluid could easily be spilled on someone standing below the tank.
3. A capacity gage should be installed so that the exact amount of fluid in the tank can be determined and the amount of fluid to be added can be easily computed. Having to add fluid to the 5 1/2" to 6" level by alternately pouring and checking the dipstick is a nuisance and increases the probability of spillage. The recommended gage eliminates the use of a ruler. A ruler incidently is usually shellaced and this substance may dissolve in the glycol solution. Chances are good that almost any short stick would be used as a measuring device anyway so the number of probable contaminants would not be limited to shellac.

4. A suitable container for filling the expansion tank should be designated. If a common container such as a fuel can is used the possibility of introducing a harmful fluid such as diesel fuel or motor oil is present. An equally likely possibility that ethylene glycol solution may end up in a gasoline tank must be considered as well. A light (perhaps plastic) container, with a handle, nozzle spout, and contents label should be specified.

10.2 Problem

The Air Conditioning Control Panel ACP-1, located in the upper launcher equipment room contains switches PE-4, PE-6, PE-8, PE-9, PE-10, PE-11, PE-12, several noise filters, test points, and one circuit breaker. The test points and filters were marked but none of the switches were labeled. The circuit breaker was not labeled. None of the air lines are marked as to contents or direction of flow. When adjustment of the pneumatic electric switches is required, as by Par. 5-18 or 5-19 for example, identification labels such as PE-2 or PE-5, greatly support the servicing technician. The inside of other control panels of this system were not examined.

Recommendation

Label the pneumatic electric switches contained within the air conditioning control panel and label the circuit breaker CB-4. Label all pneumatic lines as to contents and direction of flow. Check within other ECS control panels for similar deficiencies.

10.3 Problem

The Alarm Panel AP-1 located adjacent to the air conditioning control panel discussed above contains several controls and displays that are not labeled. Specifically four thermostats TA-1, TA-2, TA-4 and TC-1; two flow sensors, FA 1 and FA 2; and five pressure gages, PG-14, PG-15, PG-16, PG-21 and PG-22 should be labeled. The pneumatic lines are not labeled, as to contents or direction of flow.

Recommendation

The labels should be installed above each display and control on the rear wall of the panel, or on the rear panel wall at the side of the display or control. Do not place label directly on the item. Label the pneumatic lines as to content and direction of flow.

10.4 Problem

There are seven gages in the Chiller Unit located at the LF support building. Four of the seven gages are unlabeled and the three remaining gages are identified by names different from the designations used in T.O. 21-SM80A-2-7. Specifically the unlabeled gages are PG-2, PG-3, TG-4 and TG-5. The improperly marked gages are identified as PG-1, PG-4, and PG-5 in the T.O. fig. 3-11 but at LF's B4 and D11 at Ellsworth these gauges were marked Oil, Discharge and Suction, respectively. Three circuit breakers located on the front of the chiller unit control panel door are not identified but should be marked CB-3, CB-2 and CB-1 from left to right. Valves V-14, V-14A were not labeled.

Recommendation

1. Place labels near all gages and valves. The labels should use terminology used in the technical order.
2. The circuit breakers should be marked.
3. The inside of the Chiller control panel was not examined because the panel was locked. It is recommended that maintainability deficiencies within the panel be identified.

10.5 Problem

Inspection of T.O. 21SM80A-2-7 indicates at least 15 different gages are present in the LF, ECS. These gages are not range coded. The normal indication values of these gages presented in the section on LF trouble analysis suggests that 14 of the 15 gages could be range coded to show normal operating ranges while the remaining gage has differential indications because the gage reading will vary with the performance of other components of the system. Specifically the gages that may be codable are:

<u>Gage No.</u>	<u>Normal Operating Range</u>
1. PG-31	14-16 psig
2. PG-5	more than 15 psig
3. PG-14	10 psig
4. PG-17	less than 8 psig
5. PG-19	less than 8 psig
6. PG-16	more than 7.5 psig
7. PG-30	29-31 psig
8. PG-34	more than 31 psig
9. PG-32	29-31 psig
10. TG-5	41-42 °F
11. TG-4	35-36 °F
12. TG-1	53-57 °F
13. PG-15	more than 3 but less than 13 psig
14. PG-22	more than 3 but less than 13 psig

One gage PG-13, may not be codable because 13 psig and any value less than 4 psig are normal indications.

Recommendation

Range code these gages.

10.6 Problem

A component of the chiller unit in the LF Support building is a tank believed to be a freon receiver. This tank is unmarked except for the manufacturer's identification plate. A capacity gage is located on the side of the tank in a position that requires the reader to thrust his head into the chiller unit frame to read it. This gage is marked in units denoting a full tank, half full, quarter full, etc. The tank has no lifting eye. A plastic shipping cap protects what appears to be a filling nipple. The weight of the tank is not indicated.

Recommendation

1. Label the tank to show its function, contents, capacity and weight.
2. Mount the gage so that it can be accurately read from a station outside of the chiller frame. The gage face should be calibrated in units such as quarts, pints or gallons. If the freon in this unit must be maintained above a specific level, the gage should be range coded to show an adequate and inadequate reserve.
3. A lifting eye should be located on the tank.
4. The filling nipple should be protected by a cap that is fastened to the tank with a retaining chain.

10.7 Problem

Refrigerant compressor RC-1, a component of the chiller unit, depicted in Fig. 1-27, T.O. SM80A-2-7, does not have a lifting eye nor is its weight marked on it. At sometime this unit will have to be removed at some maintenance facility and an eye will facilitate handling to a considerable degree.

Recommendation

1. Equip this compressor with a lifting eye.
2. Label the unit's weight on it.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 1211-2 Date May 23, 1963 Page 1 of 3

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 1389/1329 Title Manual Motor Starter Switch, LF Support Bldg - Wing II
1211

Part No. _____ Serial No. _____

Demonstration Event Unscheduled Location Ellsworth B4-D11 Date May 3, 4, 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	<u>N/A</u>	14	Lines and Cables	<u>N/A</u>
2	Standardization		15	Fasteners	
3	Interchangeability		16	Covers, Cases, and Shields	
4	Packaging and Mounting		17	Disposable Modules	
5	Accessibility		18	Test Equipment	
6	Work Space		19	Servicing and Handling Equipment	
7	Testing and Servicing		20	Tools	
8	Displays		21	Platforms, Stands, and Shelters	
9	Handles		22	Technical Order	
10	Labels and Marking		23	Figure 'A'	
11	Controls		24	Form B/C	
12	Work Aids		25	Specifications	
13	Connectors and Connections	<u>N/A</u>	26	Personnel Requirements	<u>N/A</u>

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4 .

COMMENTS: Noted while evaluating LF, ECS, Fig. A 1211

Figure A 1329/1211/1389

The presence of manual switches wired in series with automatic/hand controlled selector switches is degrading the functioning of certain equipment located in the Wing II LF support buildings. Specifically, the equipment known to be affected is the electric unit heater, EUH1; damper FC-SD operator D-5; exhaust fan S103; and combustion air damper RA-1 motor. The following discussion gives particulars to show why manual switches should be removed from the affected circuits.

ELECTRIC UNIT HEATER, EUH-1

This heater is a component of the RPIE air conditioning, heating and ventilating system (Fig. A 1389) as shown in schematic Fig. 1-9, D2-13608-3 or SAC-CEM-21-SM80B-2-20-1, the heater can be controlled by selecting either manual or automatic regulation with the Unit Heater Selector Switch. Another switch, called the Manual Motor Starter can control the operation of the heater fan motor. The problem is caused by leaving this switch in the open position. With the Motor Starter Switch open the heater elements can come on but the fan will not run. This condition, if unchecked, will burn up the heater. This switch was not in the Wing I configuration. The switch appears to be redundant and a harmful feature in the heater circuit. It is not especially helpful during maintenance. It should be removed from the circuit.

DAMPER FC-5D (Motor operator D-5)

Damper FC-5D is opened and closed by operator D-5. This damper, an air inlet to the LF support building is mounted in the side of air plenum PL-1. The damper is normally closed but will open when the exhaust fan (automatic/manual) selector switch is energized unless the Manual Motor starter switch to the damper motor is open. Although this damper is wired into the RPIE ventilating system (Fig. A 1389) it is really a component of the LF Environmental Control System (Fig. A 1211). The function is shown in Fig. 1-24 T.O. 21-SM80A-2-7 and in schematic in Fig. 1-9, D2-13608-33 (SAC-CEM-21-SM80B-2-20-1). This Manual Motor Starter Switch is redundant. It tends to defeat the purpose of the damper when it is left open. It is unmarked and frequently left open according to information obtained at Ellsworth. The switch should be removed from the system.

EXHAUST FAN S-103

This fan is wired into the same circuit as the damper FC-5D operator D-5 described above. It has a manual motor starter switch that is a redundant, useless item. This switch if left open will prevent the S-103 fan from operating. It should be removed from the circuit.

COMBUSTION AIR DAMPER RA-1 MOTOR

In the ceiling of the LF support building, this damper is supposed to open when the diesel generator runs. The motor operating this damper is part of the LF Power Generation and Distribution System, Fig. A 1329 described in schematic Fig. 4-17, D2-13608-31. Although the damper should open automatically when the diesel generator starts it will not if the manual switch that is located beside the support building door is open. . This switch is unlabeled and its location gives the impression of a light switch. Because power is supplied to the motor from the diesel generator only, the only function the manual switch has is to close the damper when the generator is running or prevent it from opening. In either case no useful purpose is served. It defeats the purpose of the damper. The switch should be removed from the circuit.

In summary, manual switches are being placed in circuits that were intended to operate automatically. The switches must be closed if the equipment is to function properly. They have often been left open. These switches were not in the Wing I configuration. They serve no beneficial purpose. They do cause system malfunctions, and in the case of the unit heater may cause serious damage. A Boeing Technician at Ellsworth reported four heaters have been damaged so far because the switch was open. Four switches have been discussed and it is possible that other support building housed systems may have components wired as these are wired; the sump pump controls may be affected for example. Documents are not available at this time to check on this possibility.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1213-1/1251-3 Date 3-8-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 1213 Nomen Digital Data Processing Equipment OA-3850/GYK-1(v)
 Dwg. No. 8323348-502 Serial No. 4
 Observed Event T.O. V&V Location VAFB Date 3-6-63
 Title or Description Drawer Checkout and Static Evaluation
 T.O. Procedures 31X2-32-3-2 Sections VII thru XVII

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	3	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	3	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	4
11	Controls	4	24	Form B/C	N/E
12	Work Aids	4	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	2

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4. a. A17, the "site tailoring plug" in the Converter, Digital to Diphase CV-1236/GYK-1(V) must be removed during testing. The plug is inside the drawer and its removal requires removal of the top dust-cover which is secured by 44 screws.

Recommendation.

The dust cover should be modified to incorporate a sliding panel which will give rapid access to this plug.

This is similar to the problem and recommendation of EO-1251-1, of November 29, 1962.

- b. A large number of components in all drawers of this equipment are soldered in, the major exception being the PCA's. As noted in EO-1265-1, the soldering in of components will result in the need to send drawers to Depot for repair in many instances.

Recommendation.

Wherever feasible, and wherever justified by a high failure rate, components should be repackaged to have plug-in or screw-type terminations.

- c. As noted in previous reports, the Standard Minuteman Rack has its electrical connectors grouped at the top of the rack; this leads to a requirement to use a step ladder when making connections during test.

Recommendation.

The rack should be redesigned so that the electrical connectors are more accessible to operating personnel.

- Item 7. When testing the Panel, Indicator SB-1411 (GYK-1 (v) it is necessary to remove the Filter Assembly (see Fig. 7-1 of T.O. 31x2-32-3-2). This involves the removal of 18 screws and is in conflict with sections 10.4.3.8 and 10.4.3.10 of MIL-STD-803.

Recommendation.

- a. The sub-assembly holding the Filter Units should be an open structure, which would permit access for test-probes.
- or b. The Filter Assembly should be hinged along the bottom side and held by a minimal number of quick-release fasteners.

- Item 10. Panels A2, A3, A4, A5, A6 and A7 of the Status Message Processing Group, and panels A3, A5, A6 and A7 of the Command Message Processing Group all weigh more than 45 pounds but are not so labelled.

Recommendation.

Appropriate weight labels should be affixed.

- Item 16. Top dust covers on the drawers of the Fig. A 1213 are secured by 44 captive slotted screws, while bottom covers are secured by 20 Phillips quick-release fasteners. See EO-1265-1.

Recommendation.

All cover fasteners should be of the same variety, and the number of fasteners securing the top cover should be reduced.

- Item 22. Trouble-shooting charts in T.O. 31x2-32-3-2 (Figs. 7-1, 8-3, 9-1 etc.) call for replacement of soldered-in components.

Recommendation.

As noted in EO-1265-1, the T.O. should reflect the no-soldering policy by differentiating between replacements that may be performed at Field Level and those that will require Depot Level maintenance.

- Item 26. Some repairs of Fig. A 1213 equipment drawers require the use of soldering techniques. In order to avoid the wasteful tie-up of equipment in a Depot "pipe-line" it would be necessary to provide personnel qualified to solder at the SMSB, or alternatively the equipment should be reworked to eliminate soldered connections.

MAINTAINABILITY EVALUATION/OBSERVATION-REPORT

Report No. EO-1214-1 Date 3-8-63 Page 1 of 3

Prepared by A. H. Smith M/S 6207-1 phone 866-3761

Figure A No. 1214 Nomen Liquid Cooling Equipment, Ground Guidance & Control MXK-118/F37U

Dwg. No. 25-23793 Serial No. 0000001

Observed Event None Location VAFB Date 3-8-63

Title or Description Static Evaluation

T.O. Procedures 3559-35-1

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	3	17	Disposable Modules	N/O
5	Accessibility	4	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	1
7	Testing, Servicing	2	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/E
9	Handles	4	22	Technical Order	4
10	Labels, Marking	2	23	Figure A	3
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/O	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4. The refrigerant unit employs the use of crimped and silver-soldered pipe connections and terminations; this calls for the use of specialized equipment and personnel during servicing.

Recommendation.

The need for brazing should be eliminated by the use of manually operated valves and standard threaded connections. Although brazing is extensively used in commercial applications it is believed that this is due to the cheapness of the method rather than its suitability for maintenance.

- Item 7. As noted in item 4, the process of servicing the refrigerant unit is considerably complicated by the need for brazing.

- Item 10. a. There are no weight labels on the assemblies of the Fig. A 1214.

Recommendation.

Weight labels should be affixed to all assemblies which are handled separately.

- b. During relay replacement, para. 3-26 of T.O. 35E9-35-1, step c requires that wires from the relay assembly shall be removed and marked.

Recommendation.

These wires should be identified by adhesive labels to avoid the possibility of error in assembly.

- Item 15. An excessive number of screws is used to mount the cover of the electronic amplifier.

Recommendation.

The number of screws should be reduced.

- Item 19. During TAT Demonstration 1-12 (Removal and replacement of G&C unit pump package) it was found to be impossible to use the handlift truck as called out in T.O. 21-SM80A-2-6 because it was too large and cumbersome, and would not allow the handling dolly to be employed. However, a T.O. change was written requiring removal of the unit onto the dolly by hand.

It is believed that this problem may also be unique to Vandenberg because of the difference in location of the personnel access hatch.

Recommendation.

None. The T.O.-change mentioned will avoid this difficulty.

Item 23. The figure A does not contain Maintainability design requirements.

Recommendation.

Maintainability requirements should be incorporated at the next revision.

Item 26. As noted in item 4 above, servicing of the refrigerant unit requires the services of a welder.

Recommendation.

Redesign of the plumbing to incorporate threaded unions and valves would eliminate this requirement.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1214-2 Date 3-15-63 Page 1 of 2
 Prepared by R. L. Stearns M/SMI-FA phone 761-4320
 Figure A No. 1214 Nomen G & C Liquid Cooler
 Dwg. No. _____ Serial No. _____
 Observed Event Maintenance Location Malmstrom D-6 Date 3-13-63
 Title or Description Replacement of Chiller. Water Refrigerating
 T.O. Procedure Old Unit Serial No. 59. New: 350

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	4
2	Standardization	3	15	Fasteners	3
3	Interchangeability	N/E	16	Covers, Cases, Shields	N/A
4	Packaging, Mounting	3	17	Disposable Modules	N/O
5	Accessibility	4	18	Test Equipment	N/E
6	Work Space	4	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	N/O	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	N/A	22	Technical Order	N/O
10	Labels, Marking	3	23	Figure A	N/O
11	Controls	N/A	24	Form B/C	N/O
12	Work Aids	N/A	25	Specifications	N/O
13	Connectors, Connections	4	26	Personnel Requirements	N/O

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 2:

The hole in the chiller hoisting eye is about 1/2 the diameter of the mechanical truck hoist hook.

Recommendation:

All hoist eyes and hoist hooks should be compatible and standardized.

Item 4:

The chiller is mounted with six bolts. The unit weight is about 200 lbs. The unit has no method of positioning for mounting bolt installation.

Recommendation:

About two inches inboard on the mounting rails, drill drift pin holes so the unit can be positioned.

Item 10:

The hoisting eye is not labeled.

Recommendation:

Label the hoisting eye.

Item 15:

The six 3/8" (approx.) mounting bolts have fine threads. This makes it very difficult to install them due to the tendency for cross threading (12 minutes and 2 stripped bolts were expended in installing the last bolt).

Recommendation:

Use a coarse thread to decrease maintenance time and number of bolts required.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1228-1/1251-1/4012-1 Date November 29, 62 Page 1 of 6

Prepared by John L. Wright 2-5261 N/S 50-66 Phone III 6-6263

1228,

Figure A No. 1251-4012 Nomen Data Processing Equip./DAC Test Set

Dwg No. 8323617/8323616/8321617 Serial No. Not Recorded

Test No. Demo. 1-20, Fault Isolation Held at MAEB, Nov. 5 and Nov. 7, 1962

Maintenance Level ☒ ORG ☐ Field ☐ Depot Type N/A ☐ Scheduled ☐ Unscheduled

MAINTAINABILITY CHECKLIST				
1	Standardization	N/O	13 Displays	N/A
2	Interchangeability	N/O	14 Handles	4
3	Packing & Mounting	4	15 Fasteners	3
4	Accessibility	2	16 Covers, Cases, Shields	4
5	Work Space	4	17 Platforms, Stands & Shelters	N/A
6	Connectors & Connections	3	18 Labels & Marking	2
7	Fault Isolation	3	19 Disposable Modules	N/O
8	Lines & Cables	4	20 Technical Orders	3
9	Test Service Points	1	21 Figure A	N/A
10	Test Equipment	3	22 Form B/C	N/A
11	Tools	N/A	23 Model Specification	N/A
12	Controls	4	24 Personnel Requirements	N/A

MAINTAINABILITY PROBLEMS:

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower:

CHECKLIST RATINGS

4 Good Maintainability
 3 Satisfactory Maintainability
 2 Unsatisfactory Maintainability
 1 Poor Maintainability

N/A Not Applicable
 N/O No Observation Possible
 N/E Not Evaluated

RATING ANALYSES

Item 4. Accessibility.

Paragraph 2-49bd of T.O. 21-SM80A-2-3 requires, "Remove connector assembly J2." This seemingly simple step takes about one-half hour for accomplishment. The following actions are necessary:

- (1) The test set (Fig. A 4012) must be either moved or partially disconnected from the cables which enter it vertically, to provide clearance for drawer removal.
- (2) The Waveform Converter drawer of Fig. A 1251 must be removed and carried to some accessible work location.
- (3) The drawer cover, which is held by 43 captive screws, must be removed.
- (4) The connector assembly (which is not J2 itself but is connected to J2; see item 20a analysis) must be removed.
- (5) The cover must be replaced (all screws must be tight or the heads will prevent the drawer from closing).
- (6) The drawer must be inserted in the rack.
- (7) The test set must be reconnected.

Then, after a single program board check, another half hour is wasted in repeating the above procedure, just to replace the J2 plug!

RECOMMENDATION:

The connector assembly specified by paragraph 2-49bd of T.O. 21-SM80A-2-3 should be made readily accessible, reducing the time required for checkout of Fig. A 1228 and Fig. A 1251 by virtually a full hour. This could be done most simply by providing a sliding access door in the Waveform Converter drawer cover. The connector assembly could then be removed quickly without removing the drawer from the rack. (NOTE: Accessibility of plugs P2 and P3 in drawer A5 of Fig. A 1251, which must be checked for part number during performance of para. 2-49cb in T.O. 21-SM80A-2-3, should also be investigated. The required part number check was not made during the demonstration).

Item 6. Connectors and Connections.

Test set cable connectors mate with connectors at the top rear of Fig. A 1228 and Fig. A 1251. These connections are not accessible without a stepladder. Moving the ladder in and out of position during the test is clumsy and time consuming, and might conceivably lead to equipment damage. It cannot, however, be left in place to facilitate the connection changes required during the test, because it obscures the test set and otherwise gets in the way.

RECOMMENDATION:

One possible way of eliminating the ladder problem would be redesign of Fig. A 1228 and Fig. A 1251 to provide more accessible test connectors, eliminating the necessity for breaking the connections at the top rear of the racks (Refer to para. 4.r of M Memo 62-1).

Item 7. Fault Isolation

- a. Paragraph 2-33y of T.O. 21-SM80A-2-3 is a step in the Fig. A 4012 self-verification test procedure. If the test operator observes a FAULT indication upon performance of the step, he is instructed to try it again, "an additional five times; GOOD indicator should light at least once." This hardly seems to be a positive fault isolation capability. During the observed demonstration it only confused the technicians, and gave them the idea that one GOOD light in six tries would be sufficient on all test steps.

RECOMMENDATION:

If possible, the "one GOOD light in six tries" concept indicated in paragraph 2-33y of T.O. 21-SM80A-2-3 should be completely eliminated. The Fig. A 4012 test set should give only absolutely positive indications.

- b. When an unexpected malfunction indication occurred during the demonstration, a technician stated that trouble has occurred with program boards. A malfunction indication may occasionally appear for a good drawer, only to be eliminated when the program board is shifted slightly in the programmer panel of the Fig. A 4012 test set. This did not, however, occur during the demonstration.

RECOMMENDATION:

Dimensions and tolerances of the Fig. A 4012 test set programmer panel and its program boards should be checked, to ensure that the designed fit is not apt to be too loose.

- c. Another possible explanation of an unexpected malfunction indication was offered by the supervisor of the demonstration team. He produced a letter (2-7010-6A-344, dated Nov. 5, 1962, a copy of which is attached to this report) which was written to warn all checkout supervisors of three identical cases in which the ACO 4012 test set had given an incorrect indication of fault location. The indication which occurred was not the same one specified by the letter, but his confidence in the test set's ability to locate a fault correctly was not very strong. He thought it possible that a similar incorrect indication was occurring. (Actually the fault was subsequently attributed to a loose cable connection).

The test steps described in the letter correspond to paragraphs 2-49j through r. of T.O. 21-SM80A-2-3. The T.O. procedure directs: if fault indicators light for program board L/3A, "replace drawer 402A4" (Converter, Wave Form), then repeat the step; "if the same indicators light again replace drawer 402A5" (Decoder, Command Signals). Nowhere does it indicate that a faulty drawer 402A3 (Line Selector, Electronic) may be the cause of this malfunction.

RECOMMENDATION:

If Fig. A 4012 and ACO 4012 are identical, the portion of the test procedure using program board L/3A should be revised to include replacement of the 402A3 drawer if replacement of the 402A4 and 402A5 drawers fails to correct the fault indication. It would also be desirable to modify the test circuitry, so that the test set will indicate the additional fault possibility through illumination of the LINE SELECTOR, ELECTRONIC MX-3776/GYK-2 fault indicator (in addition to those already specified in step 2-49j of T.O. 21-SM80A-2-3).

- d. Steps ca through cc of T.O. 21-SM80A-2-3 constitute one complete test operation; this operation may reach apparently satisfactory completion even though a fault exists. Assume, for example, that the installed combination of plugs P2 and P3 is such that the GOOD indicator should light in 15 seconds. Then assume that it actually takes 10 times that long, or 2½ minutes, before the GOOD indication appears. Even though the delay time is wrong by a factor of 10, the results appear satisfactory because the GOOD indication occurs "in 3 seconds to 3 minutes," as specified.

RECOMMENDATION:

The ambiguous time limit specified in paragraph 2-49cc of T.O. 21-SM80A-2-3 should be eliminated, by either (1) redesign of the Fig. A 4012 test set to produce one uniform time delay for all P2-P3 combinations, or (2) provision of a complete tabulation of time delays for all P2-P3 combinations.

Item 10. Test Equipment.

Analyses for this item are entirely given under item 7 above. The only discrepancies noted were associated with the FAULT isolation capabilities of the Fig. A 4012 test set.

Item 15. Fasteners.

The cover of the Waveform Converter drawer in Fig. A 1251 is held by 43 captive screws. Removal of these screws for access to the internal components of the drawer therefore requires a great deal of time. It would be natural to assume that the other drawers in both Fig. A 1251 and 1228 also have over-fastened covers.

RECOMMENDATION:

The number of screws which fasten the drawer covers of Fig. A 1228 and Fig. A 1251 could be very significantly reduced without sacrificing any real operational necessity.

Item 18. Labels and Marking.

- a. T. O. 21-SM80A-2-3 refers to drawers of Fig. A 1228 and Fig. A 1251 exclusively by reference designations, yet these designations are not marked on the equipment.

RECOMMENDATION:

Drawer reference designations should be inscribed either on the drawers themselves or on the sides of the racks, at the proper drawer locations.

- b. The connector assembly specified incorrectly by paragraph 2-49bd of T.O. 21-SM80A-2-3 as J2 (it actually is mounted in socket J2) has no reference designation stencilled on it. This has already led to the incorrect T. O. statement (see item 20a analysis) and will undoubtedly cause some further confusion among maintenance technicians.

RECOMMENDATION:

The correct reference designation should be stencilled on the connector assembly mounted in the tailoring plug receptacle (J2), shown in figure 2-23A of T. O. 21-SM80A-2-3.

- c. Settings of MODE TIMER and LONG-TIME TIMER switches were made during the demonstration on the basis of part numbers for P2 and P3, as specified in paragraph 2-49 cb of T. O. 21-SM80A-2-3. The switch settings were tabulated in figure 2-23 of the T. O. opposite P2 and P3 part numbers; in the 14 November 1962 change the part numbers were replaced by "Decoded Time" columns. F. Crotty of Publications states that the Air Force has tentatively decided to stencil the decoded times, which are from 0.21 minute to 5.376 hours, on the plugs for reference.

RECOMMENDATION:

The P2 and P3 plugs should not be marked with decoded times. This would only confuse the organizational maintenance technicians, since the times to be observed in paragraph 2-49cc of T. O. 21-SM80A-2-3 vary only from 3 seconds to 3 minutes. Reference to figure 2-23 of the T. O. strictly by part number will avoid any possibility of confusing the time to be taken for the test step with the "decoded times" for the plugs. If the "decoded times" are desired during SMSB or depot maintenance they can be either tabulated in the appropriate T. O.'s or marked on the plugs simply as numbers, without time identification. For organizational maintenance purposes, P2 and P3 should be stencilled

- (1) with reference designation
- (2) with identifying part number
- (3) with no time-identified information.

- d. Paragraphs 2-50e, f, and i of T. O. 21-SM80A-2-3 direct that switches of the Fig. A 4012 test set be set to positions "indicated on key plate." Step 2-50c (now deleted) of the T.O. issue used during the demonstration further identified it the "LINE GAUGE AND MILES key plate stored at the launcher." There seems to be confusion regarding the location of this key plate within the "launcher." The actual plate was not in evidence during the demonstration; instead, a tattered sheet of paper had the required information pencilled on it, and was taped to the top drawer front on Fig. A 1251.

RECOMMENDATION:

The key plate specified in paragraphs 2-50e, f, and i of T. O. 21-SM80A-2-3 should indeed be a metal plate and should be permanently mounted somewhere on Fig. A 1251. The top drawer front is blank, and might be a good location. However, this would make it necessary that the plate be removed and reinstalled each time the drawer is replaced.

Item 20. Technical Orders.

- a. Paragraphs 2-49bd and bf of T. O. 21-SM80A-2-3 require removal and replacement of "connector assembly J2," referring to figure 2-23A for the location. Figure 2-23A calls out the location as "Tailoring Plug Receptacle." Inspection during the demonstration indicated that J2 is actually the reference designation of the receptacle.

RECOMMENDATION:

Nomenclature should be consistent in paragraphs 2-49bd and bf, and figure 2-23A of T. O. 21-SM80A-2-3. Reference designation J2 should appear in the figure for the receptacle, rather than in text for the plug. The plug's correct reference designation should appear in text. (Item 18b analysis also recommends that the plug have the reference designation stencilled on it.)

- b. Paragraph 2-49cb of T. O. 21-SM80A-2-3 requires recording of part number suffixes for plugs P2 and P3 in 401A5, to be used for reference to figure 2-23. However, the 14 November change to the T. O. replaced plug part numbers with "decoded times," yet provided no correlation between the two.

In addition, the unused columns of figure 2-23 are somewhat misleading. Paragraph 2-49cb indicates that both MODE TIMER and LONG-TIME TIMER switch settings are to be made; apparently the former depends on P2 and the latter on P3. The presence of the LONG-TIME column in the P2 portion of the figure, and the MODE TIMER column in the P3 portion serve only to confuse the reader. Dashes in a table usually indicate that something is either immaterial or indeterminate, neither of which is the case here.

RECOMMENDATION:

The columns of figure 2-23, T. O. 21-SM80A-2-3, which contain only dashes should be completely deleted, since the headings are simply not applicable. The instructions of paragraph 2-49cb and the left-hand column contents of figure 2-23 should be made compatible. (Note that the item 18c analysis recommends that decoded times not be marked as such on plugs P2 and P3.) If the Air Force persists in the intent to use decoded times, or if the marking method remains undecided, tabular columns might be provided for both part number and decoded times. However, ultimate use of only the part number remains by far the most desirable alternative because it would be the least apt to confuse the maintenance technicians.

- c. Paragraph 2-50e of T. O. 21-SM80A-2-3 directs that switches of the Fig. A 4012 test set be set to positions "indicated on key plate." This simple statement does not provide adequate identification of the key plate. In a previous issue of the T. O., paragraph 2-50c (now deleted) identified it as the "LINE GAUGE AND MILES key plate."

RECOMMENDATION:

If "LINE GAUGE AND MILES" nomenclature (or some other) is correct for the key plate specified in paragraph 2-50e, T. O. 21-SM80A-2-3, it should be included in the paragraph. When a location for the key plate is decided upon, that information should be included, also. (See item 18d analysis.)

November 5, 1962
2-7010-6A-344

To: Checkout Supervision
Subject: L5-34T Data Analysis Central, SCN

Reference: D2-10066, Para. 8.5.3.5. Operation 260 of L5-34T

On three sites the following events and results were noted in referenced operation.

With card L/3A in the ACO 4012, the Decoder Command Signals Fault Light illuminated immediately on depressing the equipment drawer test button on the ACO 4012. With card L/3B in the ACO 4012, the Converter Wave Form Fault Light illuminated. With card L/3C in the ACO 4012, the Line Selector Electronic Fault Light illuminated.

According to RCA tech. rep. the first fault is the valid one, but this case seems to be an exception. The Decoder Drawer was rejected and replaced with no change in malfunction; neither did replacing ACO 4012 help. After a loss of approximately fifty man hours, the replacement of the Line Selector drawer cleared the trouble.

Although the Decoder Faulty Light illuminates on the ACO 4012, the test evidently fails in the Line Selector Drawer. The data flow between the drawers plus the instantaneous illumination of the fault light points to this theory. Anyway in three cases, replacement of the Line Selector drawer eliminated the malfunction.

Original signed by
E. A. Andrews
Special Support Group

EAA/lka/lmr

D2-14934-6
Page 192

ATTACHMENT TO Report No. E0-1228-1/1251-1/4012-1

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1228-2 Date April 19, 1963 Page 1 of 4
 Prepared by A.H. Smith M/S V1-07 phone 866-3761
 Figure A No. 1228 Nomen Status - Command Message Processing Group OA-3594/GYK-2
 Dwg. No. 8323617-502 Serial No. 12
 Observed Event None Location VAFB Date April 15, 1963
 Title or Description Evaluation and Drawer Checkout
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/E	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	2
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	2	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	N/E	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4 a. The Fig A 1228 is mounted in a Standard Minuteman Rack. As noted in EO-1265-1 and others, all external electrical connections are grouped at the top of the cabinet; this results in a requirement to use a stepladder to reach the connectors, which are also somewhat inaccessible due to the presence of overhead cable-trays and air-ducting.

Recommendation.

To correct this condition a basic redesign of the Minuteman Standard Rack would be required, in order to place the connectors in a more accessible position.

- b. The flexible air-duct connection on the racks observed at VAFB are made entirely of soft material. Since the duct register and the rack opening are not directly in line an S-bend occurs in the flexible duct. The flexible ducting tends to collapse irregularly due to the lack of circular stiffeners, and it is possible that ageing of the ducting and movement during test hook-ups could cause a considerable change in effective cross-section, thereby altering the flow of cooling air to the rack. It is conceivable that this could result in overheating and a resultant No-Go condition.

Recommendation.

The existing soft flexible ducting should be replaced by stiffened constant cross-section type ducting.

- Item 5 a. As previously noted in EO-1284-2 and others, drawer connectors on the Wire Tray Assembly of the Minuteman Standard Rack are mounted on the back surface of the connector plate with the connector protruding through a hole in the plate. In order to repair or replace broken or bent pins in the drawer connectors it therefore becomes necessary to remove the entire rack in order to gain access to the interior of the Wire Tray Assembly. The time to accomplish such repairs is in the order of 8 hours plus the time to organize necessary authorization and paperwork.

This situation conflicts with item 10.5.2.3 of MIL-STD-803, which states, "The rear of plug connectors shall be accessible for test and service, except where potting, sealing or other considerations preclude this.

Recommendation,

Except in cases where the wiring at the rear of the drawer connectors is potted, rendering them repairable at SMSB or depot, all drawer connectors on the Wire Tray should be made more readily accessible.

This could be accomplished either by mounting the connectors on the front face of the connector plate or by mounting the connectors on hinged panels.

- b. Accessibility of the Site Tailoring Plug in the Waverform Converter Drawer has been dealt with in EO-1228-1.

Item 10 a. All drawers in the Fig A 1228 weigh more than 45 lbs, but are not labelled to this effect.

Recommendation.

Weight labels should be affixed per section 10.4.3.1 of MIL-STD-803.

- b. T.O. 21-SM80A-2-3 usually refers to drawers of the Fig A 1228 by reference designations and A-number. At VAFB the reference designation is stencilled on the equipment room wall between the Fig A 1228 and the Fig A 1251, which is somewhat ambiguous, and the drawers are not identified by the A-numbering system.

Recommendation.

The reference designation should be stencilled either on the equipment rack or on the floor at the foot of the rack, and the drawers should be identified by A-numbers inscribed on the front face of the rack.

Item 16

The top dust covers of drawers in the Fig A 1228 are secured by 44 screws, which appears to be an excessive number since they do not appear to be necessary for structural reasons.

Recommendation.

The number of screws should be reduced to the minimum consistent with structural integrity and anti-RFI considerations, (if any).

Item 22

Paragraph 2-49 of T.O. 21-SM80A-2-3 (changed 6 January 1963) covers ten pages; such length of paragraphs is quite typical, but the actual paragraph number occurs only on the first page. It therefore becomes somewhat tedious to find a wanted paragraph.

Recommendation.

The paragraph number should appear in the top right-hand corner of all pages, beneath the section number. This is the case at present on those pages where a paragraph begins but the information is actually redundant in this instance since the paragraph number already appears on that page at the paragraph title-line.

Item 23

The Figure A does not contain Maintainability Design Requirements.

Recommendation.

Maintainability Design Requirements should be incorporated at the next revision.

Item 26

Soldering capability is required to replace Filter Units in the Monitor Unit, Line Failure, and the Converter, Wave-Form, and is required very extensively to repair the Power Supply.

Recommendation.

Either the drawers of the Fig A 1228 should be reworked to eliminate soldering, or an authorized soldering capability should be provided at the Field Level of Maintenance.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1243-1/3013-1 Date 1-30-63 Page 1 of 4
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 1243/3013 Nomen Launch Control Console/Console Test Set
 Dwg. No. 25-24172/25-25980-1 Serial No. 000004/000003
 Observed Event Demo 1-18, 20 Location VAFB Date 1-29-63
 Title or Description TAT Class I Demo Console Checkout
 T.O. Procedures 21-SM80A-2-3 Paras. 3-21A and B, 2-4 thru 2-15

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	N/O
5	Accessibility	3	18	Test Equipment	4
6	Work Space	3	19	Servicing, Handling, Equip.	N/O
7	Testing, Servicing	4	20	Tools	2
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	1
10	Labels, Marking	4	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	3	25	Specifications	N/E
13	Connectors, Connections	3	26	Personnel Requirements	4

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4 a. The instrument panel of the Console Test Set AN/GSM-58 is secured to the bottom of the case by 22 screws, which appears to be an excessive number.

Recommendation: The number of screws should be reduced. Ten should be adequate.

- b. Test Cables for the Console Test Set are stored in the lid of the case, being retained by a hinged cover. The hinged cover is lined with sponge rubber of approximately two inches thickness. The excessive, and apparently unnecessary, thickness of the padding results in considerable difficulty in closing the cover, and makes careful arrangement of the cables necessary.

Recommendation: The thickness of the rubber padding should be reduced to half an inch.

Item 6

During the Traffic-on-net and SCN-test-received checkout procedure, (paragraph 2-14 of T.O. 21-SM80A-2-3) it is necessary to connect test cables to 300ALJ6 and J7. These jacks are located on the back of the Launch Control Console, and are difficult to reach. There are a number of other cables mounted on the back of the console, and these are even more difficult to reach due to the small clearance between the console and the wall of the capsule, and due to the fact that the connectors would be manipulated at the fullest extent of the arm.

Recommendation: All cables on the back of the Console should be re-located so as to be more readily accessible, or alternatively the console should be moved approximately three inches further away from the wall.

Item 12

Connectors P11 of Display Panel Cable, and P13 of Status Monitor Cable, in the Console Test Set, are of the changeable keying variety. One has a male keying shell, the other a female. To change the keying, a knurled lock-nut must be loosened and screwed out approximately one eighth of an inch, then the shell must be moved out so as to disengage its retaining castellations. The shell may then be rotated to the desired position, pushed back to engage the castellations and secured by tightening the locking unit. Considerable difficulty was encountered during the demonstration for two reasons:

1. The T.O. did not explain the action of these special connectors.
2. The keying shells were stiff and were not easy to disengage from their castellations. Even after the mode of operation had been deduced it was still difficult to withdraw the female shell without risking damage to the connector pins or to the fine-threaded lock-nut. This was finally accomplished by inserting the blade of a screwdriver in a groove near the end of the shell and levering the shell out very carefully.

Recommendation:

1. A tool should be provided with the Test-Set to facilitate withdrawal of the female keying shell. A simple spring-steel device which expands and grips the groove in the shell would be quite adequate.

2. The T.O. should be revised to incorporate a fuller description of the key-changing process (see item 22).

Item 13

W1 of the GSM-58 has to be connected to 300A1J7 at the rear of the console, during the test procedures. The connector that is normally connected to J7 is an elbow connector, due to work-space considerations, but P10 of W1, the test connector, is a straight plug, making connection difficult unless the kick-panel at the rear of the console knee-hole is removed.

Recommendation: P10 of W1 of the GSM-58 should be a 120 degree elbow connector.

Item 15

The hinged cable-storage cover in the lid of the AN/GSM-58 is secured by two quarter-turn fasteners. Due to the large pressures exerted on these fasteners (see item 4) it is probable that they will be high failure rate items. If the female part of the fastener fails, it will be very difficult to replace due to the rivetted and welded construction of the lid.

Recommendation:

1. The pressure should be reduced as indicated in item 4.
2. Larger, more robust fasteners should be used.
3. A third fastener should be added to distribute the load more evenly.

Item 16

All the connectors in the AN/GSM-58 have loose plastic dust covers, including those on the instrument panel.

Recommendation: Captive dust covers should be used.

Item 20

When removing the Launch Control Panel (Demonstration 1-18) per paragraph 3-21A, of 21-SM80A-2-3, it is necessary to undo the allen screws holding the Mechanical Code Units on to the back of the panel. The purpose of this step is to dissipate the codes in the Code Units.

The allen screws utilized are of a non-standard size; and it was found that a suitable allen wrench was not included in the tool-kit available. Further inquiry revealed that wrenches used at the Code Inserter Verifier room had been purchased locally, and that the item is comparatively difficult to obtain. A special wrench used by Boeing technicians (ground to size from a larger wrench) was eventually obtained, but considerable time was wasted.

Recommendation:

1. The need for using a bastard-size screw should be re-evaluated. If their usage is supposed to make access to the code units more difficult, it should be borne in mind that the screws are not countersunk and maybe removed by using long-nosed pliers. If security is not the reason, then the use of a standard size of screw should be strongly recommended.
2. If the existing screws must be used, then a special wrench should be supplied and listed in the T.O. as necessary special equipment.

- Item 22 a. Paragraph 2-10c of 21-SM80A-2-3 contains a note explaining how to change the keying of plugs P11 and P13 of the GSM-58. This note does not describe the process accurately enough, and it was necessary during the demonstration to disassemble the plugs before their mode of operation was discovered.

Recommendation: The Note should be expanded along the following lines: "Key plug P11 to plug P13 by unscrewing knurled sleeve nut on barrel of plug approximately one eighth of an inch, pulling keying shell outwards to disengage castellations, turning barrel to position 2 (as indicated through window on barrel), and tightening sleeve nut."

- b. Paragraph 2-13c was found to be very confusing and easily misunderstood, especially steps (2) through (5). Considerable discussion resulted before the correct method and sequencing of the test was discovered.

Recommendation: The relevant portions should be re-written along the following lines.

2-13c

- (2) Push LCC etc. push button is released
NOTE

For the remaining positions of the STATUS DISPLAY SELECTOR switch, an audible alarm may be activated (buzzer or bell) and one of the two ALARM indicators on the Alarm-Control Panel may be illuminated. Refer to Fig. 2-5 to determine the proper reactions for each switch position.

- (3) Move STATUS DISPLAY SELECTOR switch to LAUNCHER A, FAULT-ALARM 1 position.

- (4) Push LCC DISPLAY TEST push button and hold in pressed position.

- (5) Push ALARM RESET switch on Alarm-Monitor Panel when alarm is activated; audible alarm should reset.

- (6) Release LCC DISPLAY TEST push button; visible Alarm should go out.

- (7) Repeat steps (3) through (6) for the other STATUS DISPLAY SELECTOR switch positions listed in Fig. 2-5

NOTE

For those switch positions listed in Fig. 2-5 that do not result in activation of an alarm, it is only necessary to push the LCC DISPLAY TEST push button momentarily to confirm illumination of the appropriate MISSILE STATUS INDICATOR or LAUNCHER PANEL INDICATOR LIGHT.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1265-1/4018-4/1251-2 Date 3-8-63 Page 1 of 4
 Prepared by A.H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 1265 Nomen Digital Data Group LCC-OA3541/GYK-1 (v)
 Dwg. No. 8323562-501 Serial No. 5
 Observed Event V&V Location VAFB Date 3-4-63
 Title or Description Drawer Checkout and Static Evaluation
 T.O. Procedures 31x2-32-3-2 Section XVIII through XXIII

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	3	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	3	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	4	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C	N/E
12	Work Aids	4	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	2

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 1. Field-level fault isolation capabilities are rendered all but useless by the no-soldering philosophy. If indeed no soldering is to be permitted at the SMSA then it is highly questionable whether it will be worth the time and trouble to put faulty drawers through the formality of checkout on the Figure A 4018. With the exception of the PCA's in these drawers, (which are wire-wrapped), almost all other remedial replacements would involve soldering and are hence forbidden at Field-Level.

Coupled with the fact that the Figure A 4018 fault isolation capability is somewhat restricted and incomplete, it seems to be inevitable that a large proportion of faulty drawers will waste a lot of time before eventually being sent to depot for repair.

Recommendation.

Alternative a. Field-level checkout of equipment drawers containing a preponderance of soldered connections should be discontinued. Drawers revealed as being faulty by the Figure A 4012 DAC Test Set should be sent to Depot with no further expenditure of effort.

Alternative b. The equipment drawers should be entirely reworked, replacing all soldered connections by screwed, wrapped, or crimped connections.

Alternative c. The ban on soldering should be rescinded, or at least modified to allow soldering at Field Level by specially qualified personnel.

Item 4. a. Replacement of equalizing coils, transformers, and PCA's common to Figure A 1265 drawers will be comparatively slow regardless of where the work is done because the units are "wired-in" to associated circuitry.

Recommendation.

As a supplemental measure to those outlined in item 1, the above-mentioned modules should be repackaged to a plug-in configuration, provided the failure-rates expected for each item would warrant the change.

Item 5. The standard Minuteman equipment rack is a very sound structure, but it has one feature which is less than optimum as far as Maintainability is concerned, namely the grouping of electrical connectors at the top of the rack. It is always necessary to use a ladder to reach the connectors, and in some instances, (particularly in the LF) accessibility is impaired by overhead air-trunking and cable-trays.

Recommendation.

One possibility would be to route the cables along the back of the racks at ground level into an aperture at the bottom, connecting them vertically. In effect this would amount to turning the rack

cable-tray upside-down and raising the rack to allow access underneath.

- Item 10. No weight labels are displayed on the drawers of the Figure A 1265, although at least two drawers, A6 and A7, weigh more than 45 pounds.

Recommendation.

Appropriate weight labels should be displayed.

- Item 16. The drawer top covers are secured by 44 slotted captive screws, while the bottom covers are secured by 20 Phillips quick release fasteners.

Recommendation.

- a. The number of screws used to secure the top cover should be reduced.
- b. All fasteners should be of one variety, preferably slotted quick-release.

- Item 22. a. During drawer checkout process using Figure A 4018, Boeing personnel interjected a verbal warning at Paragraph 18-5 step n. After inserting the drawer in the test fixture, they advised the airman to reach down behind the test adapter and "jiggle" it to ensure that the connectors were properly mated. They stated that in their experience this action had eliminated spurious NO-GO's.

Recommendation.

1. The mechanical design of the Figure A 4018 test fixture should be improved so that the mating of connectors is positive.
 2. A caution note should be inserted in the T.O. recommending manipulation to complete the mating process.
- b. Checkout and troubleshooting charts of 31x2-32-3-2 (example Figure 18-2) call for replacement of components which are soldered in. As mentioned under item 1 above, this will present an immediate impasse because of the no-soldering edict.

Recommendation.

Unless soldering is to be permitted at the SMSA, the T.O. should be revised to differentiate between those actions that are "legal" at Field Maintenance level and those which require Depot Level maintenance.

In Figure 18-2 for example, only four out of 36 actions are "legal" at Field Level.

Item 23. No maintainability requirements are defined in the Figure A.

Recommendation.

Maintainability requirements should be incorporated at the next revision.

Item 26. As stated in items 1 and 22 the maintenance concept of this equipment is severely compromised by lack of soldering capability at the SMSA.

Recommendation.

Depot Level soldering capability should be provided at the SMSA in the form of acceptably trained personnel.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1251-4 Date April 24, 1963 Page 1 of 3

Prepared by A. H. Smith M/S V1-07 phone 866-3761

Figure A No. 1251 Nomen Digital Data Group OA-3593/BYK-2

Dwg. No. 8323616-505 Serial No. 10

Observed Event T.O. V&V Location VAFB Date April 8, 1963

Title or Description Drawer Checkout and Static Evaluation

T.O. Procedures T.O. 31X2-32-3-2 Section XXVIII through XXXIII

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/E	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	2
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	2	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	N/E	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4 a. The Figure A 1251 is mounted in a Standard Minuteman Rack, one characteristic of which is the grouping of external electrical connectors at the top-rear of the unit. This results in the necessity to utilize a stepladder to reach the connectors; accessibility is further impaired by the presence of overhead cable-trays and air ducting.

Recommendation.

A basic redesign of the rack configuration would be required in order to relocate the connectors at a more convenient level.

- b. The flexible air-ducting utilized to connect the Figure A 1251 rack to the Environmental Control System tends to collapse irregularly when subjected to an S-bend. It is possible that further cross-sectional changes may occur after calibration due to ageing or disturbance. Such a change in air-flow could conceivably result in an out-of-tolerance temperature condition and subsequent No-Go.

Recommendation.

Stiffened, constant cross-section flexible ducting should be used in place of the existing soft ducting.

- Item 5 a. Due to the fact that Drawer Connectors are mounted on the rear face of the Wire Tray connector panel, it is necessary to remove the entire rack to repair these connectors (See EO-1228-2 and others).

Recommendation.

Alternative a) The drawer connectors should be mounted on the front face of the connector panel.

Alternative b) The connectors should be mounted on hinged panels to allow access to the rear.

- b. It is necessary during test operations to remove the "site tailoring plug" in the Waveform Connector Drawer. At present this entails the removal and replacement of 44 screws to remove the top dust cover. (See EO-1251-1)

Recommendation.

A sliding panel should be provided in the dust cover to allow convenient access to this item.

Item 10

With the exception of the Waveform converter drawer, all drawers in the Figure A 1251 weigh more than 45 lbs., but are not so labeled.

Recommendation.

In accordance with section 10.4.3.1 of MIL-STD-803, weight labels should be affixed.

Item 16

As is common in all DAC equipment, top dust covers on the drawers are secured by 44 captive screws, while the bottom covers are secured by twenty quick-release fasteners.

Recommendation.

The number of screws securing the top dust cover should be reduced, and should preferably be of the quick-release variety.

Item 22

Paragraph 2-49 of the 4.6.63 version of T.O. 21-SM80A-2-3 covers twelve pages, due partly to inherent length of the paragraph, and partly to the revision process. The actual paragraph is only identified on the first page, which renders use of the T.O. unnecessarily time-consuming.

Recommendation.

The paragraph number should appear in the top right-hand corner of every page to facilitate use of the T.O.

Item 23

The Figure A does not contain Maintainability design requirements.

Recommendation.

Maintainability design requirements should be incorporated at the next revision.

Item 26

Soldering capability is required extensively to effect repairs to components of the Figure A 1251.

Recommendation.

Either the Figure A 1251 should be reworked to eliminate soldered joints or a soldering capability should be provided at Field Level of maintenance. (See EO-1265-1)

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 1251-5 Date 24 May 1963 Page 1 of 3

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 1251 Title LF Digital Data Group

Part No. 8323616 - 509 Serial No. Unknown

Demonstration Event 1-20 Location Ellsworth AFB Date 1 May 1963

Site B-9

T.O. Procedures T.O. 21-SM80A-2-3

MAINTAINABILITY CHECKLIST				
1	Fault Isolation and Repair	2	14	Lines and Cables
2	Standardization	1	15	Fasteners
3	Interchangeability	1	16	Covers, Cases, and Shields
4	Packaging and Mounting	2	17	Disposable Modules
5	Accessibility	2	18	Test Equipment
6	Work Space	3	19	Servicing and Handling Equipment
7	Testing and Servicing	1	20	Tools
8	Displays	1	21	Platforms, Stands, and Shelters
9	Handles	1	22	Technical Order
10	Labels and Marking	3	23	Figure 'A'
11	Controls	1	24	Form B/C.
12	Work Aids	4	25	Specifications
13	Connectors and Connections	1	26	Personnel Requirements

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The purpose of this demonstration was to troubleshoot the
LF Digital Data Group. Due to space limitations maintainability engineers
were denied admittance. The following problems were obtained by interviewing
the personnel involved with the demonstration.

Item 6

Problem: The rack on the left rear of the electronic maintenance van hinders removal and return of equipment to the van.

Recommendation: It would facilitate maintenance operations if this equipment rack is removed.

Item 10

Problem: Figure 2-16, page 2-38, of T.O. 21-SM80A-2-3 labels cable W2 115 VAC. The receptacle is labeled 120 VAC.

Recommendation: Both labels should be compatible.

Item 12

Problem: Section III, paragraph 3-9 of T.O. 21-SM80A-2-3 has a "CAUTION" specifying attaching personnel safety belt lines to the truck. No attaching rings or points are available on the truck for this purpose.

Recommendation: Provide attaching points, properly labeled, in all Minuteman maintenance vans for safety belt line attachment.

Item 19

Problem: The truck mounted hoist has one speed.

Recommendation: A slow speed would facilitate maintenance and increase safety.

Item 22

Problem: Paragraph 3-13 of T.O. 21-SM80A-2-3 calls out a lift pallet. The pallet has been cancelled and a rope is used to lower and remove equipment from the personnel hatch.

Recommendation: Delete references to the lift pallet and remove the illustration in Figure 3-2, page 3-5, from T.O. 21-SM80-2-3. If deemed necessary a rope tying procedure might be advisable for inclusion in T.O. 21-SM80A-2-3 as well as other technical orders calling for lowering and removing of test equipment from the launch facility.

Item 26

Problem: This problem is presented for information as it is a result of a SAC Directive which requires two men to be together at all times during proximity to a weapon system. This task calls for two men. When equipment was lowered down the personnel hatch both men had to go to the bottom of the hatch to unhook the lowered equipment. Then both men had to go topside and repeat this process until all equipment was lowered. The reverse procedure was used at the completion of the maintenance task.

Recommendation: The intent of this SAC Directive is understood, but it is felt that during the equipment lowering and raising operation the men could be within audible range.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EQ-1283-1 Date 19 March 1963 Page 1 of 3
 Prepared by Ralph L. Stearns M/S M1-FA phone 761-4320
 Figure A No. 1283 Nomen Motor-Generator Set, Launch Facility
 Dwg. No. _____ Serial No. New 154 Replaced 1786
 Observed Event Maintenance Location A-8 Malmstrom AFB Date 3-16-63
 Title or Description Maintenance replacement of the M-G set.
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/E	14	Lines and Cables	4
2	Standardization	N/E	15	Fasteners	4
3	Interchangeability	N/E	16	Covers, Cases, Shields	4
4	Packaging, Mounting	N/E	17	Disposable Modules	N/O
5	Accessibility	4	18	Test Equipment	N/A
6	Work Space	4	19	Servicing, Handling, Equip.	3
7	Testing, Servicing	N/E	20	Tools	3
8	Displays	3	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	N/E	23	Figure A	N/A
11	Controls	N/E	24	Form B/C	N/A
12	Work Aids	N/A	25	Specifications	N/A
13	Connectors, Connections	4	26	Personnel Requirements	N/A

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 8: The replacement Motor-Generator, serial No. 154, had a card giving an old startup and shutdown procedure. The procedure did not agree with the T.O. or with the latest concept.

Recommendation:

The proper startup and shutdown procedure should be displayed on all M-G sets.

- Item 19: The maintenance van hoist, which is supposed to lift the M-G Set out of the personnel hatch, is rated for 1300 lb with boom extended. (Boom must be extended to lift equipment out of the personnel hatch). The M-G set net weight is at least 2100 lb. This leaves the handling equipment rating 800 lb. below the minimum required rating:

Recommendation:

An adequate hoist be provided with the maintenance van.

- Item 20: To remove the 3/4" hex head bolts, anchoring the M-G Set to the floor mounting frame, requires the use of a special "crows-foot."

Recommendation:

The M-G Set should be removed by removing the twelve bolts holding the rubber shock mounts to the M-G Set.

- Item 22: (a) Paragraphs 2-42ab and 2-43c of T.O. 21-SM80A-2-11 require the use of the maintenance van hoist to lift the M-G Set. The hoist rating is only 2/3 the required lift.

Recommendation:

Change T.O. to indicate a different hoist must be used.

(b) Paragraph 2-42g of T.O. 21-SM80A-2-11 calls for the removal of safety wire. The cable connectors have holes for safety wire, but there is no place on the M-G Set to fasten the wire. Therefore, no safety wire.

Recommendation:

Eliminate the requirement to remove non-existing safety wire.

Item 22: (Continued)

(c) T.O. 21-SM80A-2-11 requires the removal of the 3/4" hex head bolts. This requires a "crows-foot", and leaves the shock mounts on the M-G set. The M-G set with shock mounts attached will not pass through the personnel hatch.

Recommendation:

The T.O. be changed so the M-G Set is removed from the shock mounts, leaving the shock mounts attached to the mounting base.

(d) The present T.O. 21-SM80A-2-11 M-G Set removal procedure requires the use of the M-G Set dolly. This involves four or five steps.

Recommendation:

Eliminate most of these steps by not using the dolly. Lift M-G Set with hoist & move as near upper floor opening as possible. Release M-G set and move hoist to the upper floor hoist rail. Connect hoist to M-G set end bell lifting eye. Lift M-G set to upper level. (It can be done with ease and safety; we did it.)

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1283-2 Date 3-22-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 1283 Nomen Motor Generator PU-515/GSW-4
 Dwg. No. 43-2028-759-1 Serial No. 0001708
 Observed Event T.O. V&V Location VAFB Date 3-20-63
 Title or Description Motor Generator Shutdown & Start
 T.O. Procedures 21-SM80A-2-11 Paras. 2-19 thru 2-22

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	4	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	N/O
7	Testing, Servicing	4	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, Shelters	4
9	Handles	N/A	22	Technical Order	4
10	Labels, Marking	4	23	Figure A	3
11	Controls	N/A	24	Form B/C	N/E
12	Work Aids	N/O	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	4

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4. During Motor Generator Shutdown procedure, (para. 2-20 of 21-SM80A-2-11), the final act which stops the motor is withdrawal of the D.C. power cable. A caution note warns that the connector must be withdrawn with a "quick careful" motion to keep arcing to a minimum. During the shutdown observed there was no noticeable arcing, but if a real possibility of connector damage exists, an alternative circuit breaker should be added into the D.C. power circuit.

Recommendation.

A D.C. circuit breaker should be incorporated into the Control Assembly, together with an over-current protection device to guard against the possibility of a mistaken attempt to connect the D.C. supply while the motor is stationary.

Item 16. The Control Assembly access plate is secured by 41 hex-headed bolts. There is no indication in the Figure A or elsewhere that this method of securing the panel is necessary for structural or security reasons.

Recommendation.

Section 10.4.3.5.5 of MIL-STD-803 states "where space permits, hinged covers should be used to reduce the number of fasteners required". It is therefore recommended that the access plate should be replaced by hinged door-type covers.

Item 23. a. The last two sentences in the Figure A (1-4-63 revision of D2-6952 Vol. II) are as follows:

"The motor generator set shall be stopped by removing the load break type d-c. power connector and subsequently opening the primary power circuit breaker. Continuous a-c. power shall be provided to critical loads by the motor generator set when it is supplied by the primary or the emergency power source or during transfer between same."

The shutdown procedure as stated in T.O. 21-SM80A-2-11, para. 2-20 calls for removal of primary power before disconnecting the d-c power connector. There appears therefore to be a conflict between the two documents, and it is believed that T.O. 21-SM80A-2-11 contains the correct procedure.

Recommendation.

At the next revision the Fig. A should be revised to eliminate the conflicting statements.

b. The Figure A does not contain Maintainability design requirements.

Recommendation.

At the next revision Maintainability design requirements should be incorporated.

MAINTAINABILITY ~~XXXXXXXXXX~~/OBSERVATION REPORT

Report No. EO-1283-3 Date April 12, 1963 Page 1 of 3
 Prepared by A. H. Smith M/S V1-07 phone 866-3761
 Figure A No. 1283 Nomen Motor Generator PU-515/GSW-4 (Launcher)
 Dwg. No. 43-2028-759-1 Serial No. 0001708
 Observed Event T.O. Pre V&V Location VAFB Date April 10, 1963
 Title or Description Brush Adjustment
 T.O. Procedures T.O. 21-SM80A-2-11 Paragraph 2-84

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	N/E
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	N/E	17	Disposable Modules	N/E
5	Accessibility	2	18	Test Equipment	N/E
6	Work Space	4	19	Servicing, Handling, Equip.	N/E
7	Testing, Servicing	2	20	Tools	2
8	Displays	N/A	21	Platforms, Stands, Shelters	N/E
9	Handles	4	22	Technical Order	3
10	Labels, Marking	4	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	4	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	N/E

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 5

There are four brush assemblies on the D.C. motor of the Fig A 1283, spaced by ninety degrees, and located on diagonals. The bottom left-hand brush assembly is therefore placed in the corner between the motor bed-plate and the control-box. During the attempted preliminary V & V observed, it was discovered that work on this assembly is very difficult, if not actually impossible. No way could be found to operate the dial indicating scale. Similar difficulty was experienced with the bottom right-hand brush assembly, due to the closeness of the wall.

Recommendation.

The spring tension measurement does not appear to be possible in the way suggested by the T.O. - or with the existing test equipment. It seems probable that it would be economically unsound to remove the generator from the L.F. to perform these adjustments at the SMSB, so it is concluded that an item of special test equipment is justified. The provision of a suitably mounted pulley-wheel, (which could be manually held in position on the generator housing) together with a piece of nylon monofilament, would allow the tension measurement to be made axially instead of radially and would avoid the difficulties of access to both bottom brush-sets.

Item 7

Steps f and g of paragraph 2-84 require the operator to manually retract the solenoid plungers and check clearance between brushes and commutator using a feeler gage. It is very difficult to retract the solenoid armatures on the bottom brush assemblies, and even more difficult to insert the feeler gage. (See also item 20).

Recommendation.

The checking of brush clearances would be made very much easier if it could be arranged to have the solenoids actuated electrically; it might also, incidentally, be a more representative test.

This could best be accomplished by providing a suitable isolating jack on the Control Cabinet Assembly which would isolate the solenoids and connect them to an external 36 volt supply.

The solenoids could be lifted without modifying the existing cabinet by connecting a 36 volt supply across diode CR 1 by means of alligator leads, however this method has the obvious disadvantages that it is necessary to open the control cabinet first, and there is some risk of damaging CR 1 by application of the wrong polarity.

Item 16

It was observed that the wire-mesh portions of the D.C. Motor Screen had been damaged in places. In one spot a tear almost 3 inches long had occurred. This condition is undesirable, in that it leads to the possibility of R-F interference problems, as well as to the danger of allowing objects to enter the motor casing.

Recommendation.

The D.C. motor screen should be strengthened or protected from casual damage.

Item 20

Due to the geometry of the D-C motor housing and the brush assemblies, it is very difficult to insert a feeler gage between the brush and the commutator unless the gage has been suitably bent before-hand. It is also difficult to ensure that insertion of such an item will not damage either the brushes or the commutator.

Recommendation.

A special Go-No-Go gage should be provided for the checking of brush clearances. It should be an L - shaped tool, with the foot of the L being the gage. The gage should be "stepped" so that the first step represents the minimum clearance, while the second, or No-Go step represents the maximum clearance. The gage should be made of material with adequate dimensional stability and which would preferably be soft enough to preclude damaging the commutator or brushes in use; it should also be suitably shaped to measure a clearance between curved surfaces.

Item 22

Step e of paragraph 2-84 of T.O. 21-SM80A-2-11 states simply "Inspect brushes for proper seating." It is difficult to see the brushes, let alone determine whether they are seating properly, without actually removing them, however the T.O. does not mention this fact.

Recommendation.

Step e should be expanded somewhat to explain how the brushes should be inspected. It might also be considered worthwhile to mention that the sandpaper should be "rough-side-out", since it is not unknown for even experienced mechanics to make this simple error.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 1283-4 **Date** May 23, 1963 **Page** 1 of 2

Prepared by Wilbur Lohss and Philip Giles **M/S** **50-66** **Phone** **656-6598**

Figure A No. 1283 **Title** Motor-Generator Set, L. F.

Part No. 43-2028-759-1 Serial No.

Demonstration Event Unscheduled **Location** Ellsworth B5 **Date** May 7, 1963

T.O. Procedures

MAINTAINABILITY CHECKLIST					
1	Fault isolation and Repair	N/R	14	Lines and Cables	N/R
2	Standardization		15	Fasteners	
3	Interchangeability		16	Covers, Cases, and Shields	
4	Packaging and Mounting	N/R	17	Disposable Modules	
5	Accessibility	3	18	Test Equipment	
6	Work Space	N/R	19	Servicing and Handling Equipment	
7	Testing and Servicing		20	Tools	
8	Displays		21	Platforms, Stands, and Shelters	
9	Handles		22	Technical Order	
10	Labels and Marking		23	Figure 'A'	
11	Controls		24	Form B/C	
12	Work Aids		25	Specifications	
13	Connectors and Connections	N/R	26	Personnel Requirements	N/R

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: _____

.....

Problem: Fasteners

The motor generator set, Fig. A 1367, has an access panel fastened with recessed allen screws. Unless a socket wrench allen adapter is available, removing this access panel may be an unduly long and tedious task.

Recommendation:

Hex head screw fasteners should be used to permit the convenience of standard tools during maintenance.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1284-2 Date March 15, 1963 Page 1 of 4
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 1284 Nomen Power Supply Group OA-3386/GSW-4
 Dwg. No. 25-22552-36 Serial No. 2
 Observed Event _____ Location Vandenberg AFB Date 3-12-63
 Title or Description Static evaluation
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST				
1	Fault Isolation	2	14	Lines and Cables
2	Standardization	3	15	Fasteners
3	Interchangeability	4	16	Covers, Cases, Shields
4	Packaging, Mounting	3	17	Disposable Modules
5	Accessibility	2	18	Test Equipment
6	Work Space	4	19	Servicing, Handling, Equip.
7	Testing, Servicing	2	20	Tools
8	Displays	4	21	Platforms, Stands, Shelters
9	Handles	4	22	Technical Order
10	Labels, Marking	4	23	Figure A
11	Controls	N/A	24	Form B/C
12	Work Aids	N/O	25	Specifications
13	Connectors, Connections	4	26	Personnel Requirements

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower

Item 1.

Discussions with maintenance personnel at VAFB indicate that difficulties have been experienced in isolating Wiring Tray faults both on the Figure A 1284 and on other equipment utilizing the Standard Rack configuration. The frequency of such faults is very low according to the Reliability group, but when such faults do occur the fault isolation process can become somewhat lengthy. Due to the difficulty of repairing Wiring Tray faults (see items 4 and 5) it is the natural tendency to exhaust all other possibilities first, which involves a fair amount of transportation of drawers back and forth to the SMSB for drawer checkout.

Neglecting such items as manufacturing wiring errors, the principal source of Wiring Tray faults appears to be recessed drawer connector pins. During earlier phases of the operation at VAFB some of these faults were caused by the use of oversize test probes, which caused expansion and/or recession of female pins, however this difficulty was largely eliminated by procedural directive. It was felt that a "break-out box" was required to facilitate testing of the Wiring Tray and an item of ACO equipment was produced. It was not apparently fully developed, however and has not been extensively used.

Due to the basically sound alignment of the equipment drawers and to close quality control on probing, faults in Wiring Tray connectors are now very rare, but the potential danger remains that under other circumstances, the frequency of Wiring Tray faults may rise; if this did occur, considerable time wastage could result. In a bad case, where recessed pins were giving intermittent faults, for example, it is quite conceivable that down times in the order of two or three days could occur.

Recommendation.

- a. If quantitative analysis of Wiring Tray faults justifies it, a "break-out box" should be added to the existing Test Equipment. The desirable features of such an item might include the following:
 1. It should possess basically the same connector positioning characteristics as the equipment drawers.
 2. The depth of insertion of the test connectors should be variable to allow detection of "recessed pins".
 3. The unit should have a high degree of adaptability to different drawers and equipment racks to reduce the number of different break-out boxes required.
 4. Consideration should be given to the possibility of producing a testing device to be used in conjunction with the "break-out box" which would avoid the necessity for utilizing pin-to-pin continuity testing. Pin-to-pin continuity testing requires analysis of the wiring bundle and must of necessity be a slow task. It is possible that connector continuity could be established by utilizing some device such as an Impedance Bridge which could detect proper

connector continuity by indicating the existence of an increase in stray capacity on those pins which are connected to a wire.

- b. Suitable caution notes should be added to Organizational Maintenance troubleshooting charts to warn against direct probing of drawer or wiring-tray connectors (Note: Such cautions may already exist--the relevant T.O.'s are not available for evaluation by the writer at this time.)

Item 2.

The two circuit-breaker panels of the Figure A 1284 are of a non-standard configuration. Instead of utilizing a standard drawer with rear connectors, screw-type connections are made directly to the terminals of the contact breakers, and the panels are secured directly to the frame of the rack by means of screws.

Recommendation.

To minimize replacement time, and to reduce the risk of errors in connection, the circuit breakers should be mounted in a standard drawer.

Item 4.

The grouping of external electrical connectors at the top of the equipment rack is a feature of the Minuteman Standard Rack, and has been dealt with in other MEOR's. In this case, since the rack is in the Launch Facility equipment room, the accessibility problem is aggravated by the presence of a low air-conditioning duct.

Recommendation.

The Minuteman Standard Rack should be redesigned to provide better accessibility of electrical connectors.

Item 5.

Due to the method of mounting drawer connectors on the Wire Tray assembly it is necessary to remove the entire rack in order to repair or replace broken or bent connector pins. According to maintenance personnel this task requires 8 hours to perform, with an additional 4 hours in preparing to do the job and getting the paperwork organized.

Recommendation.

Item 10.5.2.3 of MIL-STD-803 states "The rear of plug connectors shall be accessible for test and service, except where potting, sealing or other considerations preclude this".

In this case, since the connectors are internally mounted, there is no obvious requirement for preventing convenient access to the rear of the plug.

Except in cases where the connectors are potted, and are therefore only replaceable at SMSB or depot, all connectors on the Wire Tray assembly should be made more readily accessible than at present.

Two possibilities exist:

1. The connectors should be mounted on the front face of the wire tray assembly with sufficient slack in the wiring to permit the connector to be pulled forward and repaired in place.
2. The connectors should be mounted on hinged panels which may be swung out to permit access to the rear of the plug.

Note: It cannot readily be determined whether the rate of incidence of connector problems would justify the above changes.

Item 7. The difficulties in testing the Wire Tray assembly are dealt with under item 1 above.

Item 15. The Circuit Breaker panels and the Relay Access panel are secured to the rack by means of Phillips-headed screws.

Recommendation.

If these panels are not repackaged to a standard drawer configuration, the Phillips-headed screws should be replaced by quick-release fasteners.

Item 18. As indicated in item 1, an area of deficiency exists in test equipment for the rapid isolation of Wire-Tray faults.

Recommendation.

See item 1.

Item 23. The figure A does not contain Maintainability design requirements.

Recommendation.

Maintainability design requirements should be incorporated at the next revision.

MAINTAINABILITY-EVALUATION/OBSERVATION REPORT

Report No. FO-1289-1/4152-2/1284-1 Date 3-14-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3261
 Figure A No. 1289 Nomen Power Supply Group OA-3385/GCW-4
 Dwg. No. 25-24197-40 Serial No. 2
 Observed Event V&V Location VAFB Date 3-12-63
 Title or Description Power Supply Checkout and Static Evaluation
 T.O. Procedures 3502-2-63-1 Section IV (Function No. 108)

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	3	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	2	18	Test Equipment	1
6	Work Space	4	19	Servicing, Handling, Equip.	N/E
7	Testing, Servicing	4	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	4
10	Labels, Marking	4	23	Figure A	3
11	Controls	4	24	Form B/C	N/E
12	Work Aids	3	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	4

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 2.

Four of the six panels of the Power Supply rack are of a non-standard configuration. Instead of the standard practice of mounting equipment in a drawer with connectors at the rear, these items are screwed or bolted directly to the rack:

- a. D.C. Circuit Breaker panel
- b. Access panel
- c. A.C. Circuit Breaker panel
- d. Battery Charger panel

The first three items are not particularly significant because they contain very little active circuitry. In the case of the Battery Charger, PP-3028, there is little doubt that reliability considerations dictate the need for bolted terminals, but there appears to be no reason why this condition should not be met while using a standard drawer configuration. As it is, removal of the Battery Charger involves removal of the access panel, unbolting the assembly and terminals, and sliding the unit onto the handtruck.

Recommendation.

The Battery Charger PP3028/GSW-4 should be mounted in a standard drawer configuration unless reliability or economical trade-off considerations indicate that this is undesirable.

Item 4.

The Power Supply Group is mounted in a standard Minuteman Equipment rack, which results in the grouping of fourteen connectors on the top surface. As mentioned in several other MEOR's this leads to less than optimum accessibility.

Recommendation.

The rack should be redesigned to provide better accessibility to the electrical connectors.

Item 5.

If it is ever necessary to change a pin in one of the jacks on the Wire Tray Assembly, it will apparently be necessary to remove the entire tray first. This would require removal of the entire rack and would place the LCC out of commission. It is estimated that this process could hardly be accomplished in less than eight hours.

The inaccessibility of jacks and wiring in the cable-tray is a feature of the Standard Minuteman Equipment Rack that may be significant in other items.

Recommendation.

- a. The cable tray should be redesigned so that it is possible to repair damaged connectors without the necessity for removing the entire cable-tray. This might be accomplished by mounting the connectors on the front face of the cable-tray, with sufficient slack in the wiring to each connector to permit servicing without removal.
- b. A review should be held to determine the desirability of making similar changes to other equipment cable-trays.

Item 12. See item 5 of EO-4152-1. It is not possible to remove dust covers when a drawer is located in the Fixture, Cooling Air without distorting them.

Recommendation.

The size of the access holes should be increased to allow installation and removal of dust covers while the drawer is in the fixture.

Item 15. The access panels, circuit breaker panels and Battery Charger access panel are secured by slotted screws.

Recommendation.

If the panels are not repackaged to conform with the standard method of securing panels by locking handles per item 3 above, these screws should be replaced by quick release fasteners.

Item 18. The Electrical Dummy Loads DA-304, DA-305, DA-306 (part of Fig. A 4152) were found to have transposed electrical connectors. See item 4a, of EO-4152-1.

Item 23. The Figure A does not contain Maintainability Design Requirements.

Recommendation.

At the next revision Maintainability requirements should be added.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 1323-1 (LCF Misc.) Date May 28, 1963 Page 1 of 2

Prepared by W. Lohss and P. G. Giles M/S 50-66 Phone 656-6598

Figure A No. 1323 Title Pull Box Access and Security Switch Labeling

Part No. _____ Serial No. _____

Demonstration Event Unscheduled Location Ellsworth, D-1 Date April 26, 1963

T.O. Procedures

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/R	14	Lines and Cables	N/R
2	Standardization		15	Fasteners	
3	Interchangeability		16	Covers, Cases, and Shields	
4	Packaging and Mounting		17	Disposable Modules	
5	Accessibility		18	Test Equipment	
6	Work Space		19	Servicing and Handling Equipment	
7	Testing and Servicing		20	Tools	
8	Displays		21	Platforms, Stands, and Shelters	
9	Handles		22	Technical Order	
10	Labels and Marking		23	Figure 'A'	
11	Controls		24	Form B/C	
12	Work Aids		25	Specifications	
13	Connectors and Connections	N/R	26	Personnel Requirements	N/R

CHECKLIST RATINGS

1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable

2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4 .

COMMENTS: Noted while observing procedure verification on Fig. A 1367.

LCF Power Distribution System

Problem: Accessibility

A pull box, housing an RFI filter is located in the LCF access shaft about 10 to 15 feet above the floor. Above it are two lightning arrestors and a smaller pull box. Then units are illustrated in Fig. 1-2, SAC-CEM-21-SM80B-2-21-1.

The wires and filters within the pull box are accessible only after the bottom panel of the box is removed. This panel is held fast by 34 bolts. Technicians at LCF D-1 at Ellsworth report that when work was performed on the filters recently, removal and installation of this panel was a tough job.

Recommendation:

1. Lower the pull boxes and lightning arrestors to permit access while standing on the shaft floor.
2. Hinge the access panel to the largest pull box, so the panel will not have to be lifted.
3. Reduce the number of fasteners holding the panel.

LCF Security System

Problem: Labeling

When entering the launch control center a push button switch can be seen mounted on the capsule wall to the right of the doorway. This switch actuates the lock on the security room door upstairs. The switch is labeled START.

Recommendation:

1. Remove the START label.
2. Label the switch to identify it as the security room door switch.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 1329-1 Date May 22, 1963 Page 1 of 2

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 1329 Title LF Power Generation and Distribution System

Part No. _____ Serial No. _____ Wing II

Demonstration Event Unscheduled Location Ellsworth B-4 Date May 1, 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	4	14	Lines and Cables	N/R
2	Standardization	N/R	15	Fasteners	N/R
3	Interchangeability	N/R	16	Covers, Cases, and Shields	N/R
4	Packaging and Mounting	N/R	17	Disposable Modules	N/R
5	Accessibility	3	18	Test Equipment	N/R
6	Work Space	N/R	19	Servicing and Handling Equipment	N/R
7	Testing and Servicing	N/R	20	Tools	N/R
8	Displays	N/R	21	Platforms, Stands, and Shelters	N/R
9	Handles	N/R	22	Technical Order	N/R
10	Labels and Marking	4	23	Figure 'A'	N/R
11	Controls	N/R	24	Form B/C	N/R
12	Work Aids	N/R	25	Specifications	N/R
13	Connectors and Connections	N/R	26	Personnel Requirements	N/R

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: These observations were made when evaluating Fig. A 1211.

DIESEL ENGINE CRANKING AND ALARM PANEL - WING II

Problem: Fault Isolation and Marking

The diesel engine cranking and alarm panel at the LF Support Building does not have a lamp test capability. This panel contains displays that should light whenever any of the following conditions occur: diesel generator engine overspeed, high water temperature, low lube oil pressure, engine fails to start, sump pump high water level, day tank low fuel level, and main tank low fuel level. If a panel lamp burns out and a fault occurs the panel will not display this information; and to a technician checking the panel all appears to be well because the panel is not lighted. The most practical way to check the panel lights at the present time is to replace each bulb with a good test bulb. Another method, demonstrated by a technician, is to ground each sensor, simulating a fault and causing a good lamp to burn. This is an impractical technique but it was the method of checking the panel lights suggested by an experienced technician. In this case he spent more than five minutes just checking the sump high water level alarm lamp. Each fault display is lighted by a single lamp. Each display is labeled but the panel's general function is not identified by label.

Recommendation:

1. Provide a lamp test capability for this panel.
2. Label the panel to identify its function.
3. Correct the maintenance analysis, D2-6951, Vol. IV H, (Wing I), which identifies this panel as a Generator Control Panel. SAC-CEM-21-SM80B-2-21-1 (D2-13608-31) refers to this panel in Fig. 1-17 as the LF Diesel Engine Cranking and Alarm Panel. Though this name does not precisely reflect the function of the panel it is not the misnomer that Generator Control Panel is.

AUTOMATIC SWITCHING UNIT

Problem: Accessibility

The automatic transfer switch cabinet located in the LF support building has two doors. Each is fastened by 12 round head screws and hinged at the sides. To open one cabinet door 12 screws must be removed requiring eight to ten minutes work. This time is doubled if access to both sides of the panel is required. The hinge assemblies appear to use a special pin. These pins are loose fitting devices causing considerable slop in the movement of the door on the hinge. Unit reference designation numbers were stenciled on the door. The left door was numbered 444 at the top and 445 at the bottom, and the right door was numbered 443 at the bottom. What these numbers mean is unclear.

DIESEL ENGINE CRANKING AND ALARM PANEL - WING II

Problem: Fault Isolation and Marking

The diesel engine cranking and alarm panel at the LF Support Building does not have a lamp test capability. This panel contains displays that should light whenever any of the following conditions occur: diesel generator engine overspeed, high water temperature, low lube oil pressure, engine fails to start, sump pump high water level, day tank low fuel level, and main tank low fuel level. If a panel lamp burns out and a fault occurs the panel will not display this information; and to a technician checking the panel all appears to be well because the panel is not lighted. The most practical way to check the panel lights at the present time is to replace each bulb with a good test bulb. Another method, demonstrated by a technician, is to ground each sensor, simulating a fault and causing a good lamp to burn. This is an impractical technique but it was the method of checking the panel lights suggested by an experienced technician. In this case he spent more than five minutes just checking the sump high water level alarm lamp. Each fault display is lighted by a single lamp. Each display is labeled but the panel's general function is not identified by label.

Recommendation:

1. Provide a lamp test capability for this panel.
2. Label the panel to identify its function.
3. Correct the maintenance analysis, D2-6951, Vol. IV H, (Wing I), which identifies this panel as a Generator Control Panel. SAC-CEM-21-SM80B-2-21-1 (D2-13608-31) refers to this panel in Fig. 1-17 as the LF Diesel Engine Cranking and Alarm Panel. Though this name does not precisely reflect the function of the panel it is not the misnomer that Generator Control Panel is.

AUTOMATIC SWITCHING UNIT

Problem: Accessibility

The automatic transfer switch cabinet located in the LF support building has two doors. Each is fastened by 12 round head screws and hinged at the sides. To open one cabinet door 12 screws must be removed requiring eight to ten minutes work. This time is doubled if access to both sides of the panel is required. The hinge assemblies appear to use a special pin. These pins are loose fitting devices causing considerable slop in the movement of the door on the hinge. Unit reference designation numbers were stenciled on the door. The left door was numbered 444 at the top and 445 at the bottom, and the right door was numbered 443 at the bottom. What these numbers mean is unclear.

Recommendations:

1. The screw fasteners should be omitted from the door design. Because hinges are present, the use of door handles would seem perfectly sound.
2. The hinge pin diameter should be increased to remove the slop.
3. The use of unit reference designation numbers should be clarified.

MAINTAINABILITY VALUATION/OBSERVATION REPORT

Report No. EO-1337-1 Date February 25, 1963 Page 1 of 3
 Prepared by Ralph L. Stearns M/S 50-66 phone 6-6262
 Figure A No. 1337 Nomen Distribution Box J-1269/GSW-4
 Dwg. No. 25-23468 Serial No. 7
 Observed Event Evaluation Location EDL Laboratory Date 2-22-63
 Title or Description _____
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	N/A	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	N/A
5	Accessibility	3	18	Test Equipment	N/E
6	Work Space	4	19	Servicing, Handling, Equip.	N/E
7	Testing, Servicing	4	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	4
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C	4
12	Work Aids	N/A	25	Specifications	3
13	Connectors, Connections	3	26	Personnel Requirements	N/E

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4, Packaging, Mounting

- A. The two large access panels must be supported and aligned by the technician while he is trying to install the retaining bolts.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.7.5 "Guide pins or their equivalent shall be provided on units for alignment during mounting."

- B. To remove relay K3 the wiring to relay K2 must be removed.

Recommendation:

Per MIL-STD-803 paragraph 10.4.2.3.3 "All throwaway assemblies or parts are accessible without removal of other components."

- C. Due to the location of cable connector receptacles J30, J32, J33 and J34 it is almost impossible to remove the cables without first removing other cables.

Recommendation:

Per MIL-STD-803 paragraph 10.5.2.1.2 "Connectors shall be located far enough apart that they can be grasped firmly for connections and disconnections. Space required will depend upon the size and shape of the plug."

Item 5, Accessibility

See Item 4 paragraph "B" and "C".

Item 10, Labels, Marking

Part of the label for circuit breaker No. 6, VRSA Emergency Power, is hidden by a mounting screw.

Recommendation:

Per MIL-STD-803 paragraph 5.2.4. "Labels should not be hidden by units and parts. For example, labels on the chassis should not be placed under the parts which they identify. Also see MIL-STD-130B. Paragraph 4.2."

Item 13, Connectors, Connections:

See Item 4 paragraph "C."

Item 15, Fasteners

There are eighty-six hex-head bolts holding the two access panels to the distribution box.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.7.1 "A minimum number of screws or bolts shall be used for unit installation."

Item 23, Figure A:

The Figure A does not contain any Maintainability Design Requirements. In accordance with AFBSD Exhibit 61-56 Maintainability Design Requirements must be included in the Figure A's for all OGE and MGE Minuteman equipment for which Boeing is responsible.

Recommendation:

When the Figure A is revised Maintainability Design Requirements should be added.

Item 24, Specifications

Model Specification, Distribution Box, (S-133-111-1-28), Boeing Document D2-6600, has no reference to maintainability.

Recommendation:

Conform to MIL-M-26512B (USAF) section 3.2.6.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-1337-2 Date May 10, 1963 Page 1 of 3

Prepared by A. H. Smith M/S V1-07 Phone 866-3761

Figure A No. 1337 Title Distribution Box J-1269 / GSW-4

Part No. 75-23468-38 Serial No. 9

Demonstration Event 585-6 Location VAFB Date March 20, 1963

T.O. Procedures - Unscheduled Maintenance during Missile Emplacement

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/E	14	Lines and Cables	1
2	Standardization	1	15	Fasteners	2
3	Interchangeability	1	16	Covers, Cases, and Shields	P/E
4	Packaging and Mounting	3	17	Disposable Modules	N/A
5	Accessibility	3	18	Test Equipment	N/E
6	Work Space	1	19	Servicing and Handling Equipment	N/E
7	Testing and Servicing	1	20	Tools	1
8	Displays	1	21	Platforms, Stands, and Shelters	N/A
9	Handles	1	22	Technical Order	1
10	Labels and Marking	P/E	23	Figure 'A'	3
11	Controls	1	24	Form B/C	N/E
12	Work Aids	N/A	25	Specifications	N/E
13	Connectors and Connections	P/E	26	Personnel Requirements	N/E

CHECKLIST RATINGS

1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable

2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The rating P/E means that the item has been previously evaluated

D2-14934-6 Page 237

Item 4

During the observed event, the VRSA unit failed, and an attempt was made to remove the unit from the back of the Distribution Box. It was found that one of the mounting bolts was turning without becoming looser. Eventually the unit was removed by sawing through the bolt.

Subsequently the Distribution Box was opened to remove the portion of sawn-off bolt, and it was found that the cause of the trouble was that the VRSA mounting bolt had passed through the "floating-captive" nut some 8 to 10 threads, far enough to pop the rivets which secure the hexagon cap to the nut-plate. The hexagon cap fell off thereby freeing the unit, and preventing removal.

The technicians reported that this problem is "not uncommon", but no accurate estimate of frequency of occurrence can be formed.

If this situation should occur at a launcher which is in Strategic Alert, it would be necessary to perform the Distribution Box Shutdown procedure in paragraph 2-22, T.O. 21-SM80A-2-11, which includes shutdown of the LF and insertion of safing pins, etc.

The existing method of securing the VRSA mounting points to the Figure A 1337 conflicts with the following items in MIL-STD-803:

10.1 "..... rapid and easy removal and replacement of mal-functioning units" (In this case the "malfunctioning unit is the nut-plate)

10.4.3.8.1.4 "Unit should not be placed behind other items which are difficult to remove."

10.4.3.10.2 "Units shall be so located that no other equipment must be removed to remove."

10.4.3.10.4 "Access to units maintained by one operator shall not require removal of equipment maintained by a second ... etc."

10.4.3.11 "..... access may be achieved without danger to personnel from electrical charge" (This is the consideration that would require LF shutdown to gain access to inside of Figure A 1337, apart from security regulations).

Recommendations.

There are two alternative methods of resolving this problem.

- a. If the general configuration of the existing mounting technique is to be retained, either or both of the following changes must be made:

1. The depth of the hexagon nut-retaining cap must be increased.
2. The length of the mounting bolts must be reduced, and the bolts attached by lanyards to prevent inadvertent substitution of a longer bolt.

This method would not strictly avoid the conflict with MIL-STD-803, but it would probably reduce the frequency of occurrence to an acceptably low level.

- b. In order to properly avoid conflict with the above mentioned items of MIL-STD-803 the VRSA mounting method must be changed. This could be accomplished by making the mounting point externally mounted on the back of the Figure A 1337.

Item 5 Accessibility of the VRSA nut-plates has been dealt with in item 4 above.

Item 23 Item G of the "Recommend Solution" of the Figure A states that "It shall be a design objective that unauthorized access to all Distributor terminals necessary for launch require a minimum of twenty minutes. Modifications which are operationally acceptable include:

- a. Use of materials resistant to a cutting torch.
- b. Encapsulation of all internal connections.
- c. Cover fasteners requiring time-consuming application of a special tool for removal.

It appears that the basic objective of these requirements is to prevent unauthorized launching.

The recommended solution, however, has the unfortunate side-effect of making legitimate maintenance more time-consuming and difficult than it would otherwise be.

Recommendation.

A design study should be made to determine the feasibility of accomplishing the "unauthorized launch" prevention objective without rendering legitimate maintenance so difficult.

A concept that would seem promising would be the provision of a suitably guarded electrical interlocking and circuit-breaking mechanism.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1338-1 Date 3-8-63 Page 1 of 2
 Prepared by A. H. Smith M/S 6207-1 phone 866-3261
 Figure A No. 1338 Nomen Communications Control Console OA-3460/GSW-4
 Dwg. No. 25-27095-2 Serial No. 4
 Observed Event None Location VAFB Date 3-5-63
 Title or Description Evaluation
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	4	17	Disposable Modules	4
5	Accessibility	2	18	Test Equipment	4
6	Work Space	N/A	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	N/O	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	N/E
10	Labels, Marking	4	23	Figure A	3
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/O	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	2

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 5.

The track of the console operator's seat impedes access to five of the storage batteries. If it becomes necessary to work on the batteries the entire chair and track assembly unit must be removed because the track is bolted down to the floor and to the five covers across which it passes.

Recommendation.

The track should be redesigned to avoid the necessity for removal when opening the battery access panels.

This could be accomplished by cutting the track into appropriate sections and mounting the sections permanently on the access covers. In this way an individual cover may be removed without disturbing the remainder.

Item 15.

The telephone-transmitter control panel and the aiming and status panel are both secured to the console by Allen-headed screws.

Recommendation.

Presuming that it would be economically unsound to repackage the panels to a more standard drawer configuration, the Allen-headed fasteners should be replaced by the more conventional slotted or Phillips-headed fasteners.

Item 23.

The Figure A contains no Maintainability design requirements.

Recommendation.

Maintainability design requirements should be incorporated at the next revision.

Item 26.

Soldering is required to effect repair of several items in the equipment panels.

Recommendation.

a. The equipment should be repackaged to avoid the use of soldered connections.

or b. A soldering capability should be provided at the SMSA.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1367-1 Date 1-2-63 page 1 of 4

Prepared by A. H. Smith M/S 6207-1 phone 866/3761

Figure A No. 1367 NOMEN Motor Generator (LCC)

Dwg. No. 10-20945 Serial No. _____

Observed Event T.O. V&V Location VAFB Date 1-2-63

Title or Description Motor Generator Checkout

T.O. Procedures 21-SM80A-2-11, Figure 1-10A

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	2	17	Disposable Modules	N/A
5	Accessibility	2	18	Test Equipment	3
6	Work Space	N/A	19	Servicing, Handling, Equip.	N/O
7	Testing, Servicing	N/O	20	Tools	N/O
8	Displays	N/A	21	Platforms, Stands, Shelters	N/O
9	Handles	4	22	Technical Order	N/E
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	N/A	24	Form B/C	N/E
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	2	26	Personnel Requirements	4

Checklist Ratings

- 4 Good Maintainability
- 3 Satisfactory Maintainability
- 2 Unsatisfactory Maintainability
- 1 Poor Maintainability

- N/A Not Applicable
- N/O No Observation Possible
- N/E Not Evaluated

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4.

The Control Panel box was not packaged for ease of maintenance-in-place. Due to the location of the generator in a pit, it is almost impossible to remove the access panel without removing the entire Motor Generator Set from the pit. The T.O. therefore calls for removal of the M.G. for most of the fault isolation steps.

During the V&V exercise observed, an over-voltage condition was discovered on step w of Figure 1-10A. The 60 cycle output was 125 volts, which is 2.6 volts high. At this point it would have been necessary to remove the M-G from the pit and replace the 60 cycle regulator if the T.O. fault isolation procedure was followed. The Test Operator decided to proceed with the V&V and appeal to Seattle engineering for a waiver on this point but due to A.F. personnel problems, the V&V was abandoned. It is obvious, however, that re-packaging of the Control Panel could eliminate the need for M-G set removal.

Two possible ways of accomplishing the re-packaging are:

- a. Re-design the Control Panel so that the 60 cycle regulator, 400 cycle regulator and Transfer Panel are plug-in units that are withdrawn vertically from the top surface of the Control Panel.

or

- b. Re-design the Control Panel box so that the top surface may be removed, allowing access to the terminals and mounting-bolts from above. This solution, while much less desirable than a., could be accomplished with very much less effort, and could even be implemented as a retrofit effort at wing level.

Item 5:

The D.C. power connector is very difficult to install; organizational personnel report that installation time varies from fifteen minutes to as much as four hours.

The difficulty is considered to be due to the location of the connector, coupled with work-space problems.

The D.C. power cable is very large (approx. 3" dia) and is terminated in a special connector with a long rigid body. The socket is approximately 2 feet below the floor surface, close to the side wall of the pit.

Installation would be considerably eased if the D.C. power connector were to be re-located at the top of the Control Panel.

It is also possible that the bulky special connector could be dispensed with when the circuit-breaking modifications are incorporated in the LCC Motor Generator.

Item 10

Although each part of the M-G had a label, no serial number could be found for the combination of parts making up the Figure A 1367.

Item 13

See item 3 concerning the D. C. power cable connector.

When replacing modules in the Control Panel it is necessary, according to paragraphs 1-40, et. seq., to remove wires from the terminal boards, and tag them for identification purposes. Such connections should be permanently identified to reduce the possibility

of error.

Item 16

The comments in item 4 concerning packaging of the replaceable modules contained in the Control Panel could be considered as a deficiency in the Control Panel Cover; although the cover protects the equipment adequately, it also impedes access.

Item 18.

On step q of Figure 1-10A, alligator clip leads are used to connect a test meter to the 120 vac 60 cycle buss and neutral. The leads specified terminate at the meter in a double "banana" jack. During the V&V observed, the technician transposed the leads in error, thereby grounding the live connection and burning up the test lead. No serious damage occurred, fortunately, but it is felt that the leads used for this test should be clearly distinguished.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1412-1 Date 1-4-63 Page 1 of 2

Prepared by A. H. Smith M/S 6207-1 phone 866-3761

Figure A No. 1412 Nomen Voice Reporting Signal Assembly

Dwg. No. 10-21330-2 Serial No. 0000001

Observed Event Unsched. Maint. Location VAFB Date 1-4-63

Title or Description Replacement of Faulty Audio Reproducer Module

T.O. Procedures TCTO 21-SM80A-644

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	2
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	4	17	Disposable Modules	4
5	Accessibility	4	18	Test Equipment	4
6	Work Space	N/A	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	3	20	Tools	2
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	3	22	Technical Order	4
10	Labels, Marking	4	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	2	25	Specifications	N/E
13	Connectors, Connections	2	26	Personnel Requirements	2

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 7. When replacement of an Audio Reproducer Unit is required, present practice calls for removal of the message tape from the faulty unit, and its installation in the new unit. This process takes one hour to perform and also disturbs the environment within the unit. The work should be performed in an environmentally controlled area to prevent the inclusion of dust and other foreign matter in the tape mechanism.

These requirements could be avoided and maintenance time saved if the Audio Reproducer Unit was fitted with a tape at the point of manufacture.

Item 9. The unit weighs approximately 70lbs., and is labelled to this effect. The label also calls for a two-man lift. The unit is provided with a single hinged handle in the centre of the front panel, which invites single-man lifting. Two handles should be provided to avoid possible injury to personnel.

Item 12. Electrical connections to the VRSA are made through a 100-pin connector, which is also used during fault-isolation as an access-point for probing. This activity could have detrimental effects on the reliability of the connector.

A proper break-out for access to the connector pins should be provided as a work aid.

Item 15. Printed Circuit Boards and Audio Reproducer Modules are attached to the chassis by means of Allen screws which are located close to the base of these items, approximately six inches deep. This geometry precludes the use of standard Allen wrenches.

The use of slotted screws for mounting purposes would allow the use of a normal screwdriver, and eliminate the need for a special Allen wrench tool. (See item 20)

Item 20. Due to the use of Allen screws for mounting components to the chassis, and to the geometry (see item 15), technicians in the Contractor Support Area at VAFB have found it necessary to have a special long-handled Allen wrench manufactured. If the mounting method is not changed, then a special wrench should be provided.

Item 26. Soldered joints are used extensively throughout the Assembly, resulting in the necessity for depot repair.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-1412-2 Date 1-22-63 Page 1 of 3
 Prepared by Ralph L. Stearns M/S 50-66 phone 6-6263
 Figure A No. 1412 Nomen Signal Assembly, Voice Reporting
 Dwg. No. 09621000 (10-21330) Serial No. P-3
 Observed Event _____ Location 9,101 Bldg. D. C. Date 1-18-63
 Title or Description Inspection
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/A	14	Lines and Cables	4
2	Standardization	3	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	3	17	Disposable Modules	N/A
5	Accessibility	2	18	Test Equipment	3
6	Work Space	N/A	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	N/A	20	Tools	3
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	N/A
10	Labels, Marking	4	23	Figure A	N/A
11	Controls	4	24	Form B/C	N/A
12	Work Aids	N/A	25	Specifications	N/A
13	Connectors, Connections	4	26	Personnel Requirements	N/A

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 2.

A special allen wrench, a standard allen wrench, two sizes of phillips screw drivers, and a common blade screw driver are required to perform maintenance.

Recommendation

By standardization of the types of bolts the requirement for different hand tools could be minimized.

Item 4.

- a. Due to the location of some of the mounting base mounting bolts several of the plug-in circuit boards have to be removed before their mounting base can be removed.

Recommendation

Changing the location of the base mounting bolts would eliminate this problem.

- b. Due to the location of the filter unit mounting bolts the plug-in circuit board mounting base must be removed.

Recommendation

Changing the location of the filter unit mounting bolts would eliminate this problem.

Item 5.

See Item No. 4.

Item 15.

See Item No. 2

Item 18.

Figure A 4539 Test Set, Voice Reporting Signal Assembly is connected to VRSA by a cable about four feet long and 2 1/2 inches in diameter. The stiffness of this cable makes the use of the test set very difficult.

Item 20.

1. To remove the plug-in circuit boards and filter unit requires an allen wrench of greater than normal length.

Recommendation

Changing the allen head bolts to slotted hex-head bolts would eliminate the requirements for a special tool.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-1412-3 Date 29 May 1963 Page 1 of 2

Prepared by P. G. Giles and W. F. Lohss M/S 50-66 Phone 656-6264

Figure A No. 1412 Title Signal Assembly, Voice Reporting

Part No. 09621000-611A Serial No. 220

Demonstration Event CSA Location Ellsworth AFB Date 8 May 1963

T.O. Procedures

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	1	14	Lines and Cables	4
2	Standardization	1	15	Fasteners	2
3	Interchangeability	1	16	Covers, Cases, and Shields	2
4	Packaging and Mounting	2	17	Disposable Modules	N/A
5	Accessibility	1	18	Test Equipment	2
6	Work Space	N/A	19	Servicing and Handling Equipment	N/A
7	Testing and Servicing	N/A	20	Tools	N/A
8	Displays	4	21	Platforms, Stands, and Shelters	4
9	Handles	1	22	Technical Order	N/A
10	Labels and Marking	1	23	Figure 'A'	N/A
11	Controls	1	24	Form B/C	N/A
12	Work Aids	N/A	25	Specifications	N/A
13	Connectors and Connections	1	26	Personnel Requirements	N/A

CHECKLIST RATINGS

- 1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable
 2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The VRSA was monitored using the VRSA Test Set, P/N 09627000-601A, S/N15. Two problems were found during this check (Items 8 and 14).

Item 8

Problem: The VRSA Test Set, P/N 0927000-601A, S/N 15, has a indicator light assembly mounted on the front panel. The lamp assembly has a green lens and is labeled "STEPDOWN FAULT."

Recommendation: Change the lens from green to red in accordance with MIL-STD-803, paragraph 6.1.2.1.

Item 14

Problem: The cable assembly that connects from the VRSA Test Set to VRSA is too short. The cable is identified as: Cable Assembly W5(TSI724/GSW-4), P/N 09627008-601A, MFR 08446, S/N 0000015. In order to connect the cable it is necessary to place the test set on the work bench and VRSA on a stool so that both front panels are in approximately the same plane. The electronic technician had to wrestle the cable in order to complete the connection.

Recommendation: Increase the cable length to permit easy connection with both units standing on the same level.

MAINTAINABILITY EVALUATION/REPORT

Report No. EO-3022-2 Date February 19, 1963 Page 1 of 8
 Prepared by Alexander Henschel M/S 50-66 phone JU 6-6263
 Figure A No. 3092 Nomen Test Set, Programmer Group, AN/GSM-57
 Dwg. No. 25-26825, 25-29147, 25-31488, Serial No. 0004
25-29127
 Observed Event Qualification Location EDL Date February 15, 1963
 Title or Description Testing Functional Test
 T.O. Procedures N/A

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	3	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	3	18	Test Equipment	3
6	Work Space	4	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	3	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C Form C only	3
12	Work Aids	3	25	Specifications	3
13	Connectors, Connections	3	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Rating Analyses for Test Set, Programmer Group, AN/GSM-57**Item I - Fault Isolation**

Fault isolation to a replaceable component is an unduly complicated task. The self-test provision of AN/GSM-57 provides a GO-NO-GO indication. If a NO-GO is indicated the Test Set must be checked by use of the AN/GJM-15 Test Center and AN/GSM-61 Test Adapter Group. This does not insure the fault will be located since it may be in the power circuitry necessitating use of the AN/GSM-82(V) Test Equipment. After the fault has been corrected, a self-test will be run to determine whether or not a GO condition now exists. Therefore it is conceivable that four or more tests will run before the Test Set is returned to an operational status.

Recommendation:

Investigate the possibility of using a break-out box in conjunction with Standard Test Equipment, self-test provision of the AN/GSM-57, and the AN/GSM-82(V) Test Equipment. This type of test setup would shorten troubleshooting and checkout by eliminating the need for converting from one test situation to another.

Item 4 - Packaging, Mounting

A. The suitcases and their feet will not withstand normal organizational usage.

Recommendation:

Zero Modular Packaging per catalog E59 or equivalent would provide the rugged test equipment suitcase needed for organizational usage.

B. The upper chassis of the Fault Locator, 25-29127-5, is mounted on the lower chassis. Mounting alignment is such that the corner hex head screws are too close to the case (four places).

Recommendation:

Initiate an ADCN to correct the out of tolerance condition.

Item 5 - Accessibility

Accessibility is limited for the connection of the AN/GSM-57 to the Programmer Group at the Launch Facility. Nine cables have to be connected at the top rear of the Programmer Group which necessitates use of a step-ladder.

Recommendation:

Investigate packaging the Programmer Group in the type of equipment rack which is used at the Launch Control Facility. This type of rack would allow more work space and would facilitate faster test setup.

Item 7 - Testing, Servicing

The test program for the AN/GSM-57 consists of punched program cards. There is no instruction on or near the card reader stating which way the Programmer card should be inserted. Instructions are in T.O. 21-SM80A-2-3.

Recommendation:

Provide an instruction placard or the outline of a program card on the card reader to eliminate any doubt as to which way the card should be placed.

Item 10 - Labels, Marking

A. The cable carrying case weighs 128 pounds with all cables. The eighteen cable compartments are unmarked as to which cable it is for, allowing the technician to place each cable where he wants to.

Recommendation:

Mark the weight of the carrying case, ref. MIL-STD-803 section 10.4.3.1 Mark each cable compartment for a particular cable. This will insure all cables are accounted for when the maintenance crew leaves the LF and will maintain the weight distribution of the cables in the proper manner. See Attachment A.

B. Test setups could be made quicker if a placard were provided in the top cover of the Fault Locator (cable hook-up placard for Programmer Group checkout) and the Distribution Box (cable hook-up placard for self-test).

Recommendation:

Provide a cable hook-up placard in the Fault Locator and the Distribution Box suitcases. See attachment B.

Item 12 - Work Aids

See discussion presented in Items 7 and 10.

Item 13 - Connectors, Connections

The multitude of connections for self-test and fault isolation is discussed in item 1. Item 5 covers the accessibility aspect of making the test connections.

Item 18 - Test Equipment

The AN/GJM-15 Test Center and AN/GSM-61 Test Adapter Group are used to troubleshoot the AN/GSM-57 Test Set.

Recommendation:

Investigate the possibility of using Standard Test Equipment and the AN/GSM-82(V) Test Equipment only. Use Standard Test Equipment for troubleshooting and maintenance whenever possible. See MIL-M-26512B (USAF).

Item 22 - Technical Order

See Attachment C.

Item 23 - Figure A

Figure A Technical Requirements section should have a maintainability and operability paragraph.

Recommendation:

Conform with instructions in AFBSD Exhibit 61-56.

Item 24 - Form B/C

Form C analysis needs revision as to personnel requirements particularly in the callout of clock hours to complete certain tasks.

Recommendation:

Revise Form C's as more accurate time lines become available. Areas to be improved are test setup, test accomplishment, and return to prior configuration times.

Item 25 - Specifications

Model Specification, Test Set, Programmer Group (S-133-121-3-1-10), Boeing Document D2-9140, has no reference to maintainability.

Item 25 - (Continued)

Recommendation:

Conform to MIL-M-26512B (USAF) section 3.2.6.

Item 26 - Personnel Requirements

See Item 24.

ADD (18TYA)

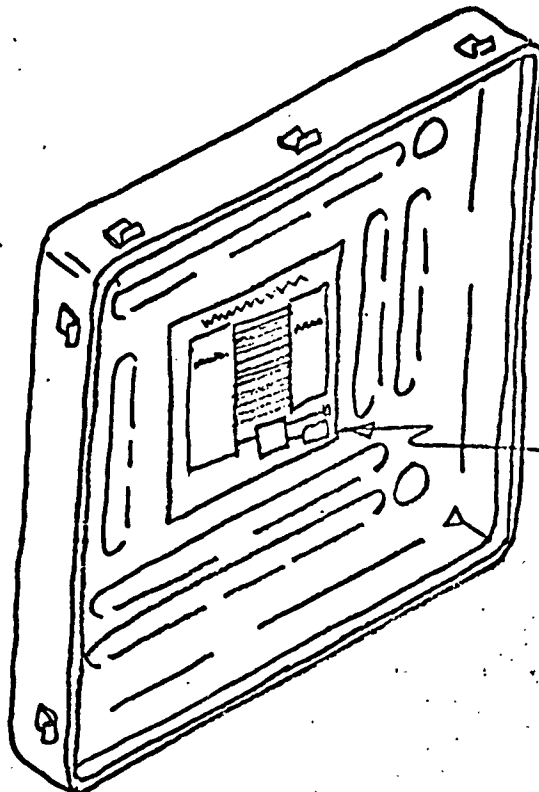
WEIGHT WITH ALL CABLES - 128 LB

ADD WEIGHT DESIGNATION TO EACH FLAP

DESIGNATE EACH COMPARTMENT

- ELECTRICAL CABLE CASE
25-29147

ATTACHMENT B



ADD
PLACARD SHOWING
CABLE HOOK-UP
FOR PROGRAMMER
GROUP TEST
SET SELF-TEST
(REF. T.O. 21-SM80A-23)
FIG. 2-25

COVER, DISTRIBUTION BOX
25-31488 (REF.)

COORDINATION SHEET

TO

J. E. Fitzharris 2-5252 39-90
B. R. Johnson 2-5252 39-90

NO. MEG-3-34

SSSSSS File 410.0

GROUP INDEX

Minuteman Maintainability Engineering Group

DATE FEB 14 1963

SUBJECT

T.O.'s: 21-SM80A-2-3, 21-SM80A-8-1, and
33D9-111-3-1

MODEL WS-133A

Reference:

Coordination Sheet No. MEG-3-11, dated 1/22/63.

A Maintainability study is presently in progress on Figure A number 3092, Programmer Group Test Set, AN/GSM-57, 57A. The subject T.O.'s are being used in conjunction with this study. Maintenance information on the Programmer Group Test Set can be improved by incorporation of the following recommendations:

1. At present T.O. 33D9-111-3-1 has no detailed instructions for performance of Self-Test. Section 5-25 is listed as not available.

Recommendation:

Insure that section 5-25 of T.O. 33D9-111-3-1 is consistent with sections 2-54 thru 2-56 of T.O. 21-SM80A-2-3. The only difference should be the fact that T.O. 33D9-111-3-1 will be for the SMSA and T.O. 21-SM80A-2-3 will be for the LF. Incorporate the suggestions contained in Coordination Sheet MEG-3-11 in the Self-Test procedure.

2. The Index of Punched Program Cards contained in each of the subject T.O.'s is not consistent. Figure 2-2, page 2-7, of T.O. 21-SM80A-8-1 differs from Figure 2-34A, page 2-74A, of T.O. 21-SM80A-2-3 which differs from section 1-12, page 1-4, of T.O. 33D9-111-3-1. Each of these figures should list the same items and information.

Recommendation:

Use the same Index of Punch Program Cards for the AN/GSM-57, 57A in all three T.O.'s. Insure that the punched card information is accurate.

Prepared by:

A. Henschel

A. Henschel

Approved by:

*J. S. McEacheran*J. S. McEacheran
Minuteman M Engineering GroupAH:clj
2/13/63

D2-14934-6

Page 260

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-3092-3 Date April 5, 1963 Page 1 of 3

Prepared by A. H. Smith M/S 6207-1 phone 866-3726

Figure A No. 3092 Nomen Programmer Group Test Set AN/GSM-57

Dwg. No. 25-26725-2 Serial No. 5

Observed Event Maintenance Location VAFB Date April 3, 1963

Title or Description Incorporation of modification and use at LF

T.O. Procedures 21-SM80A-2-3 Paragraph 2-52

MAINTAINABILITY CHECKLIST				
1	Fault Isolation	2	14	Lines and Cables
2	Standardization	2	15	Fasteners
3	Interchangeability	4	16	Covers, Cases, Shields
4	Packaging, Mounting	3	17	Disposable Modules
5	Accessibility	4	18	Test Equipment
6	Work Space	3	19	Servicing, Handling, Equip.
7	Testing, Servicing	N/E	20	Tools
8	Displays	4	21	Platforms, Stands, Shelters
9	Handles	4	22	Technical Order
10	Labels, Marking	3	23	Figure A
11	Controls	4	24	Form B/C
12	Work Aids	N/E	25	Specifications
13	Connectors, Connections	4	26	Personnel Requirements

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 1

During a pre-demonstration checkout the Figure A 3092 Test Set indicated No-Go's on all phase voltage checks for the Regulator Assy. voltage MX-3629/GSW-4. The Regulator was changed, but the same No-Go's occurred. A second Test Set was substituted, but with the same results. It turned out that both Figure A 3092 Test Sets had been similarly damaged during checkout at the contractor support area, due to non-incorporation of a modification. The fault was finally discovered by the lengthy process of disabling evaluator outputs one at a time until it was found that one output of the A5 card was -30V instead of -10V, due to a broken-down transistor. The difficulty arose because, despite the failure, both sets repeatedly passed self-test. A total time of approximately five days elapsed before the fault was isolated, although some of this time was spent in moving equipment due to Vandenberg unique scheduling. It is estimated that this particular fault could hardly have been isolated in less than two shifts under the most favorable circumstances.

Recommendation.

The specific incident described above is very unlikely ever to occur again, and it would probably be uneconomical to modify the self-check process to check the specific items concerned. It is considered worth while, however, to initiate an evaluation to see if there are other potentially difficult situations. Any results from such an analysis could be added to the trouble-shooting charts, to aid in a speedy resolution of similarly abstruse problems.

Item 2

The Power Supply PP-3267/GSM (Figure A 4523) that is used with the Figure A 3092 has suffered damage on two occasions at VAFB due, it is believed, to a lack of standardization of AC power cables. On one of the occasions, a wire bundle in the Power Supply was burned up due to the inadvertent use of an ACO AC power cable with a Figure A power supply. Apparently the connections for the Figure A equipment differ from those in the ACO equipment, although the plug keying was the same. The second incident, which occurred at the SMSA, was caused by the use of a non-standard cable to connect the VARIAC during bench checkout of the PP-3207.

Recommendation.

The AC input power cable, W-2 of PP-3267 (part no. 29-25048-1), should be carefully checked to ensure that the wiring is standard, and is compatible with the PP-3267 input power jack; also, any mechanically similar cables (such as that used with the ACO version of the Figure A 4523) should be checked to ensure electrical compatibility.

Item 4 Terminal Boards TB2, TB3, TB8, and TB9 in the Fault Locator are very difficult to work on because they are located close to an internal corner. It is necessary to remove the terminal board mounting plate first, which is rendered difficult by inaccessible fasteners.

Recommendation.

The terminal board mounting plate should be made more easily removable; this could be accomplished by securing it with screws which remove from the exterior surface of the Fault Locator top-chassis.

Item 6 The problem of making the many test connections to the top surface of the Programmer Group has been dealt with in EO-3092-1.

Item 10 The test programmer card-numbering system is confusing, since it is difficult to discover whether a deck is complete or not. (see EO-3092-1)

Recommendation.

All cards in a deck should bear a deck identification number and a separate serial number. Gaps in the serial sequence should be filled with blank cards similarly numbered so that it may be quickly ascertained whether the deck is complete.

Item 15 The bolts used to secure the Fault Locator chassis to the case, at the card reader end, are rendered partially inaccessible due to the overhang of the card-pockets.

Recommendation.

Holes should be cut into the bottoms of the card-pockets to allow the use of a socket wrench. These holes would also, incidentally, tend to prevent the accumulation of dust and dirt in the card-pockets thereby possibly avoiding card-reader errors.

Item 26 Soldering is used extensively in the Fault Locator Unit, which precludes repair at Field-level.

Recommendation.

Soldered joints should be replaced by solderless joints wherever this is feasible and/or an authorized soldering capability should be provided at the SMSB.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-3092-4 Date 22 May 1963 Page 1 of 3

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 3092 Title Fault Locator, Programmer Group, Test Set

Part No. 25-29127 Serial No. 22

Demonstration Event Unscheduled Location EAFB CSA Date 25 April 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/A	14	Lines and Cables	3
2	Standardization	1	15	Fasteners	3
3	Interchangeability	1	16	Covers, Cases, and Shields	3
4	Packaging and Mounting	2	17	Disposable Modules	N/A
5	Accessibility	2	18	Test Equipment	2
6	Work Space	N/A	19	Servicing and Handling Equipment	N/A
7	Testing and Servicing	4	20	Tools	N/A
8	Displays	3	21	Platforms, Stands, and Shelters	N/A
9	Handles	1	22	Technical Order	N/A
10	Labels and Marking	3	23	Figure 'A'	N/A
11	Controls	3	24	Form B/C	N/A
12	Work Aids	N/A	25	Specifications	N/A
13	Connectors and Connections	3	26	Personnel Requirements	N/A

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The following problems were noted on the Fault Locator,
Programmer Group, 25-29127, which is a part of the Test Set, Programmer Group.

- Item 7 a. All meters on the front panel on Minuteman test equipment must be calibrated every 30 to 60 days in accordance with D2-12075, which will eventually be included in the applicable T.O.'s. To do this simple operation on the Fault Locator the entire test set must be disassembled and reassembled. This operation requires approximately four man-hours to accomplish. In addition, the reliability of the test set is degraded by this frequent disassembly and reassembly.

Recommendation: Install three nut plates on the front panel for the meter mounting and increase the wire length to the meter. This type or similar recommendation should be incorporated on all Minuteman test sets having front panel meters and, thereby, will comply with MIL-T-21200C, paragraph 3.2.2. (c). This recommendation has been submitted to the Boeing Suggestion Group by: Clifton Keck, Electronics Technician, M/S ET 02, Ellsworth AFB, S. D.

- b. The test cards, 25-26642, are too thin, several had to be replaced.

Recommendation: Increase the test card thickness.

- Item 8 a. All indicating lights have bulb redundancy except the "WAR HEAD ALARM".

Recommendation: Provide a spare bulb for the "WAR HEAD ALARM" on the front panel with a function label. An alternate recommendation is to use a lamp fixture having bulb redundancy. See MIL-STD-803, paragraph 6.1.3.4.

- b. The Fault Locator has no way to check bulb failure.

Recommendation: Provide a "PRESS TO TEST" switch to enable quick bulb "go" identification. See MIL-STD-803, paragraph 6.1.3.4.

- Item 10 a. Self test cards are not marked for proper insertion in the card reader assembly. Special T.O. information is required.

Recommendation: Print arrows or other identification on the card to indicate proper insertion of the card in the reader assembly. See MIL-STD-803, paragraph 10.4.3.5.1.

- b. The thumb cut-out on the card reader assembly is not labeled for efficient card removal.

Recommendation: Provide a label for the card removal thumb cut-out.

- Item 11** The "SELECTOR SWITCH" knob is not indexed. If the knob comes loose approximately two hours will be wasted tracing circuits to determine correct knob position.
- Recommendation: Index the knob to shaft making it impossible to improperly install the knob. This recommendation will comply with MIL-E-4158C, paragraph 3.2.5.3.
- Item 13** The Bendix electrical connectors are inferior to the Pyle-National connectors. The Pyle-National connectors have a mounting flange which is bolted to the front panel by four screws. The Bendix connectors are mounted by a single large nut. The nut on the Bendix connector loosens causing the connector to be loose on the front panel. In addition the connectors are subject to pin damage due to being less rigid than the Pyle-National connectors.
- Recommendation: Use Pyle-National connectors in lieu of Bendix. To minimize modification cost, install internal tooth lock washers underneath the nut and back panel or apply Lok-Tite on the connectors retaining nut threads after tightening the nut.
- Item 14** The common portable power supply power cable, P/N 29-25050-1, is too short. The cable is part of ACO 4523 power supply and is connected to the Fault Locator, Programmer Group. Due to the large diameter of the cable it is difficult to bend or index the connectors.
- Recommendation: Increase the length of the power cable.
- Item 15** The card reader assembly slide screws become loose. The screws are a special spanner head type and require a special small spanner wrench to tighten.
- Recommendation: Install internal star washers underneath the screw head and brass spacer, and between the brass spacer and reader assembly housing.
- Item 16** Permanent dust caps for the connectors are not provided. Quality Control insist that all connectors have dust caps. Spare dust caps are used on the larger Pyle-National connectors and plastic shipping covers are used for the smaller connectors.
- Recommendation: Provide dust caps with a retaining chain for all electrical connectors on the fault locator.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. WFL-2-1 EO-3109-1 Date 15 Oct. 1962 Page 1 of 3

Prepared by W. F. Lohss M/S 50-66 Phone 6-6263

Figure A No. 3109 Nomen Test Set, Alarm Set, AN/GSM-59

Dwg No. 25-26827 Serial No. _____

Test No. T.O. 21-SM80A-2-4 Validation _____ Held at STP III

Maintenance Level ☐ ORG ☐ Field ☐ Depot Type ☐ Scheduled ☐ Unscheduled

MAINTAINABILITY CHECKLIST					
1	Standardization	4	13	Displays	N/A
2	Interchangeability	N/A	14	Handles	4
3	Packing & Mounting	4	15	Fasteners	N/A
4	Accessibility	4	16	Covers, Cases, Shields	4
5	Work Space	3	17	Platforms, Stands & Shelters	N/A
6	Connectors & Connections	3	18	Labels & Marking	2
7	Fault Isolation	4	19	Disposable Modules	N/A
8	Lines & Cables	4	20	Technical Orders	4
9	Test Service Points	3	21	Figure A	N/A
10	Test Equipment	4	22	Form B/C	N/A
11	Tools	4	23	Model Specification	N/A
12	Controls	4	24	Personnel Requirements	N/A

MAINTAINABILITY PROBLEMS:

NOTE: See Attached sheets by item number. Items rated three and under have comments.

Item 5

The aisle space between the Charger Alarm Set Group and the LF Launch Tube wall is marginal. No recommendation can be made due to the design and/or modification considerations; however, a 90° connector plugs at the rear of the fault locator will alleviate this problem (See Item 6 for details).

Item 6

- I. The aisle space between the batter charger Alarm Set Group and the LF Launch Tube wall is marginal. This condition is further aggravated when both the test set fault locator and the Antenna Test Set Group are setting in the aisle. When the cable assembly connectors are installed on the back of the fault locator, they protrude and further impair movement. It was observed during this validation that the Boeing Technician's leg bumped into a protruding connector plug almost breaking it off.

In order to obtain maximum aisle room and minimize connector damage, it is recommended that the connector plugs which interface at the back of the fault locator be changed from straight connector plugs to 90° connector plugs. To obtain maximum cable length, the plug-receptacle shall be indexed to permit the cable to go up. The present 120 VAC power cable connector P8 is adequate as it does not protrude.

- II. The receptacles on back of the fault locator test set has protective plastic caps. The caps are not attached to the chassis which will result in their loss.

It is recommended that protective caps, such as BACC14F, be used that can be secured by a chain to prevent their loss and facilitate replacement.

Item 9

The fault locator test set panel has 16 test point receptacles (TP1-TP16) plus one ground receptacle arranged in a row at the top of the panel. Protective caps are used for the receptacles and have attaching chains to prevent loss of the caps. The chain attaching screws are attached to the chassis, thereby, requiring unscrewing 17 caps before the panel can be removed. The same maintenance delay exists when the panel is replaced.

Item 18

- I. The following label and marking recommendations are made to the front panel of the test set fault isolator:

1. The panel should have additional functional lines or blocks; e.g., the "ON-OFF" switch and "POWER ON" light, the three "PRESS" buttons and the "GO" and "NO-GO" lamps.
2. The following labels should be added to provide positive correlation:
 - (a) A label to identify the fuse and its rating.
 - (b) A label for the cage to indicate its function and "INNER SCALE" and

Item 18 (Continued)

- "O OUTER SCALE". The symbol "O" could also be added to the gage inner band, and the symbol "O" added to the gage outer band.
- (c) Underneath the "SWITCH TEST SELECTOR" change the label to read "O READ INNER SCALE".
 - (d) The "ON-OFF" toggle switch should also be labeled "PWR SW". (NOTE: The abbreviation is used because of space limitation.)

II. The two handles on the front panel of the fault isolator obscure lettering. The left handle obscures the "R" and part of the "F" in the label "RF AREA SIMULATION". The right handle obscures the "SW" in the labels "INNER SECURITY SW" and "OUTER SECURITY SW".

It is recommended that the labeling be moved slightly to eliminate the above problem.

III. The following additional labels are recommended to the Antenna Test Set Group:

1. Provide "ON-OFF" labels for the six toggle switches.
2. The "PHASE SHIFTER ADJUSTMENT" bar requires correlative arrows to indicate the direction the bar slides.

Item 3. Two connectors on the rear of the Fault-Locator panel are identical, and appear to have the same keying. They are J9 and J11. Since they are adjacent, some confusion could arise, and the keying on one should be changed.

Item 4. Test-set Antenna TS-1606/GSM-59 consists of a box, used for stowing cables, and a lid containing the Antenna Simulator. It is possible to get all the cables in the box, but the process requires ingenuity and patience. The problem is aggravated by a short tie-down strap (see Item 15). It is quite possible that the cables could be damaged by the sharp bends required if they were packed in intense cold. Damage to the cables could also occur due to the projecting handles on the panel of the Antenna Simulator in the lid. The only solution to this problem would appear to be enlarging the box or providing additional storage space.

The Antenna Simulator panel is secured to the lid by 28 screws, when 6 or 8 should be sufficient.

Item 8. The meter on the Fault-Locator panel has two scales, identified on the face of the meter as A and B. The Test Selector switch positions are referred to the appropriate scale by red or black dots, with a legend above the switch identifying the black dot as referring to the "Inner Scale", and the red dot the "Outer Scale".

The scales should be referred to as A and B to agree with the meter marking, and the dots should be replaced with the letters A and B. In time the dots will probably become obscured by dirt or wear, leading to possible confusion over test results.

Item 10. Each of the three boxes comprising the AN/GSM-59 weighs 90 lbs. or more but none are labelled to this effect. Warning labels should be affixed showing that two-man lift is required.

Each of the 17 cables bears a number of yellow labels with a confusing amount of "low significance" information. The identity and function of a cable is not immediately apparent, and attempting to find a particular cable in the pile can be irritating and time-consuming. The use of a differently colored label bearing nothing but the cable number and function in bold letters would be useful.

Item 13. The connectors provided on the cables were not apparently designed with exterior field use in mind.

All co-axial connectors require multiple -turn installation, where quarter-turn connectors would have been more appropriate.

The 70 ohm co-axial connectors are particularly unsuitable, since they are the conventional laboratory variety which are very prone to becoming detached from the cable under conditions of rough usage. A molded type should be used, or at least one having an adequate cable-clamping device.

All the connectors, with one exception, are provided with loose plastic dust covers; these are very likely to disappear in time, leaving the connectors open to sand, dust, mud, and moisture. The dust covers should be of a captive variety.

Item 15. The lateral cable tie-down strap in the Antenna Test Set Group is too short at the buckle end. When replacing the cables after use, the buckle gets lost under the cables; this is very frustrating since recovery disturbs the carefully arranged cables.

The job of stowing the cables would be facilitated somewhat if this strap were to be lengthened by six inches.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-3109-3 Date March 2, 1963 Page 1 of 7
 Prepared by R. L. Stearns M/S 50-66 phone 6-6263
 Figure A No. 3109 Nomen Test Set, Alarm Set AN/GSM-59
 Dwg. No. 25-26827 Serial No. 2
 Observed Event Evaluation Location EDL Date February 22, 1963
 Title or Description _____

7.0. Procedures

Fault Locator Alarm Set TS-1606/GSM-59 Serial No. 2
 Test Set Group, Antenna, OA-3801/GSM-59 Serial No. 2
 Test Set, Antenna Calibration TS-1824/GSM-59 Serial No. 16

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/E	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	N/E
5	Accessibility	3	18	Test Equipment	N/A
6	Work Space	N/E	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	N/A	20	Tools	3
8	Displays	N/E	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	4
10	Labels, Marking	3	23	Figure A	3
11	Controls	3	24	Form B/C	4
12	Work Aids	N/E	25	Specifications	4
13	Connectors, Connections	4	26	Personnel Requirements	N/A

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- F. The antenna adapter, part of the Test Set Antenna, is difficult to remove from its storage space.

Recommendation:

The fasteners should be changed to easily operated quick release type.

- G. The cable storage area for the Antenna Calibrator Set is so small it is very difficult to make it contain the cables.

Recommendation:

Adequate storage space be provided.

Item 5, Accessibility

- A. Wire bundles located directly over terminal boards TB1, TB2, TB3, TB4, TB5, and TB6 make the terminals inaccessible.

Recommendation:

Relocate the wire bundles so the terminals are accessible.

- B. The position of the retaining bolt on the lower clamp of Capacitor C2 of the Fault Locator Alarm Set makes it impossible to loosen the clamp without the use of a special tool.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.7.3 "Field removable assemblies and units shall be replaceable with nothing more than common hand tools."

Item 10, Labels, Marking

- A. It is difficult to determine which plug-in circuit board in the Fault Locator Alarm Set goes into which receptacle.

Recommendation:

Label the circuit boards and the receptacles with reference designations in accordance with MIL-E-4158C paragraph 3.6.2, and MIL-STD-130B paragraph 4.2

Item 10 (Continued)

- B. All of the suitcases were over forty-five pounds but were not labeled with their weight.

Recommendation:

Per MIL-STD-803 "All units weighing 45 pounds or more shall be permanently labeled with their weight."

- C. The front panel of the Fault Locator Alarm Set has a Test Selector Switch and a Test Selector Indicator on it. The Indicator has two scales label "A", (outer scale) and "B" (inner scale). The Test Selector is labeled "O Read outer scale" and "● Read inner scale."

Recommendation:

Per MIL-STD-803 paragraph 5.1.7 "abstract symbols (squares, Greek alphabet, etc.) will not be used as labels. Common meaningful symbols such as the percent sign, plus sign, etc., are acceptable."

- D. The Fault Locator Alarm Set Function Selector switch has "R/T" used as an abbreviation for Receiver Transmitter.

Recommendation:

When abbreviations must be used conform to MIL-STD-12.

- E. The cable storage areas of the test set do not have cable inventories or location placards. Nor does the test set have a cable inventory. Due to the lack of cable inventory placards Boeing has been losing cables at Malmstrom AFB.

Recommendation:

A cable inventory placard be fastened to each cable storage area.

- F. The abbreviation "NS" is used on the Test Set Group, Antenna. It is believed this means "Nano-second" but MIL-STD-12B gives the following meanings:

- (1) National special (thread)
- (2) Near side
- (3) Nickel steel

F. (Continued)**Recommendation:**

Conform with MIL-STD-803, paragraph 5.1.4 "Abbreviations, where required, shall be common or meaningful and shall conform with MIL-STD-12 and ANA Bulletin 261."

- G.** The labels for terminal boards TB1 and TB2, part of the Antenna Calibration Set, are under the wires going to the terminal boards.

Recommendation:

Conform to MIL-STD-803 paragraph 5.2.4 and MIL-STD-130B paragraph 4.2.

Item 11, Controls

- A.** The Function Selector Switch, part of the Alarm Set Fault Locator, has its stop located two steps beyond the last labeled function.

Recommendation:

Refer to MIL-STD-803 paragraph 9.6.5.5.3 "Provide stops at the beginning and end of the range of control positions if the switch should not be operated beyond the end positions or specified limits."

- B.** The Phase Shifter adjustment control, part of the Antenna Test Set Group, does not operate freely and smoothly without binding, and is hard to set accurately.

Recommendation:

Refer to MIL-E-4158 paragraph 3.2.5.2 "Mechanical operations - Play and backlash shall be held to the minimum and shall not cause poor contact or inaccurate setting. Controls shall operate freely and smoothly without binding, scraping, or cutting; controls shall be lubricated when lubrication does not interfere with operation. Continuous positioning, circular, pointer type knobs shall be used for discrete positioning operations."

Item 15, Fasteners

- A. The selector switches, part of the Alarm Set Fault Locator, are fastened to the front panel by means of high torque screws. To remove these screws requires a high torque type screw driver.

Recommendation:

Refer to MIL-STD-803 paragraph 10.4.3.7.2 "Whenever possible, identical screw and bolt heads shall be used. This is to enable various panels and components to be removed with one type of tool." Also refer to MIL-E-4158 paragraph 3.2.31.1 "Standard tools. Without detracting from design, standard tools shall be used to the greatest extent practicable (standard tools are tools, normally hand tools, manufactured by two or more recognized tool companies). Type and variety of tools shall be kept to the absolute minimum."

- B. The cable straps, on the cables stored in the Antenna Test Set Group suitcase, are made of a material which is not compatible with the type of buckle used. The buckle cannot be kept tight.

Recommendation:

Change material of type of buckle, so the straps can serve their function.

Item 16, Covers, Cases, Shields

- A. The test points located on the front panel of the Alarm Set Fault Locator, have multi-turn covers. These covers decrease the accessibility of the test points.

Recommendation:

Use a quick-disconnect type dust cover to increase the accessibility.

- B. Many of the cable connectors do not have protective covers.

Recommendation:

To decrease the cable connector damage provide all cables with protective covers.

- C. The six time-delay toggle switches, part of the Antenna Simulator, have protective covers.

Recommendation:

To lower the cost and increase the operability change the switches to toggle switches without protective covers.

Item 20, Tools

See Item 15 paragraph A.

Item 23, Figure A

The Figure A does not contain Maintainability Design Requirements. In accordance with AFBSD Exhibit 61-56 Maintainability Design Requirements must be included in the Figure A's for all OGE and MGE Minuteman equipment for which Boeing is responsible.

Recommendation:

When the Figure A is revised, Maintainability Design Requirements should be added.

MAINTAINABILITY EVALUATION/REVIEW REPORT

Report No. EO-4012-2 Date 2-6-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4012 Nomen DAG Test-Set (ACO equipment)
 Dwg. No. _____ Serial No. 000002
 Observed Event None Location VAFB Date 2-5-63
 Title or Description Static Evaluation
 T.O. Procedures 21-SM80A-2-3 Para. 2-33

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	1	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	2	17	Disposable Modules	4
5	Accessibility	4	18	Test Equipment	N/E
6	Work Space	4	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	4	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/A	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 1. In general, this test-set is of somewhat superior detailed design from a Maintainability viewpoint, however, according to the using group at VAFB, it has never been made to function. Whether this is due to generally poor reliability or to some undiscovered incompatibility is not clear as yet. It is quite certain that, in its present form, it represents a serious Maintainability problem since it would obviously lead to difficulties due to its inability to perform its test function.

More specific information will be available when an opportunity occurs to witness dynamic use of the item.

- Item 4. Cases 3 and 4 of the test-set are similar to each other, containing a program-board compartment in the bottom of the case, with a cable-stowage space above.

It was observed that an effort has been made to provide adequate cable-stowage capabilities, but the result is not quite successful. The usual suit-case tester problem exists, namely getting the cables into their allotted space and getting the lid closed on them in a reasonable time.

One cable in case 3 showed a number of small but deep cuts in its insulation, and inspection of the lid revealed a possible explanation; the pressure-venting device protrudes inwards and may have caused the damage during lid-closure.

The cables are stored in a special tray which is secured to the top of the program-board compartment by 15 slotted quick-release fasteners. The ends of some of the cables are placed in a recess at one end of the case, down beside the program board compartment. If it is required to gain access to the program-boards, it is necessary to unwind and remove all the cables, undo the 15 fasteners, and remove the cable-tray.

The connector arrestors in the center of the tray are so designed that each cable must be stored in its proper location and in a complicated sequence which is printed on a label on one of the arrestor lids. The arrestor lids are hinged flaps with a quick-release fastener at the open end; the hinges are flimsy and it seems likely that they will fail in use.

Recommendation:

- A. The cable tray should be redesigned so that it may be removed without disturbing the cables.
- B. The 15 fasteners should be replaced by a small number of fasteners which are accessible without the need to remove the cables.
- C. The connector-arrestor flaps should be provided with more robust hinges.

- Item 10. a. No weight labels were found on the cases of the test-set. The cases are all too heavy for one man lift, but the two handles on the ends of the case might invite an attempt to lift the case resulting in probable damage to the individual or the equipment.

Recommendation:

Weight labels specifying two-man lift should be affixed to the cases.

- b. The equipment identification label for case 3 was mounted inside the wall of the cable-tray.

Recommendation:

The label should be moved to the outside of the cable-tray where it is not obscured by the cables.

- c. The test cables are identified only by drawing number.

Recommendation:

The cables should bear identification labels of the type which are common in other test-sets. These labels show the cable designation, the receptacles with which the connectors mate, as well as the drawing number.

- Item 15. On case number 1, the quick-release fasteners holding the equipment chassis into the case were difficult to release. The difficulty was due to an outward bowing of the case along the longer sides; this bow caused the studs to bear against the outside of the chassis holes, thereby causing the chassis to catch against the shoulders of the studs.

In order to release the chassis two men were required; one to compress the sides of the case, the other to lift the chassis clear.

Recommendation:

The shoulders of the stud should be narrower than the diameter of the stud shaft.

- Item 16. The program-board holding fixture on the Signal Monitor, (Case 2) is provided with a plywood protective cover which is installed when no board is being used. When removed from the test set this board could easily be mistaken for a piece of scrap wood, and could be lost or destroyed.

Recommendation:

The cover should be painted and identified.

- Item 22. T.O. 21-SM80A-2-3 paragraph 2-34a contains a note describing how to change the keying of the adjustable plug on cable 714.

This note does not describe the process fully enough, and should be expanded to indicate the need for disengaging the castellations on the keying shell.

Recommendation:

The note should be expanded as indicated in item 22a of EO 1243-1/3013-1.

- Item 26. All units of the test-set employ soldered connections internally. This precludes repair at Field-level due to the restriction on soldering at Field-level.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 4012-3 Date May 22, 1963 Page 1 of 2

Prepared by Philip Giles & Wilbur Lohss M/S 50-66 Phone 656-6598

Figure A No. 4012 Title DAC Test Set, AN/GYM-1

Part No. _____ Serial No. 0000053

Demonstration Event ACO Location Ellsworth D-1 Date April 27, 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/R	14	Lines and Cables	N/R
2	Standardization	N/R	15	Fasteners	N/R
3	Interchangeability	N/R	16	Covers, Cases, and Shields	4
4	Packaging and Mounting	N/R	17	Disposable Modules	N/R
5	Accessibility	N/R	18	Test Equipment	N/R
6	Work Space	N/R	19	Servicing and Handling Equipment	N/R
7	Testing and Servicing	N/R	20	Tools	N/R
8	Displays	N/R	21	Platforms, Stands, and Shelters	N/R
9	Handles	N/R	22	Technical Order	N/R
10	Labels and Marking	N/R	23	Figure 'A'	N/R
11	Controls	N/R	24	Form B/C	N/R
12	Work Aids	N/R	25	Specifications	N/R
13	Connectors and Connections	N/R	26	Personnel Requirements	N/R

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The test set was seen in operation briefly. A systematic
evaluation could not be performed but the attached problem was noted.

4012 TEST SET, DAC AN/GYM-1

Problem

The DAC Test Set Signal Monitor, illustrated in Fig. 2-15, T.O. 21-SM80A-2-3, is equipped with a programmer panel manufactured by AMP Incorporated. This panel has no cover. Without a cover to protect the programmer panel pins they may easily bend or break if some object is dropped on them. Use of a protective board is called for in the 2-3 technical order Par. 2-33, Step 9-1 and ae-1.

Recognizing the fragile character of these pins and the impact upon test set maintenance if the pins are damaged, technicians are using plywood boards cut to the size of a test board. The plywood is inserted like a test board when the test set is not in use. This work-around has one limitation and one disadvantage. First, since the plywood can not be in place when the test boards are being inserted and withdrawn from the programmer panel, the pins remain exposed when there is maximum activity around the set. This is the most probable time for an accident to occur. Second, tiny plywood slivers fall between the pins and interfere with the contact between the pins and test board circuitry.

Recommendation:

Install a fixed cover on the programmer panel handle. The pins would be protected by simply pulling the handle down.

MAINTAINABILITY EVALUATION/~~CONFIDENTIAL~~ REPORT

Report No. EO-4018-1 Date February 8, 1963 Page 1 of 4

Prepared by Alexander Henschel M/S 50-66 phone 6-6263

Figure A No. 4018 Nomen Adapter Group, Test, AN/GSM-61

Dwg. No. 25-33559 Serial No. 0001

Observed Event N/A Location EDL Date February 4 & 5, 1963

Title or Description Maintainability Evaluation of Figure A 4018

T.C. Procedures _____

MAINTAINABILITY CHECKLIST

1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	N/E	15	Fasteners	3
3	Interchangeability	N/E	16	Covers, Cases, Shields	N/A
4	Packaging, Mounting	3	17	Disposable Modules	2
5	Accessibility	3	18	Test Equipment	N/A
6	Work Space	4	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	3	20	Tools	N/A
8	Displays	3	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	N/E
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	4	24	Form B/C Form C only	3
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	2	26	Personnel Requirements	N/E

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Rating Analysis, Figure A Number 4018

4.

- A.) A total of eight fuses are mounted within assemblies 25-31605-1, 25-31604-1, and 25-31603-1. Four are mounted on the 25-32950-4 heat sink assembly which is part of the 25-31605-1 assembly. Two are mounted on the 25-33020-1 heat sink assembly which is part of the 25-31603-1 assembly. The remaining two are located in the 25-31604-1 assembly, one is a spare. Six fuses, three active and three spare, are mounted on the front panel of 25-31604-1.

Recommendation:

Place all fuses and spares (one spare per active fuse) on the front panel of their respective chassis. Provide indicating fuses for rapid and positive recognition of equipment malfunction. See MIL-M-26512B Section 3.1.1.

- B.) Three sub-contractor manufactured assemblies have printed circuit assemblies (PCA's) which are electrically terminated by wire wrapped connections. The wire route is wire harness to terminal board, then terminal board to PCA. Examination of the Reference Signal Generator Chassis 1193071-502, Waveform Converter Chassis 1193072-502, and Electrical Impedance Simulator Chassis 1193073-502 results in the following observations:

- a.) The wire between the terminal board and PCA should have sufficient slack for at least three reterminations at the PCA end. This condition is not met.
- b.) Form C maintenance analysis calls for unwrapping the wire at each PCA pin, replace the faulty PCA, and wrap each wire to the PCA. This method decreases the reliability of the electrical connection because of the wire having had an extra wrap cycle.
- c.) Maintenance technicians may forget the PCA's are wire wrapped, and pull without first removing the wiring. The results will require replacement of PCA, terminal board, and wiring.

- d.) When the AN/GSM-61 and AN/GJM-15 are being used to check assemblies for faults, unnecessary downtime will result if the fault is traced to a wire wrapped PCA. This will be the repair and checkout time difference between a fault traced to an assembly containing wire wrapped PCA's and one to an assembly containing modules which are plug-in.

Recommendation:

Alternative I.

Investigate feasibility of re-design to eliminate the use of wire wrap terminations. Provide etched circuit boards and modules with the plug connector in accordance with Boeing Standard C45BN-3A or equivalent, and the receptacle in accordance with Boeing Standard C45BN-1 or equivalent. See STL Document 6120-6882-DU-RDI.

Alternative II.

- a.) Revise Form C analysis to call out the following remove and replace techniques for wire wrapped PCA's:

Remove: 1.) Cut each wire as close as possible to the PCA pin.
Tag as necessary for identification.

2.) Remove PCA mounting hardware.

3.) Remove PCA.

4.) Strip each wire in preparation for wrapping to new PCA. If sufficient length is not available replace wire between terminal board and PCA.

Install: 1.) Install new PCA.

2.) Install PCA mounting hardware.

3.) Use a wire wrapping tool to connect wiring to PCA.

4.) Route repaired assembly through test center.

- b.) Provide a warning placard within assemblies containing wire wrapped PCA's stating the PCA's are not plug-in type.

5. Access panels at the rear of the cabinet are fastened by Phillips screws.

Recommendation:

Provide hinged access panels. See MIL-STD-803 section 10.4.3.5.5.
See Item 4.A also.

7. See items 4 and 5.

8. See item 4.

10. Certain removable assemblies weighing over 45 pounds are not marked with their unit weight. An example is the Programmer Assembly 25-28170-1.

Recommendation:

Identify unit weight for assemblies weighing over 45 pounds. See MIL-STD-803 section 10.4.3.1

13. Solder connections are used through out the unit.

Recommendation:

Use plug-in assemblies, crimp-on connectors, or components with soldered-on "pig-tail" lead wires to a plug-in or mechanical connectors. See STL Document 6120-7822-DU-RDI, Maintainability Criteria, dated 16 March 1962.
See Item 4.B also.

15. See item 5.

17. See item 4.B

24. See item 4.B

MAINTAINABILITY EVALUATION/CONSERVATION REPORT

Report No. EO-4018-2 Date 2-14-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4018 Nomen Test Adapter Group (Programmer)
 Dwg. No. 25-28170-1 Serial No. 0000002
 Observed Event Evaluation Location VAFB Date 2-11-63
 Title or Description Engineering evaluation of stepping switches.
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	N/E
2	Standardization	4	15	Fasteners	N/E
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	2	17	Disposable Modules	4
5	Accessibility	3	18	Test Equipment	N/O
6	Work Space	N/A	19	Servicing, Handling, Equip.	3
7	Testing, Servicing	N/O	20	Tools	N/O
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	N/E
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	3	26	Personnel Requirements	2

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4. The evaluation observed was concerned primarily with the stepping switches in the Programmer drawer. Other areas were not accessible for evaluation; this report will therefore be more concerned with the programmer than any other component of the Fig A 4018.

a. In general, the Programmer is a very solidly constructed item and gives a strong impression of over-engineering. Its weight (in excess of 200 pounds) appears to derive very largely from a chassis constructed of $\frac{1}{2}$ inch alloy, and from thick bundles of wires which are broken frequently by terminal boards.

Recommendation

A review of the packaging of the programmer is highly desirable, to determine the feasibility of reducing the weight of the unit and the complexity of the wiring. Special attention should be given to the possibility of dividing this unit into two or more units of more conventional size.

b. A row of three stepping-switches is mounted across the middle of the upper chassis. The switches are sealed units, approximately 6 inches by 4 inches on the base, and they are mounted by means of hex-headed studs over holes in the chassis so that the connectors protrude through. There are seven quick-release Bendix connectors on the base of each switch. One of the studs is used to mount a diode-board, the components being placed on the "inside", that is, over the head of the bolt. This arrangement causes great difficulty in removing the stepping switch, since space is very cramped underneath the chassis. The problem is aggravated by the presence of two stacks of terminal strips on the side of the unit which impede free access to the stepping-switch bases. The basically simple task of removing two components took two hours to accomplish.

Recommendation

1. The mounting studs of the stepping-switches should be accessible from above the chassis, i.e., the switches should be screwed down onto the plate instead of being secured from below.

2. An alternative mounting point should be provided for the diode-boards, and again this should be removable from above.

3. The leads to the stepping-switch should be more readily removed than at present (see item 13). This might include providing longer leads to allow the switch to be partly withdrawn allowing access to the connectors on the underside.

Item 5. In order to remove the middle one of the three topmost stepping-switches, it would apparently be necessary to remove all the connectors from the base of one of the outer switches. The task bristles with difficulties due to the extremely poor accessibility of the seven Bendix plugs on the base of each switch. These plugs are so closely packed that it is only possible to grip them with the fingers and "nudge" them around, a process which is painful, tiring, and time-consuming.

This difficulty would remain even if the recommendations of item 4 were adopted to improve the ease of removal.

Recommendation

The method of making electrical connections to the stepping-switches should be changed. Ideally these components should be plug-in units.

- Item 10** The Programmer weighs in excess of 200 pounds which requires the use of a fork-lift for handling. The unit is not labeled to this effect.

Recommendation

A weight label calling for the use of a mechanical hoist should be affixed.

- Item 13** The problem of crowding of connectors on the stepping-switches would be disposed of by the recommendation of item 5.

It was noted that there is an enthusiastic employment of terminal strips throughout the unit. These strips impede access and increase cost and complexity, without apparently serving any other function. A bundle of wires will be broken by a terminal strip, with the great majority of the wires going straight on through to be regrouped into a bundle again.

Recommendation

The existing system of wiring should be replaced by a "harness" system to avoid redundant break-points. This process would undoubtedly be eased by repackaging the unit into two drawers.

- Item 19** It was necessary to employ a hydraulic "LO-LIFT" to handle the programmer in the Vandenberg SMSB, and the process entailed the use of six men. If the weight of the unit cannot be reduced, or if the unit cannot be divided into two chassis, then a suitable handling fixture will be required.

Recommendation

It must be verified that a suitable mechanical hoist will be available for handling this item.

- Item 26** The apparently simple task of removing two stepping-switches from the Programmer required the expenditure of 12 man hours. Part of the effort required the presence of six men to aid in handling.

With proper redesign of this unit it is estimated that the time could be reduced to one man hour or less.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4018-3 Date 2-27-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4018 Nomen Test Adapter Group
 Dwg. No. 25-26876-1 Serial No. 5
 Observed Event T.O. V&V Location VAFB Date 2-25-63
 Title or Description Operational Checkout
 T.O. Procedures 33D7-50-3-1 Para. 5-5 thru 5-11

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	N/E
5	Accessibility	4	18	Test Equipment	N/O
6	Work Space	4	19	Servicing, Handling, Equip.	N/E
7	Testing, Servicing	4	20	Tools	N/E
8	Displays	4	21	Platforms, Stands, Shelters	N/E
9	Handles	4	22	Technical Order	3
10	Labels, Marking	2	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	N/E

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4. Circuit Control Boards have a pair of hooked projections on the mating surface which engage a retaining device when the Release Handle is raised.

It has been observed at VAFB that it is very easy for an inexperienced operator to damage the unit during board-insertion; if the bottom of the board is not firmly pressed inwards until it clicks, the retaining pin fouls the ends of the hooks and the great mechanical advantage of the release handles enables the operator to snap the hooks off without feeling any resistance.

Recommendation.

- a. The retaining hooks should be bevelled to reduce the flat end-area, and to allow the retaining pin less chance of fouling.
- b. The hooks should be strengthened.
- c. A cautionary note should be included in all T.O.'s dealing with Circuit Control Board removal and replacement, especially 33D7-50-3-1. See item 22.
- d. A cautionary label should be affixed to the cover of each board stressing the need to press the board home firmly before raising the handles.

Item 10. The Fig. A 4018 nameplate is mounted on the left hand end of the unit, and is invisible when the unit is used adjacent to other equipment.

Recommendation.

The nameplate should be mounted on a forward-facing surface.

Item 15. No protective cover is provided for the front of the Programmer Drawer when a Circuit Control Board is not installed. At VAFB it is the practice to tape a piece of cardboard in place.

Recommendation.

A simple plastic dust-cover should be provided for the front of the Programmer Drawer.

Item 22. a. Paragraph 5-71 is somewhat confusing. During Operational Check-out four test sequences are run, each one with a separate circuit control board. This paragraph implies that it is not necessary to turn power off before changing control boards.

During the V&V observed the Test Operator directed the Air Force technician to put the A624 into MODE 1 at the end of step 1; this procedure removes power from the 4018 and makes it safe to change boards.

Recommendation.

T.O. 33D7-50-3-1 paragraph 5-7 step 1 should be revised to show

the necessity for removing power from the Fig. A 4018 before changing Circuit Control Boards.

- b. T.O. 33D7-50-3-1 paragraph 5-4 describes the process of installing and removing Circuit Control Boards. The procedure does not stress the importance of snapping the bottom of the board firmly home before raising the handles. See item 4.

Recommendation.

A cautionary note should be added to paragraph 5-4, or step d should be rewritten to stress the importance of proper location of the board.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-4018-5 Date 15 May 1963 Page 1 of 3

Prepared by W. F. Lohss, P. Giles M/S 50-66 Phone 656-6263

Figure A No. 4018 Title Adapter Group, Test

Part No. 25-37470-4 Serial No. 10

Demonstration Event _____ Location CSA, Ellsworth AFB Date 29 April 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	1	14	Lines and Cables	N/A
2	Standardization	1	15	Fasteners	3
3	Interchangeability	1	16	Covers, Cases, and Shields	4
4	Packaging and Mounting	2	17	Disposable Modules	2
5	Accessibility	3	18	Test Equipment	2
6	Work Space	1	19	Servicing and Handling Equipment	N/A
7	Testing and Servicing	1	20	Tools	N/A
8	Displays	N/A	21	Platforms, Stands, and Shelters	N/A
9	Handles	1	22	Technical Order	N/A
10	Labels and Marking	2	23	Figure 'A'	N/A
11	Controls	N/A	24	Form B/C	N/A
12	Work Aids	3	25	Specifications	N/A
13	Connectors and Connections	1	26	Personnel Requirements	2

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The Adapter Group, Test, P/N 25-37470-4, S/N 10, was used to
checkout a Programmer Calibration Test drawer, P/N 25-22039-59, S/N 156.

The Autonetics Test Center, ACO 0624, C91, was used in conjunction with the
Cabinet Electrical Equipment, P/N 25-33559-1, S/N 7, which is located on the
top left of the Adapter.

- Item 5** The hinged cover for the electrical cabinet (top left side of the Adapter) is not used to provide maximum accessibility and convenience. The microswitch is jumpered and the top of the drawer being checked is placed over the cabinet top during drawer checkout.

Recommendation: See the recommendations to items 15 and 16.

- Item 10 a.** The Adapter has standard Minuteman drawers installed in the cabinet proper. Adjacent to the drawers on the cabinet structure are identification labels, A1, A2, etc. However, there are no corresponding labels on the individual drawers.

Recommendation: The drawers should be labeled to correspond with the cabinet labels.

- b.** The static pressure tap which is located on the back panel is not labeled by function or pressure limits.

Recommendation: Provide labels for the pressure tap indicating function and pressure limits. See MIL-STD-803 paragraph 5.1.2 and 5.1.3.

- c.** Two toggle switches associated with Test Adapter A and B displays are not labeled.

Recommendation: Label the toggle switches as to function. See MIL-STD-803, paragraph 5.1.1.

- d.** The connectors on the Adapter, Test Panel P/N 8321500-504, are marked with plug identification numbers above the plug except for J13 and J15 which are labeled below the plug. The J13 and J15 labels are not visible from the standing position.

Recommendation: The labels for J13 and J15 should be positioned above the connector for standardization and readability. See MIL-STD-803, paragraph 5.1.2 and 5.1.3.

- Item 12** Adjacent to the test cabinet a space is provided for placing drawers. To protect against damaging the Adapter top or drawers a piece of corrugated cardboard is cut to fit this space.

Recommendation: A permanent protective pad should be included in the Adapter design.

- Item 15 a. The Southco latch on the hinged cover for the electrical equipment cabinet is difficult to release and tighten, this probably contributes to the unuse of the hinged cover.

Recommendation: Remove the Southco fastener from the hinged cover and install a quarter-turn winged head quick release fastener or similar type fastener that can be released or tightened with ease or mount a knob or handle in lieu of the fastener. See MIL-STD-803, paragraph 10.4.3.5.6.

- b. The rear of the Adapter has a myriad of screws retaining the panels. Normally the panels are not to be removed, however, it was noted that the lower left hand panel (viewed from the rear) was held in place by three screws and 23 screws were missing.

Recommendation: Reduce the number of screws to the minimum number compatible with RFI design practices. See MIL-STD-803, paragraph 10.4.3.7.1.

- Item 16 The hinged cover for the electrical equipment cabinet has no protective stops in the open position. The hinged cover swings back 180° resulting in the cover or cabinet getting scratched. It is necessary to "walk" the cover open or closed by moving to the side or rear of the Adapter. The cover retards maintenance to such an extent that the cover micro-switch is jumpered and the cover is left open. An electronics technician recommended that the slide cover used on the earlier Adapter, 25-26630-1, BGS 72B, ACO 742, be used for simplicity of operation.

Recommendation:

Provide a protective stop for the hinged cover approximately 120° from the closed position. In this manner the cover can be closed or opened and held in the open position without an additional latch or catch. See MIL-STD-803, paragraph 10.4.3.8.1.3.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4043-1 Date 12-18-62 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4043 Nomen Elevator-Work Cage, Passenger & Equipment
 Dwg. No. 25-18099 Serial No. 0000004
 Observed Event BMT Emplacement Location Vandenberg AFB Date 12-18-62
 Title or Description Utilization
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	1
2	Standardization	3	15	Fasteners	4
3	Interchangeability	2	16	Covers, Cases, Shields	1
4	Packaging, Mounting	1	17	Disposable Modules	N/A
5	Accessibility	3	18	Test Equipment	N/O
6	Work Space	N/A	19	Servicing, Handling, Equip.	3
7	Testing, Servicing	4	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	1	22	Technical Order	N/E
10	Labels, Marking	2	23	Figure A	4
11	Controls	3	24	Form B/C	3
12	Work Aids	N/O	25	Specifications	N/E
13	Connectors, Connections	3	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 3. Each assembled work cage at VAFB is regarded as a set of matched parts. Dimensions vary sufficiently to preclude any useful degree of interchangeability. Improved quality control during manufacture is the only solution. 2
- Item 4. The mounting bracket for the power cable pulley is too fragile; it can be distorted by hand. The use of flanged material would improve the situation. It must be noted that the mechanical design of the elevator assembly is generally amateurish and out of keeping with standards generally to be found in an item of military equipment.
- Low reliability of the elevator must be considered as a Maintainability problem affecting all operations requiring its use. Elevator down-time, and journeys to acquire spare units are liable to be quite serious, judging by experience at VAFB. See specific items later.
- Item 5. The relay box must be removed in order to remove the bottom right-hand trolley-wheel because the nut is obscured by the support frame.
- Item 9. No handles are provided on the elevator. (see item 16)
- Item 10. There are no labels on the elevator and work cage. Identification is required for lubrication points, lubrication type and frequency, cable identification, weight, handling and service points.
- Item 11. The markings on the control pendants are ambiguous. Opinion amongst operators is evenly divided as to whether "LEFT" means clockwise or counter-clockwise looking down the tube. An instruction label should be attached to the pendants.
- Item 13. All connectors require several turns to release; there is no apparent reason why quick-release connectors could not be utilized.
- Item 14. Electrical control wires pass down the center of the hoist cable. Considerable trouble is experienced at VAFB with broken conductors, due, supposedly to the use of an inappropriate type of cable. At the present time no work-cage control pendants are serviceable at VAFB. This item is a major contributor to un-reliability of the elevator work-cage. Since the use of combined hoist and control cables is not uncommon it may be supposed that this problem could be avoided by the use of a suitable cable, or an alternative routing method.
- Item 15. Difficulty is frequently encountered when assembling the work-cage due to burring of the holes for the quick-release pins. This is probably caused by poor dimensional control in manufacture resulting in non-alignment of holes. The effect on Maintainability is to increase assembly time by approximately five-minutes per assembly and to add the requirement for reaming out the holes as required.
- Item 16. The hoist mechanism is not provided with protective covers. Units observed have all shown severe handling damage which is aggravated by the lack of proper handles, resting-points for temporary storage, dolly or container.

Specific items of handling damage are:

- a. Power cable reel outer flange bent inwards in several places.

- b. Power Cable Pulley bent inwards.
- c. All cables show damage to outer sheath, and kinking that suggests that they have been used as hand-holds.
- d. Relay box scored and dented.
- e. Power-cable guide-wheels distorted. (The unit is usually placed on its back in storage, and rests directly on these wheels.)
- f. General damage to paint work and scratching of components.
- g. General dirtiness, with moving parts, such as level-wind mechanism apparently lubricated with a stiff paste of oil and powdered sand.

All of the above types of damage would be avoided if a suitable protective cover were to be incorporated (robust, hinged with quick-release fasteners, handles and resting points).

- Item 19. See item 16. Unless a cover with proper handles is incorporated, a suitable handling and storage dolly should be provided.
- Item 24. The Form B does not specify what Maintainability requirements should be incorporated into the design.
- Item 26. Two men are required to move the work-cage and to mount the elevator. It is difficult, however, to see how this can be avoided due to inherent difficulties associated with its use in the confined space of the launcher.
- Item 2. The entire Fig. A 4043 is a special item designed to meet unusual requirements, so that a high degree of non-standardization is to be expected, particularly as far as the work cage and hoist-supporting structures are concerned.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4043-2 Date 1/25/63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4043 Nomen Elevator Work Cage
 Dwg. No. 25-18099 Serial No. 000007
 Observed Event Repair Location VAFB-SMSB Date 1/25/63
 Title or Description Replacement of damaged power cable.
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/E	14	Lines and Cables	3
2	Standardization	N/E	15	Fasteners	N/E
3	Interchangeability	N/E	16	Covers, Cases, Shields	N/E
4	Packaging, Mounting	2	17	Disposable Modules	N/E
5	Accessibility	N/E	18	Test Equipment	N/E
6	Work Space	N/E	19	Servicing, Handling, Equip.	N/E
7	Testing, Servicing	N/E	20	Tools	N/E
8	Displays	N/E	21	Platforms, Stands, Shelters	N/E
9	Handles	N/E	22	Technical Order	N/E
10	Labels, Marking	N/E	23	Figure A	N/E
11	Controls	N/E	24	Form B/C	N/E
12	Work Aids	N/E	25	Specifications	N/E
13	Connectors, Connections	2	26	Personnel Requirements	N/E

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4. a. The power cable was damaged when the cable-drum failed to reel in the slack while traversing, resulting in the elevator running-over the cable. To remove the power cable from the drum it was necessary to chip away a hard "potting" compound which surrounds the cable as it passes through the "axle" of the drum. This process is time-consuming and dirty.

The reason for using the compound is obscure; the likeliest explanation is that it is used to prevent moisture from entering the drum.

Recommendation:

An alternative method of sealing the aperture should be employed. Possibly a connector should be placed at this point with a mechanical clamp to prevent cable movement.

- b. On the unit observed it was apparent that the relay-box was breaking away from its fasteners and will eventually break loose. The structure is supported as a cantilever with rivets or bolts at the bottom end.

Recommendation:

The relay box should be braced at the top end, possibly by adding a strap between the relay box and winch motor housing.

- c. When the cable-reel is removed the tension in the re-wind spring must be released by removing the power cable connector and allowing the end of the cable to pass through the nylon guide-wheels and around the drum. If the drum is not held tightly, it unwinds rapidly, and the rewind spring becomes disengaged from the "axle". It is then necessary to open the spring mechanism to relocate the inner end of the spring into the slot.

Recommendation:

The innermost turn of the rewind spring should be slightly smaller in diameter than the axle, so that it will automatically re-engage upon rotation of the drum.

- Item 13. It is not possible at present to check-out the elevator mechanism at the SMSA because the power cable connector does not fit any existing power outlet.

Recommendation:

A spare Power and Communications Distribution Box (GS-3508) should be provided for the Support Area to facilitate check-out of the elevator mechanism.

Item 14. When replacing the power cable, it is necessary to disconnect the cable from the slip-ring mechanism.

The leads from the slip-rings are all white, resulting in the necessity to draw a diagram to ensure correct replacement.

Recommendation:

The leads from the slip-rings should be color-coded to agree with the color coding of the power cable.

MAINTAINABILITY EXTENSION/OBSERVATION REPORT

Report No. EO-4043-3 Date March 29, 1963 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4043 Nomen Elevator Work Cage (New Model)
 Dwg. No. 25-18099-A Serial No. 4
 Observed Event Proof Loading Location VAFB Date March 26, 1963
 Title or Description _____
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	3
2	Standardization	4	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	2
4	Packaging, Mounting	3	17	Disposable Modules	N/O
5	Accessibility	4	18	Test Equipment	N/O
6	Work Space	N/A	19	Servicing, Handling, Equip.	N/O
7	Testing, Servicing	N/O	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, Shelters	N/A
9	Handles	2	22	Technical Order	N/E
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/O	25	Specifications	N/E
13	Connectors, Connections	3	26	Personnel Requirements	3

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4 Traversing of the hoist mechanism is effected by a knurled drive wheel. On the equipment observed, the knurling was becoming smooth, even though it is a comparatively new item. If the wheel is prone to losing its roughness, difficulties in traversing the elevator may result.

Recommendation.

The traverse drive-wheel knurling (or "tread") should be cut deeper.

Item 9 The hoist mechanism is not provided with handles, and it is a fairly heavy item. The use of connectors, cables, and mechanical protrusions as grasp areas is very likely to result in equipment or personnel damage.

Recommendation.

Suitable handles should be provided in accordance with section 10.4.3.2 of MIL-STD-803, to allow two-man lifting of the unit. Since the unit is mechanically asymmetrical, the location of the handles is quite important, and should facilitate both installation and bench handling.

Item 10 a. There were no weight labels on the units observed, although both work-cage and hoist mechanism appear to weigh more than 45 lbs.

Recommendation.

The units should bear weight labels per section 10.4.3.1.1 of MIL-STD-803.

- b. The labeling of the control box in the work cage remains ambiguous. If the operator is facing the missile, he is then in a position to read the control button labels "right way up"; the left button, however, would cause the cage to traverse to his right. If he faces the wall, the left button would cause the cage to traverse left, but he would be reading the labels upside down.

Recommendation.

The labels should be turned around so that they are consistent with direction of motion, and arrows should be added to the labels to remove any remaining ambiguity.

Item 13 The connectors employed are the multiple-turn variety.

Recommendation.

Single-turn, quick release type connectors should be employed.

Item 14 Due to the lack of handles, loose cables on the hoist mechanism provide attractive grasp points. Such usage would certainly result in damaged cables.

Recommendation.

If a suitable protective cover can not be provided for the hoist mechanism (see item 16) the loose cables should be cleated down or protected by other means.

Item 16 a. The elevator hoist assembly is not provided with a protective cover. Cables, connectors and mechanical devices (such as the level wind mechanism) are therefore liable to handling damage as well as to the harmful effects of exposure to dirt.

Recommendation.

A robust, easily removable, protective cover should be added to the elevator hoist mechanism.

b. J1 and J2 on the hoist mechanism, and a connector on the Jack-box in the work-cage, were provided with loose plastic dust-caps.

Recommendation.

Captive dust caps should be provided.

Item 26 In the new work-cage configuration, the electrical control and communications conductors are no longer incorporated into the hoist cable, but are carried in a pendant cable which is stowed in a canvas bag at the side of the work-cage. This arrangement calls for the work-cage operator, or the second passenger, to stow the cable in the bag as the work-cage rises. This arrangement could be undesirable if the operator were in a situation calling for his undivided attention.

Recommendation.

This cannot be considered as a serious objection, because it would probably do no harm to allow the cable to remain "un-furled" if the operator was unable to attend to it. It is conceivable, however, that the loose cable could be hazardous under especially difficult conditions, and it is therefore recommended that a cable-reel be incorporated on the work-cage to take up the slack automatically.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-4043-4 Date April 26, 1963 Page 1 of 5

Prepared by A. R. Smith M/S V1-07 Phone 866-3761

Figure A No. 4043 Title Elevator Work Cage (New Model)

Part No. 25-18099-2 Serial No. 6

Demonstration Event 595-6 Location VAFB Date April 24, 1963

T.O. Procedures T.O. 21-SM80A-2-10 Section III (1 May 1962 changed 16 April 1963)

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	1	14	Lines and Cables	P/E
2	Standardization	1	15	Fasteners	P/E
3	Interchangeability	1	16	Covers, Cases, and Shields	3
4	Packaging and Mounting	3	17	Disposable Modules	N/A
5	Accessibility	N/A	18	Test Equipment	N/A
6	Work Space	3	19	Servicing and Handling Equipment	P/E
7	Testing and Servicing	1	20	Tools	1
8	Displays	3	21	Platforms, Stands, and Shelters	N/A
9	Handles	3	22	Technical Order	3
10	Labels and Marking	P/E	23	Figure 'A'	P/E
11	Controls	3	24	Form B/C	N/R
12	Work Aids	N/A	25	Specifications	N/R
13	Connectors and Connections	P/E	26	Personnel Requirements	P/E

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: Observation was made of usage of the Figure A 4043 during a Category II Missile Emplacement at Vandenberg AFB.

The rating P/E is used to indicate that the item has been previously evaluated, so as to avoid unnecessary repetition.

- b. The construction of the cage itself should be changed so as to allow direct entry from the sides, rather than having to climb over the sides or through the back. This could be accomplished if the cage sides were made into hinged doors, with suitable interlocks and safety devices to prevent motion with the doors open etc. This recommendation is independent of (a) above.

Item 8

The electrical trouble-indication lights on the distribution box (located in the upper equipment room on the launch tube wall) are supposed to glow "dimly and with equal brilliance", and according to a warning on the distribution box and in paragraph 3-6 of T.O. 21-SM80A-2-10, operation should not be continued if either or both lights are out or glowing with full brilliance. During the test observed some confusion existed for awhile due to a difference of opinion among the operators as to whether or not the lights were glowing with the proper brilliance.

Recommendation.

The trouble-indicating display should be altered so that interpretation is unambiguous. Paragraph 4.3.2 of MIL-STD-803 states that "coding techniques shall be selected from the following methods: a) color b) size c) location d) shape." The use of degrees of brightness is not recommended.

Item 9

It was observed that the elevator support structure was lowered down the access shaft and hoisted onto the launch tube assembly door by means of a rope tied around the cable-drum. Although the T.O. clearly states that the unit should not be suspended by the drum alone, the drum is such a natural choice that it is inevitable that it will be frequently used in this way. If proper and obvious handling-points were provided, this situation would not exist.

Recommendation.

The elevator should be provided with convenient, efficient, labeled handling points. (see EO-4043-1)

Item 11

On two occasions during the test observed, the elevator hoist was inadvertently operated; once by an operators elbow and once by an operators knee. On both occasions considerable consternation was shown by the occupants of the cage.

Recommendation.

The "Up" and "Down" buttons should be surrounded by a raised edge to prevent inadvertent operation.

Item 16

It was observed during the test that on one occasion a work-cage passenger reached the Launch-tube access door by climbing over the safety barrier; this is fairly common. As he stepped down, however, the top bar fell away from the wall. Inspection revealed that all four horizontal bars of the barrier were not pinned to the wall, but were merely resting on the pins. This was, of course an extremely hazardous situation, and it arose because of the great difficulty encountered in making the barrier fit. It appeared as though the verticals of the barrier were bent towards the wall, so that it required considerable force to push the horizontals back far enough to insert the pins. Inspection showed that the verticals were reasonably straight, however, and it could not be readily discovered why the barrier was so hard to install.

Recommendation.

Dimensions of the safety barrier should be examined for an additive-tolerance, or other condition that could cause this difficulty.

Item 22

- a. It was the opinion of the operators, after completing installation of the Elevators Support Structure that a more convenient method of installing the roller cable could be utilized, which would eliminate the use of a stepladder on the launch tube access door, as called for in step j. of paragraph 3-6 of T.O. 21-SM80A-2-10. The proposed method would be as follows:

j. For units incorporating TCTO 35A4-2-31-501 perform the following:

1. Remove cable and roller assembly from carrying fixture, and pass far end through elevator access door so that it hangs down onto launch tube access door.
2. Plug one end of special purpose electric cable (figure 3-3A) into distribution box. Connect other end to roller cable connector on launch tube access door.
3. Pull roller cable up and insert rollers into exposed support rail channel to the left of the open elevator access door.
4. Plug roller cable into relay box and attach cable support to support structure frame.
5. Close and secure elevator access door with support structure mounted on support rail.

Recommendation.

The method of installation suggested above should be evaluated, and if found to be acceptable, T.O. 21-SM80A-2-10 paragraph 3-6 j. should be appropriately changed.

- b. The method of passing the elevator power cable through the launch tube wall as shown in Figure 3-3A of T.O. 21-SM80A-2-10 does not agree with the method shown in Figure 3-5A. In Figure 3-3A the cable is shown passing through the launch tube access door, whereas in 3-5A it is shown passing through an unidentified hole, presumably the autocollimator window..

Recommendation.

Figure 3-5A should be corrected to agree with the instructions given for installation of the elevator support structure (paragraph 3-6).

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4095-1 Date 1/22/63 Page 1 of 1
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4095 Nomen SSCBM
 Dwg. No. 25-31150 Serial No. _____
 Observed Event USAGE Location VAFB Date 1/21/63
 Title or Description Inspection of tie-down hatch fasteners
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/A	14	Lines and Cables	N/O
2	Standardization	N/E	15	Fasteners	2
3	Interchangeability	N/O	16	Covers, Cases, Shields	N/O
4	Packaging, Mounting	N/A	17	Disposable Modules	N/A
5	Accessibility	N/O	18	Test Equipment	N/O
6	Work Space	N/O	19	Servicing, Handling, Equip.	N/O
7	Testing, Servicing	N/O	20	Tools	N/O
8	Displays	N/A	21	Platforms, Stands, Shelters	N/O
9	Handles	N/O	22	Technical Order	N/E
10	Labels, Marking	N/E	23	Figure A	N/E
11	Controls	N/A	24	Form B/C	N/E
12	Work Aids	N/A	25	Specifications	N/E
13	Connectors, Connections	N/O	26	Personnel Requirements	N/O

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 5

TIE-DOWN ACCESS HATCH QUICK-RELEASE FASTENERS

Considerable difficulty is being experienced at VAFB with the quick release fasteners, which are of a somewhat specialized design.

The locking-piece is loose on the shaft of the fastener, the two items being threaded. When the fastener is first tightened up, the locking-piece runs up the screw. When disengaged, the locking-piece remains high on the thread. Next time the hatch is installed, the locking-piece will not engage. Usually attempts are made to force the piece to engage by using pliers or wrenches. This damages the locking-piece and engagement springs.

In attempting to solve the difficulty, the locking-pieces are sometimes crushed by pliers etc. to attempt to "freeze" the locking-piece onto the shaft of the fasteners; this is not usually effective, and results in a change in the method of operation, whereby the fasteners are almost acting as 90° turn quick release fasteners. It does not lock the pieces together effectively, and usually aggravates the problem.

It does not appear to be understood that the proper method of operation is to run the locking-piece out towards the end of the threaded shaft before installation. After the initial 90° turn, the locking piece should engage the retainer and stop, and the hatch should then be tightened down by screwing the fastener up. When the hatch is removed, the locking-piece usually disengages before it has run out a sufficient distance.

The actual cause of the difficulty is considered to be lack of training in the use of these special fasteners. It is not desirable, however, to employ fasteners whose method of operation is so easily misunderstood.

The situation would be improved by the use of a different type of fastener, however, if this is considered to be unjustifiable, then a decal should be affixed to each hatch drawing attention to the need to run out the locking-piece before installation is attempted. The item should also be brought to the attention of the training groups responsible.

M INTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4152-1 Date 2-21-63 Page 1 of 4
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4152 Nomen Electrical Test and Maintenance Table FN-136/GSM-82 (v)
 Dwg. No. 25-34145-1 Serial No. 0000001
 Observed Event V&V Location VAFB Date 2-18-63
 Title or Description T.O. V&V
 T.O. Procedures 31X3-12-8-2 Paragraph 11.

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	4
4	Packaging, Mounting	1	17	Disposable Modules	N/O
5	Accessibility	4	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	3
7	Testing, Servicing	3	20	Tools	4
8	Displays	3	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	4	25	Specifications	N/E
13	Connectors, Connections	3	26	Personnel Requirements	4

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4. a. To date one Adapter Connector and 3 Dummy Loads have been found to have connectors transposed. They are: MX-4284 Adapter Connector Dummy Decoder; Dummy Loads, Electrical DA-304, DA-305, DA-306. This is not strictly a maintainability problem, but the situation must obviously be rectified if these items are to be used.
- b. The Fixture, Cooling Air, Part No. 25-35685-1 is designed to permit rotation of the drawer under test to gain access to the underside. The cooling air is supplied through a rotating joint, no doubt quite a costly feature, presumably to allow rotation while power is applied. The design of the trolley however is such as to prevent rotation of the drawer when it has an adapter and cables attached. It is necessary to remove all cables, and the adapter in order to rotate the drawer.

Recommendation.

The "table-top" structure of the trolley should be eliminated, since it is quite useless in its present form. It is too narrow to serve as a work surface. The rotating joint of the drawer fixture should be supported by simple vertical posts rising directly from the base structure. This would permit free access to the fixture and would permit rotation without dismantling of the test set-up. The cost of the fixture would also be considerably reduced by elimination of the decorative plastic and wood elements of the present fixture, together with elimination of the remarkably complex and expensive swivelled stainless steel handle.

- Item 5. When a drawer is mounted in the Fixture, Cooling Air, it is not possible to remove the dust covers from the drawers without distorting them, because the openings top and bottom are a fraction of an inch too small.

Recommendation.

The size of the access holes should be increased to allow installation and removal of dust covers while a drawer is in the fixture.

- Item 7. AVTRON T242B LOAD-BANK ELECTRICAL is adjusted by using a Multi-meter and test leads (see paragraph 11-19d of T.O. 31X3-12-8-2) but the terminals of the load bank have no provision for inserting test leads. This requires the operator to press the leads against the terminals manually while adjusting the load bank with his third hand. This procedure could also result in error due to poor electrical contact.

Recommendation.

- a. Holes should be drilled in ends of the terminals to accommodate banana jacks.
- b. Provision should be made for measuring the resistance at a proper jack on the panel of the Test-Set, Voltage Regulators, Programmer Group TS-1794/GSM(v).

- Item 8. Paragraph 11-21g calls for the use of the OHMS X1 scale to measure 30 ohm resistance of the load bank.

Recommendation.

The OHMS X10 scale will give a more accurate reading in this case. The T.O. should be changed to this effect.

- Item 10. a. During Voltage Regulator checkout, W-18 is connected to the Load Bank Electrical. The terminating lugs of W-18 are indistinctly marked as E1 and E2 by means of a molded impression. T.O. 31X3-12-8-2, Figure 11-1, refers to these terminations as P2 and P3.

Recommendation.

A yellow adhesive label identifying the terminals as E1 and E2 should be affixed, and the T.O. Figure 11-1 should be changed to agree with the hardware.

- b. The AVTRON T-242B Load Bank has no weight label although it weighs around 70 pounds.

Recommendation.

A weight label should be affixed.

- Item 13. a. W-16 is connected to the Airflow Interlock connector on the Fixture, Cooling Air during drawer testing.

The cable terminates in a connector which is approximately 7 inches in length while being only $\frac{1}{2}$ " in diameter at the point of entry into the socket. Almost any accidental blow will break this connector or the socket.

This problem is fairly common throughout much of the equipment employing Pyle National connectors, but is especially hazardous in the thinner ones. It seems amazing that a seven inch "lay-back" is required to connect three conductors.

Recommendation.

An attempt should be made to provide a more practical connector in this application. Preferably an investigation of wider scope should be initiated to determine whether Pyle National connectors should be used at all on test equipment, on account of their excessive bulk and use of multiple-turn connections.

In some applications, the use of strap wrenches and torque-wrench kits is being advocated for these connectors, which seems absurd when it is recalled that these applications are for static ground-based test equipment.

It seems almost certain that a better connector should be available at or below the price of these items, which would incorporate the desirable features of quick connect/disconnect, and ruggedness.

- Item 13. b. W-18 of the test set-up is terminated by flat circular terminal lugs. In order to connect these terminals it is necessary to remove the retaining knobs on the T242B Load Bank; it is then discovered that it is not possible to screw the terminals down tightly because the lugs are not long enough to clear the shoulders of the knobs.

Recommendation.

The terminal lugs on W-18 should be longer and more robust and should be of the open-sided variety.

- Item 15. The fasteners used to lock an Adapter on the back of a drawer tend to swing out when the drawer (minus adapter) is rotated and catch on the "table-top" surface of the Cooling Air Fixture. In one case the fastener broke off.

Recommendation.

If the recommendation of item 4b is not accepted, these fasteners should be replaced by a spring variety that will remain close to the side of the drawer fixture when disengaged.

- Item 19. Deficiencies in the Fixture, Cooling Air have been dealt with under item 4.

- Item 22. a. T.O. 31X3-12-8-2, Figure 11-1, refers to the terminals of W-18 as P2 and P3. (See item 10.)

Recommendation.

The T.O. should be revised, identifying the terminals as E1 and E2 to agree with the hardware. Flagnote 1 should be similarly revised.

- b. See item 8.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 4152-3 Date May 23, 1963 Page 1 of 2

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 4152 Title Test Equipment Electronic Facility Base Maintenance

Part No. 25-34145-1 Serial No. 000 0009

Demonstration Event Unscheduled Location Ellsworth CSA Date May 3, 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST				
1	Fault Isolation and Repair	N/R 14	Lines and Cables	N/R
2	Standardization	N/R 15	Fasteners	N/R
3	Interchangeability	N/R 16	Covers, Cases, and Shields	N/R
4	Packaging and Mounting	N/R 17	Disposable Modules	N/R
5	Accessibility	3 18	Test Equipment	N/R
6	Work Space	N/R 19	Servicing and Handling Equipment	N/R
7	Testing and Servicing	N/R 20	Tools	N/R
8	Displays	N/R 21	Platforms, Stands, and Shelters	N/R
9	Handles	N/R 22	Technical Order	N/R
10	Labels and Marking	N/R 23	Figure 'A'	N/R
11	Controls	N/R 24	Form B/C	N/R
12	Work Aids	N/R 25	Specifications	N/R
13	Connectors and Connections	N/R 26	Personnel Requirements	N/R

CHECKLIST RATINGS

1 Good Maintainability	3 Marginal Maintainability	N/A Not Applicable
2 Fair Maintainability	4 Poor Maintainability	N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4 .

COMMENTS: _____

Figure A 4152

TEST EQUIPMENT, ELECTRONIC FACILITY, BASE MAINTENANCE AN/GSM-82

Problem: Fasteners

The back of the test bench has 2 upper panels that are riveted to the bench frame. When facing the rear of the bench, inspection will show the lower left panel is fastened by 36 phillips screws. Connectors are installed in the lower right hand panel. The riveted panels are a poor maintainability feature. This is true even though the drawers are replaceable from the front since wiring is contained in this part of the bench. Restricting access to this area is incongruous with providing a removable panel to an area housing only several removable storage drawers.

Recommendations:

1. The conservative use of standard round head screws is recommended in place of the rivets.
2. Reduce the number of screws used to fasten the lower left rear panel. Use standard round head screws instead of phillips screws.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4252-1 Date 11-7-62 Page 1 of 3

Prepared by R. L. Stearns N/S 50-66 Phone 6-6263

Figure A No. 4252 Nomen Code Inserter Verifier.

Dwg No. 25-32983-1 Serial No. 0001

Test No. Inspection Held at MPC

Maintenance Level ☐ ORG ☐ Field ☐ Depot Type ☐ Scheduled ☐ Unscheduled

MAINTAINABILITY CHECKLIST				
1	Standardization	3	13 Displays	4
2	Interchangeability	4	14 Handles	4
3	Packing & Mounting	3	15 Fasteners	3
4	Accessibility	3	16 Covers, Cases, Shields	4
5	Work Space	N/A	17 Platforms, Stands & Shelters	N/A
6	Connectors & Connections	3	18 Labels & Marking	3
7	Fault Isolation	N/A	19 Disposable Modules	N/A
8	Lines & Cables	N/A	20 Technical Orders	N/R
9	Test Service Points	N/A	21 Figure A	3
10	Test Equipment	N/A	22 Form B/C	2
11	Tools	3	23 Model Specification	4
12	Controls	4	24 Personnel Requirements	3

MAINTAINABILITY PROBLEMS:

NOTE: See attached sheets by item number. Items rated three and under have comments. N/A means Not Applicable. N/R means Not Released!

Item 1. Phillips head and high torque bolts were used to mount the cover plates on the following drawers;

- a) Power supply 25-32988-1.
- b) Coder Unit Code Pack.
- c) Coder Unit Launch Control.

It is recommended that only one type of bolt be used to mount all cover plates.

Item 3. The lower row of Phillips head bolts holding the cabinet blower screens in place are inaccessible. It is recommended that hex head bolts be used. This would permit the use of a ratchet wrench.

If the lower lever, of the Coder Unit Code Pack Drawer, is depressed, without a code pack in position, the unit may jam. This results in a requirement for repairs. It is recommended that this lever be interlocked, so it can't be depressed or will not jam when a code pack is not in position.

Item 4. To remove the Indicator Code drawer the Code Unit Code Pack drawer had to be removed. This is due to the interference of the upper control lever of the Code Unit drawer. It is recommended that the lever have a slight bend built into it, thus giving the required clearance.

To repair the Set Code switches on the Code Unit Launch Control Drawer the front panel must be removed. To remove the front panel the drawer cabling harness must be removed. To correct this a complete redesign of the mounting would be required.

Item 6. Almost all connections to relays, lights, resistors, and other parts are soldered. Many of these parts could be made plug-in or have screw terminals.

Item 11. Two types of screw-drivers are required to remove covers from some drawers. If all the hold down bolts had the same type head the problem would be solved.

A special tool is required to install or remove the plug-in modules of the Verifier Unit drawer. It is recommended that the fasteners be changed to the slotted knob type thus eliminating the need for a special tool.

Item 15. Items 1, 3 and 11 cover the misuse of fasteners.

Item 18. Labels could not be found for connector receptacles on or in the following units:

- a) a) Blower connectors on both cabinets.
- b) The power input cable connector to the cabinet.
- c) The Indicator Code drawer.
- d) The Coder Unit Launch Control.

Item 18. (Continued)

Labels could not be found for the following parts:

- a) One resistor in Control Power Supply 25-32984-1.
- b) One relay (K-3) in the Verifier Unit Indicator.

Item 21. The Figure A does not have Maintainability requirements in it.

Item 22. The Form C does not cover the Repair of the Figure A.

Item 24. Maintenance personnel must be capable of soldering to maintain this equipment.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO-4278-1/4038-1 Date May 24, 1963 Page 1 of 4

Prepared by A. H. Smith M/S y1-07 Phone 866-3261

Figure A No. 4278/4038 Title TE TO LAUNCHER ENVIRONMENTAL SHELTER/BARRIER SET, LAUNCHER OPENING, SAFETY, FRU-2/E

Part No. _____ Serial No. _____

Demonstration Event Usage Location VAFB Date May 20, 1963

T.O. Procedures T.O. 21-SM80A-2-2, Paragraph 6-12

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/R	14	Lines and Cables	N/A
2	Standardization	N/A	15	Fasteners	3
3	Interchangeability	2	16	Covers, Cases, and Shields	N/A
4	Packaging and Mounting	4	17	Disposable Modules	N/A
5	Accessibility	N/A	18	Test Equipment	N/A
6	Work Space	1	19	Servicing and Handling Equipment	N/A
7	Testing and Servicing	N/A	20	Tools	4
8	Displays	N/A	21	Platforms, Stands, and Shelters	N/A
9	Handles	N/A	22	Technical Order	3
10	Labels and Marking	3	23	Figure 'A'	N/R
11	Controls	N/A	24	Form B/C	N/R
12	Work Aids	N/A	25	Specifications	N/R
13	Connectors and Connections	N/A	26	Personnel Requirements	1

CHECKLIST RATINGS

- 1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable
 2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: Erection of the Figure A 4278 and Fig. A 4038 was observed at 394-A-6 during the emplacement of a Category I Wing II Flight Test Missile

- Item 4 a. The Figure A 4278 and Figure A 4038 combine to form a very complicated structure, having more than one hundred component parts. During the observed erection a group of technicians, varying in number from 3 to 9, took two hours to reach a point at which the missile could be lowered. At that time approximately forty components parts remained unused on the apron. It is true that the operation was not performed per T.O. instructions, nor by a properly structured and trained team, but the men were experienced operators and the difficulty they experienced is considered by the writer to be an indication of excessive complexity of this equipment.

Recommendation.

A re-design effort should be initiated with the general objective of simplifying the structure and reducing installation time.

- b. The Figure A 4038 safety barrier which surrounds the environmental shelter consists of two rows of horizontal telescoping bars which lock into position on uprights. Two questions arise in connection with these items:
1. The telescoping tubes are quite close-fitting and could be susceptible to jamming if grit or corrosion should appear inside the "sleeve". If the tubes do jam they will preclude assembly of the barrier.
 2. The tubes are rather bulky, and the process of installation is time-consuming.

Recommendation.

The requirement to use solid bar horizontals should be re-evaluated. An integral chain-and-upright system would be very much simpler and quicker to install and would be less susceptible to deterioration with time.

- c. A set of kick-plates are provided with the Figure A 4038, consisting of pairs of telescoped pressed-steel plates to be attached at both ends to the uprights of the safety barrier. During the usage observed the opinion was freely expressed by the crew that these items would probably "get lost" because their usefulness was questionable and they are rather bulky and troublesome to install (see also item 15).

Recommendation.

If the solid-bar safety barrier is replaced by an integral chain-and-upright assembly, the kick-plate function could be satisfied by an extra chain at ankle height.

- d. The wooden rods, straps and support beams (items 3 and 11 in Figure 6-36A T.O. 21-SM80A-2-2) between the lower end tubes of the Fig. A 4278 and the TE do not appear to serve a necessary function. During the observed erection, these items were installed after the "tent" had been attached and they appeared to do no more than raise the "belly" of the end-panel a few inches.

Recommendation

In the interests of simplification and time-saving in erection, these items should be deleted.

If these items are intended to provide extra support in especially inclement weather, then it should be made clear in the T.O. that their use is conditional.

- e. The rail retainers (items 4 in Figure 6-33 T.O. 21-SM80A-2-2) are marked with a direction to "Torque to 500 in. lbs", this instruction appearing also in Figure 6-33 of the T.O. There is not a way to attach a standard torque-wrench to the fitting, nor is an adapter provided. Furthermore the need to apply a measured torqueing moment is questionable.

Recommendation.

This torqueing requirement should be deleted.

- f. The receiving holes for the Rail Retainers were corroded, making firm assembly of the side tubes difficult.

Recommendation.

The receiving holes should be fitted with dust caps when not in use, and should be coated with a lubricating inhibitor such as silicone grease.

- Item 10 a. In three instances during the observed erection of the Shelter framework, beams were mated with the wrong orientation, i.e. one item rotated 180° with respect to its mating part. With reference to the identification numbers used in Figure 6-33 of T.O. 21-SM80A-2-2, the elements mismated were:

1. Support beams 10 and 11
2. Beams 12 and 13
3. Beam 15 to beams 13

Recommendation.

Some form of keying the mating tubes would be desirable, however, it is believed that the problem would be satisfactorily relieved by the addition of clear indexing marks.

- b. Installation of the tent panels was complicated by difficulty in identifying the correct panels.

Recommendation.

Each panel should bear some form of identification to make its location apparent. An all-over pattern or color would be most desirable, although a picture-symbol would probably be quite adequate.

- Item 15 The Safety Barrier kickplates are secured to the uprights of the barrier by means of two leather straps-and-buckles at each end. This method is unduly pernickety, and may prove to be quite impractical in freezing conditions, or when the buckles become corroded in time.

Recommendation.

If the kickplates are not modified as recommended in item 4 c., the strap-and-buckle fasteners should be replaced, preferably by a quick-operating device such as a spring-clip.

- Item 20 The lack of a suitable torqueing device for the rail retainers was dealt with in item 4 e. above.

- Item 22 a. None of the illustrations showing the Figure A 4278 show the configuration of the erected safety barrier; during the observed test there was some uncertainty as to whether the safety barrier should go inside or outside the tent structure at the "mouth" of the launch tube.

Recommendation.

An illustration showing the safety barrier should be incorporated.

- b. See item 4 e.

Recommendation.

Requirement to torque rail clamps to 500 in. lbs. should be deleted from Figures 6-33 and 6-33A of T.O. 21-SM80A-2-2.

D2-14934-6

Page 326

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 4388-1 Date 23 May 1963 Page 1 of 2

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 4388 Title SIN/HVC Test Kit (Telephone Test Set)

Part No. 1274197-501 Serial No. 29

Demonstration Event 1-24 Location Ellsworth, B-5 Date 30 April 1963

T.O. Procedures T.O. 21-SM80A-2-5, Section III, paragraph 3-10

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/A	14	Lines and Cables	2
2	Standardization	1	15	Fasteners	4
3	Interchangeability	1	16	Covers, Cases, and Shields	1
4	Packaging and Mounting	2	17	Disposable Modules	N/A
5	Accessibility	3	18	Test Equipment	N/A
6	Work Space	N/A	19	Servicing and Handling Equipment	N/A
7	Testing and Servicing	2	20	Tools	N/A
8	Displays	2	21	Platforms, Stands, and Shelters	N/A
9	Handles	2	22	Technical Order	2
10	Labels and Marking	3	23	Figure 'A'	N/A
11	Controls	2	24	Form B/C	N/A
12	Work Aids	N/A	25	Specifications	N/A
13	Connectors and Connections	4	26	Personnel Requirements	N/A

CHECKLIST RATINGS

- 1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable
 2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The Test Adapter, MX-4114/GTM-3, was used to check the
Telephone Repeater, TA-465/GTC-9. The procedure in T.O. 21-SM80A-2-5,
Section III, paragraph 3-10, was used. The demonstration was accepted, however,
a minor discrepancy was noted (see Item 13).

Item 5

Problem: The cover to the test kit is equipped with a thick protective pad. The protective pad interferes with actuating the 1/4 - turn wing head quick release fastener, located on the left side of the cover.

Recommendation: Cut a relief in the protective pad to enable convenient access to the wing head fastener.

Item 10

Problem: The Telephone Test Set does not have a list of equipment for an inventory check. Some of the smaller pieces could be easily lost and the missing pieces could not be easily identified.

Recommendation: A list of equipment should be labeled permanently on the test set case.

Item 13

Problem: T.O. 21-SM80A-2-5, paragraph 3-10 f. requires that the AN/PSM-6 multimeter be grounded to a test point. No grounding jack is provided on the multimeter. The procedure used was to loosen a front panel screw and wrap a bare wire around the screw and retighten the screw. According to two RCA Technical Representatives the meter does not require grounding.

Recommendation: Determine if a requirement exists for grounding the meter. If no requirement exists remove grounding instructions from the T.O. If grounding is required provide a permanent ground jack on the meter front panel with adequate labeling.

MAINTAINABILITY EVALUATION/COMPARISON REPORT

Report No. EO-4489-1 Date 3-4-63 Page 1 of 4
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4489 Nomen Message Generator MX3625/GSM-62
 Dwg. No. 8324447 Serial No. 5
 Observed Event Evaluation Location VAFB Date 3-1-63
 Title or Description _____
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/O	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	2	17	Disposable Modules	4
5	Accessibility	4	18	Test Equipment	N/E
6	Work Space	N/A	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	N/O	20	Tools	N/A
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	N/E
10	Labels, Marking	3	23	Figure A	N/E
11	Controls	4	24	Form B/C	N/E
12	Work Aids	N/O	25	Specifications	N/E
13	Connectors, Connections	4	26	Personnel Requirements	2

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4a. Section 10.4.3.5.2 of MIL-STD-803 states "where possible, cases shall be designed to lift off units rather than units lifted out of cases." The reasoning behind this statement is probably as follows:

- a. The case is generally much lighter and more manageable than the unit.
- b. If a heavy unit is lowered into a case and a component or cable snags on a projection, damage will probably occur before the resistance is felt; for example a wire might be severed without even noticing the slight tug.
- c. If the unit slips from the operators grasp while lowering, damage may result due to the fall, whereas if the case slipped while lowering it onto the unit it would be less likely to cause damage.

In this particular instance, the front panel of the unit is recessed into the case; the two carrying handles, however, project outwards beyond the edge of the case, and it is possible to rest the unit on these two handles while lifting the case off. This procedure is somewhat hazardous because the handles are short and have rounded ends; it is therefore quite likely that the unit would topple and fall as the case came free. For an illustration see Fig. 4-113, page 4-318 of T.O. 21-SM80A-4-1. It may be that the design intention was to slide the unit out of its case while resting flat, however this is not too desirable because the case is larger than the unit and is not provided with guide rails; thus, if the front panel screws are removed before removing the two hex-headed bolts at the rear, the unit drops as the rear bolts are undone. If the rear bolts are removed first the weight of the unit is supported entirely by the front panel screws and may cause the last one or two screws to break or bind.

The natural tendency is to remove the rear bolts first, then raise the unit to rest on the rear surface while removing the front panel screws, then lift the unit out of the case; the easiest installation procedure is the reverse of this process, which is susceptible to the hazards mentioned above.

Recommendation:

It is clear that a complete repackaging of the unit would be prohibitively costly, and would not be justified. Two alternatives remain:

- a. The case and unit should be provided with suitable guide rails to permit withdrawal of the unit while the case is lying flat.
- b. That part of the case which houses the unit (excluding the end-section which is used for cable-storage) should be divided transversely into two sections, so that the upper section could be removed with the unit lying flat. The unit could then be turned over to remove the bottom section, as is the procedure with most of the suitcase test equipment.

- Item 4 b. The brackets on the case into which the panel mounting screws fasten tend to catch on a wire bundle as the unit is inserted into or withdrawn from the case.

Recommendation:

The wire bundle should be fastened down so that it does not project outwards from the chassis.

- c. The cables for the unit are stowed in brackets and clamps on a hinged panel in the lid of the unit. The cable scrape on the quick-release fastener brackets when the panel is opened, and the panel will not remain open while the cables are disengaged. Because the weight of the cables is greater than the weight of the lid, the device falls over and closes itself.

Recommendation:

The cables should be stowed in the lid, not on the hinged plate. The hinged plate should also hold itself in the open position.

- Item 10 a. The weight of the unit is not displayed, although it appears to be more than 45 pounds.

Recommendation:

A weight label should be affixed.

- b. As is the case with almost all Figure A equipment sold to Air Force at VAFB, adhesive labels have been affixed showing the Figure A number.

Recommendation:

A permanent label should be affixed to all equipment, showing Figure A number and (where applicable) an inventory of associated cases.

- Item 15. The chassis is held in the case by eight slotted screws on the front panel and two hex-headed bolts at the rear. The process of removing and replacing the unit is unnecessarily lengthy.

Recommendation:

The two bolts at the rear of the unit should be eliminated and replaced by guide pins only. If it is considered necessary to retain the bolts for structural purposes, they should at least be of the slotted-head variety.

- Item 16 a. The proper orientation of the unit in the case is not obvious; it will apparently go in either way. The lid is also apparently reversible.

Recommendation:

If there is any requirement for unique orientation of chassis, case, and lid, some identification marks should be provided.

- b. Both connectors on the panel of the unit are fitted with loose plastic dust caps.

Recommendation:

The dust caps should be of the captive variety.

- Item 26. As far as could be determined, all electrical connections in this unit are soldered. Since even the Printed Circuit Assemblies are soldered in, it would appear that this unit is not suitable for Field-level maintenance.

Recommendation:

- a. The PCA's should be changed to the plug-in variety. This would provide at least partial Field-level maintenance capability.
- b. The unit should be unitized according to MIL-STD-803 section 10.2, either by replacing soldered connections with screwed or wrapped connections, or by providing plug-type break-points between units.

MAINTAINABILITY EVALUATION/DESIGNATION REPORT

Report No. EO-4490-1 Date 2-11-63 Page 1 of 3
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4490 Nomen Simulator Set, Electrical Functions, Missile-Launch AN/GSM-62
 Dwg. No. 25-33940-1 Serial No. _____ Set #2 _____
 Observed Event None Location VAFB Date 2-11-63
 Title or Description Static evaluation
 T.O. Procedures 3309-14-26-1 (Operation and Maintenance)

MAINTAINABILITY CHECKLIST				
1	Fault Isolation	N/O	14	Lines and Cables
2	Standardization	4	15	Fasteners
3	Interchangeability	4	16	Covers, Cases, Shields
4	Packaging, Mounting	3	17	Disposable Modules
5	Accessibility	4	18	Test Equipment
6	Work Space	4	19	Servicing, Handling, Equip.
7	Testing, Servicing	N/O	20	Tools
8	Displays	3	21	Platforms, Stands, Shelters
9	Handles	4	22	Technical Order
10	Labels, Marking	3	23	Figure A
11	Controls	4	24	Form B/C
12	Work Aids	N/O	25	Specifications
13	Connectors, Connections	4	26	Personnel Requirements

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4 The two small junction-boxes stored in the Distribution Box are held in place by a plate which is secured by eight slotted quick-release fasteners. It is necessary to remove the dust-caps from two of the sockets in order to remove the retaining plate, because the hole in the plate is too small to pass the skirt umbilical dust cover, and the dust cap on the small connector is attached to the plate by a chain.

Recommendation.

1. The retaining cover should be hinged along one side and fastened down with no more than two butterfly type quick-release fasteners.
2. The holes should be enlarged to allow the retaining plate to be removed without removing dust caps.

- Item 8 The Signal Data Recorder has an indicator lamp adjacent to the ON-OFF switch. The word POWER is printed beside this indicator, implying that it will be illuminated when the recorder is switched on. During the evaluation the recorder was hooked up but not switched on, but it was observed that the lamp was glowing dimly. This situation was somewhat confusing because if the lamp is supposed to indicate that power is available, then it should be identified accordingly as POWER AVAILABLE, and the lamp should be bright enough to be easily discernible. If the lamp indicates that the recorder is switched on, then it should not glow at all when the unit is switched off. There is no circuit diagram in the Operation and Maintenance T.O., nor is there any descriptive material that indicates the proper mode of operation of this indicator.

Recommendation.

The function of the indicator should be clarified by an unambiguous label, and the T.O. should describe the Signal Data Recorder more fully.

- Item 10 a. It was observed that temporary adhesive labels had been affixed to each box of the test-set showing "Fig A 4490" and "CASE 1 of 6" etc.
- This practice of identifying items by temporary Fig A number labels has been adopted extensively at Vandenberg due to the confusion arising out of the use of several different identification systems. For example one item may be known by ACO number, drawing number, Federal Stock Number, BGS number or Figure A number.

Recommendation.

All Figure A items should be prominently labeled to aid in recognition.

- b. The individual cases of the Fig A 4490 observed were all identified as being serial number 2, but the over-all Test-Set number as shown on the label of the Simulator was serial number 4.

It is quite possible that this situation is the result of an error, but it does indicate the desirability of listing component parts and serial numbers on a master label.

Recommendation.

A label should be added to the test-set listing serial numbers and drawing dash numbers to aid in determination that a complete and proper set has been acquired.

c. Some of the cables bear as many as eight assorted labels of the adhesive rubber and wrap-around yellow plastic types. It therefore becomes more difficult to identify a cable when it is tangled with others.

Recommendation.

One label at either end of a cable should be sufficient, and the label should bear the identification that is used in T.O. procedures.

If it is considered necessary to label cables with jack number, "mating with" plug number, drawing number, serial number, function, wire number etc., then one of the labels should be of an outstandingly different color to simplify the task of identification.

- Item 15** a. The simulator chassis is secured to the case by 32 screws, and the small access panel is secured by 22 screws. The top and bottom lids are secured by 12 over-center latches each. All the other cases are secured by 12 latches each.

Recommendation.

Each case in the test-set should be re-evaluated to see if it is not possible to reduce the number of screws securing panels, and catches securing lids.

- Item 16** All quick-release connector dust caps have a keyed center-piece. It becomes an irritating task to locate the dust cap because there is nothing with which to rotate the center-piece.

Recommendation.

The dust cap center-piece should not be keyed.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4490-2 Date February 25, 1963 Page 1 of 7
 Prepared by Alexander Henschel M/S 50-66 phone JU6-6263
 Figure A No. 4490 Nomen Simulator Set, Electrical Functions, Missile-Launch, AN/GSM-62
 Dwg. No. 25-33940, 25-33733 Serial No. 0002*
 Observed Event Static Evaluation Location EDL Date February 22, 1963
 Title or Description Maintainability Evaluation of AN/GSM-62
 T.O. Procedures 33D9-14-26-1 (Operation and Maintenance)
 (Reference) *SM-245 Ser #000002 CY-3680 Ser #000002
 RO-186 Ser #000001 CY-3681 Ser #000002
 CY-3634 Ser #000002 J-1291 Ser #000001

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	3	15	Fasteners	3
3	Interchangeability	3	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	4
5	Accessibility	3	18	Test Equipment	4
6	Work Space	4	19	Servicing, Handling, Equip.	4
7	Testing, Servicing	4	20	Tools	4
8	Displays	3	21	Platforms, Stands, Shelters	N/A
9	Handles	3	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C FormC only	4
12	Work Aids	4	25	Specifications	4
13	Connectors, Connections	3	26	Personnel Requirements	4

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Rating Analyses for AN/GSM-62**Item 2, Standardization**

Simulator Set Cable Assembly Cases CY-3680 and CY-3681 and Simulator Set Case - Test Adapter CY-3634 have feet which are strong and well designed. The suitcases for Simulator SM-245, Recorder RO-186, and Distribution Box J-1291 have riveted feet, Zero P/N 7-701, which are easily broken.

Recommendation:

Use the more rugged feet of CY-3634, CY-3680, and CY-3681 for all MGE and ACO equipment suitcases.

Item 3, Interchangeability

The top covers for suitcases CY-3634, CY-3680, and CY-3681 are interchangeable; they should not be. Each cover can be placed on its suitcase in four different positions; only one will allow fastening the latches. The top cover for Distribution Box J-1291 can fit two ways; only one is correct. Simulator SM-245 has a top and bottom cover for its suitcase; each cover can be placed two ways; only one will allow fastening.

Recommendation:

Provide an alignment marker on the suitcase and cover to make the proper position of the cover obvious. This alignment marker could be a different color for each of the like cases in question. See MIL-STD-803 sec. 10.4.3.5.1.

Item 4, Packaging, Mounting

- a) The Simulator Assembly 25-33733-1, Recorder 25-35862-1, and Distribution Box 25-33734-1 can be placed in their carrying cases 180° from the proper position. When the Recorder is returned to its case the maintenance technician must align the RFI gasket with a dowel pin or other means before fastening the Recorder to the case.

Recommendation:

Provide alignment pins on the case so the Simulator Assembly, Recorder, and Distribution Box fit into their carrying case properly. Alignment pins will improve maintenance time and eliminate many

Item 4, (Continued)

of the stripped fasteners which result from improper chassis and case alignment. See MIL-STD-803 section 10.4.3.7.5.

- b) Components on assembly 301294-901 (TB-3) of Recorder Assembly 301292-901 are high failure rate items (diodes). Work on or removal of TB-3 requires other assemblies to be removed first.

Recommendation:

Provide greater accessibility per MIL-STD-803 section 10.4.3.10.1.

- c) The Recorder suitcase top cover, part of 10-21340-1, is hinged at one side. When the case is opened the cover can be removed from or left on the case during organizational use. If the cover is left on, the weight of the cover is sufficient to cause the hinges to tear away from the suitcase. Removing the cover will alleviate the above problem, however when it is replaced the hinge pins will be knocked out if perfect alignment of the cover hinge is not made with the case hinge pin.

Recommendation:

Provide a removable arm which will prevent the top cover from placing undue loading on the hinges when the Recorder suitcase is open.

- d) Dust covers for the Skirt Umbilical Junction Box and G&C Umbilical Junction Box receptacles have to be removed before panel 29-26830-1 of Distribution Box 25-33734-1 can be raised. This panel has to be raised in order to remove the junction boxes for use. During the removal of these dust covers the maintenance technician's fingers rub against the rough nylon material lining the circumference of the holes in the panel where the junction box connectors protrude. Enough skin is removed from the technicians's fingers during this operation to sufficiently decrease his electrical resistance thereby making him more susceptible to electrical shock.

Recommendation:

Provide a hinged panel with larger holes so that the dust covers need not be removed. Fasten the panel to the Distribution Box with a minimum of captive quick-release fasteners and have the dust covers captive to their respective junction box rather than to the panel. Use MIL-STD-803 sections 10.4.3.5.5, 10.4.3.5.8, and 10.4.3.8.1.1 as a design guide.

Item 5, Accessibility

- a) Spare fuses and a spare lamp for the Recorder are located behind the hinged partition of the top cover. Enough room is available on the front panel of the Recorder so the spares could be mounted adjacent to their active counterpart.

Recommendation:

Mount spare fuses and lamps as close as possible to their active counterpart.

- b) Cable harness is mounted directly over the twist lamp and switch wiring terminations in Simulator 25-33733-1.

Recommendation:

Route wire harness so that access to switches is improved. See MIL-STD-803 section 10.4.2.3.3.

Item 8, Displays

Non-indicating fuses are used on the Simulator and Recorder.

Recommendation:

Use indicating type fuses per section 6.1.2.3.1, item 25.1.1.1.3, Boeing Document D2-4747-1, Maintainability Design Criteria for Minuteman Electronics Equipment.

Item 9, Handles

One handle on Simulator 25-33733-1 is mounted directly over four of the Phillips screws holding down panel 25-34464-1. The handles on the Recorder are much smaller than the standard handle used on the other chassis of AN/GSM-62.

Recommendation:

Use the standard handle BACH10G5 on the Recorder. Ensure that handle mounting does not interfere with removal of other items.

Item 10, Labels, Marking

- a) Cases CY-3634, CY-3680, and CY-3681 all have the same weight marking of 100LB, however each case with cables does not weigh the same.

Item 10, (Continued)

Recommendation:

Mark the proper weight on each carrying case per MIL-STD-803 section 10.4.3.1.

- b) The following items and blueprints have the incorrect marking for pounds.

1) Recorder RO-186

2) Blueprints 25-33735 and 25-35862

Recommendation:

MIL-STD-12B and Boeing Document 13228, Manual of Writing Style, Section II-2 give the abbreviation LB as correct for pounds. Use the above reference as guides for abbreviations.

Item 13, Connectors, Connections

- a) Receptacles J6 and J6A of Recorder 25-35862 have plastic dust covers which are easily lost.

Recommendation:

Provide captive dust covers as are provided for the remaining receptacles of AN/GSM-62.

- b) The routing of the wiring harness to the printed circuit cards in the Recorder allows the wiring to become damaged when the Recorder is lifted in and out of its carrying case.

Recommendation:

Reroute the wiring harness or use a larger case for the Recorder. See MIL-STD-803 section 10.4.3.5.3.

Item 15, Fasteners

The Simulator is fastened to its carrying case by 32 Phillips screws and self-locking nuts. Recorder RO-186 is fastened to its case by 16 Phillips screws. Panel 25-34464-1 is fastened to the Simulator by 22 Phillips screws. The Distribution Box 25-33734 has 22 Phillips screws to fasten it to the case. Washers are used under each of the Phillips screws.

Recommendation:

Recorder RO-186 has an RFI gasket and therefore needs the number of fasteners used. The remaining applications however need only one half the number of screws used. See MIL-STD-803 section 10.4.3.8.12. The washers need not be used because the maintenance technician in the field will either lose or throw them away. Use captive nut plates instead of lock nuts as a means of fastening the chassis to its case. Slotted hex-head screws are recommended in lieu of Phillips screws because of their better adaptability to field maintenance situations.

Item 16, Covers, Cases, Shields

See Items 2,3, and 15

Item 22, Technical Order - T.O. 33D9-14-26-1.

- a) Section VI, Maintenance Instructions, Section VII, Troubleshooting, Section VIII, Calibration, and Section IX, Repair Instructions are listed as information to be supplied at a later date.

Recommendation:

Apply these instructions as they become available to a working situation before including them in the T.O. This will ensure that the techniques and operations called out are valid.

- b) Section I figure 1-2, Leading Particulars is in error with regard to equipment part numbers.

Recommendation:

Correct the Technical Order for the part numbers for these equipments:

(1) SM-245/GSM-62	Should be 25-33733-1
(2) J-1291/GSM-62	Should be 25-33734-1
(3) CY-3634/GSM-62	Should be 25-34046-1

- c) Section 5-12. Recorder operational checkout procedure does not have a step for turning on power.

Recommendation:

Add a step between a. and b. stating "Place power ON/OFF switch to the ON position; white pilot lamp shall illuminate."

Item 23, Figure A

The Technical Requirements section does not contain a paragraph on Operability and Maintainability.

Recommendation:

Conform with AFBSD Exhibit 61-56 by supplying a paragraph on Operability and Maintainability in the Technical Requirements section of the Figure A.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. EO 4490-3 Date 28 May 1963 Page 1 of 3

Prepared by W. F. Lohss and P. G. Giles M/S 50-66 Phone 656-6264

Figure A No. 4490 Title Simulator Set, Electrical Functions, Missile & Launch

Part No. 25-33940 Serial No. _____

Demonstration Event _____ Location CSA Ellsworth AFB Date 24 April 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST				
1	Fault Isolation and Repair	N/A	14	Lines and Cables
2	Standardization	1	15	Fasteners
3	Interchangeability	1	16	Covers, Cases, and Shields
4	Packaging and Mounting	2	17	Disposable Modules
5	Accessibility	2	18	Test Equipment
6	Work Space	N/A	19	Servicing and Handling Equipment
7	Testing and Servicing	N/A	20	Tools
8	Displays	2	21	Platforms, Stands, and Shelters
9	Handles	2	22	Technical Order
10	Labels and Marking	3	23	Figure 'A'
11	Controls	2	24	Form B/C
12	Work Aids	N/A	25	Specifications
13	Connectors and Connections	2	26	Personnel Requirements

CHECKLIST RATINGS

- 1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable
 2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: The Missile Downstage and Auxiliary Launcher Simulator,
25-28125, is a part of the Simulator Set, Figure A 4490. The Simulator is
characteristic of other Minuteman Test sets and the Item 10 and 15 problems
are common.

Item 10

- a. Problem: Some Figure A test equipment has several separate cases. Multiple case units include Figure A's 4490, 4012, 3092, and 3007. Figure A 3007 has 14 separate pieces. The technician has no immediate method to determine the number of individual cases in a Figure A, and which case, if any, is missing.

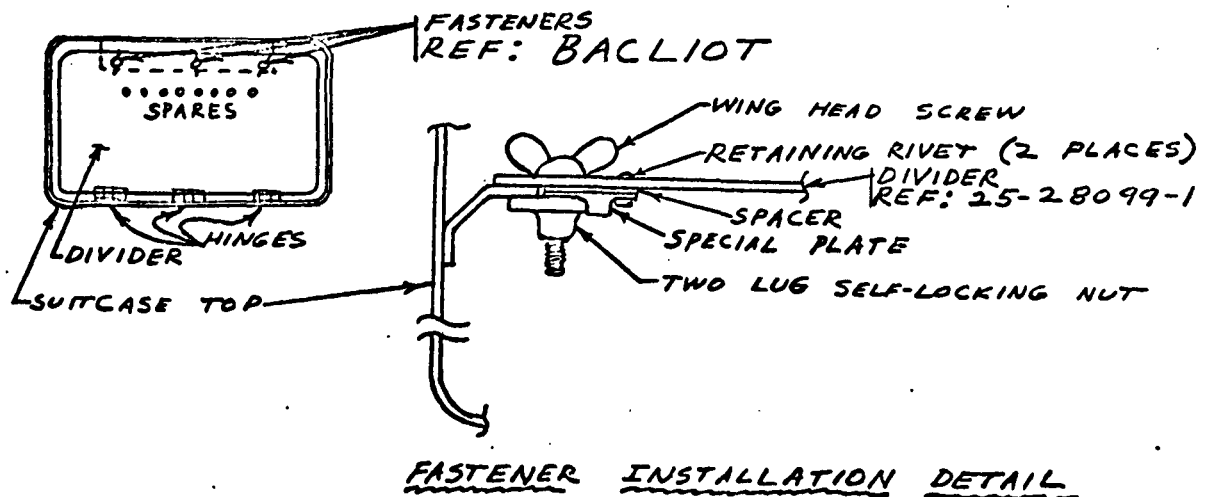
Recommendation: Mark the individual cases-for example: if the Figure A consists of three cases, label them 1 of 3, 2 of 3, and 3 of 3.

- b. Problem: Many of the cases have cables and accessories which are not listed by item on the case. It is difficult for a technician to verify if the content of a case is complete. It is possible that a trip to an LF or LCF may be wasted because a cable or other equipment is missing.

Recommendation: Provide an inventory list on all cases stating quantity, part number, and nomenclature of each piece of equipment contained in the case.

Item 15

Problem: The Launcher Simulator and other Minuteman suitcases have a hinged divider in the cover opposite the hinge, three fasteners, BACLIOT, are used. These fasteners are difficult to engage under the cover lip as the two lug self-locking nut loses its locking feature and does not rotate under the lip when the wing head screw is tightened. After tightening the wing head screw the lug nut is not under the lip. When the cover is placed on the suitcase base the cover divider swings down and breaks the spare bulbs or fuse holders mounted on the divider. This fastener problem will continue to damage equipment, reduce spares, waste manhours, and reduce the operability of the equipment. See sketch below for fastener installation details:



Recommendation: Make the BACL10T type fastener inactive for Boeing design and monitor all subcontractors to assure that this type fastener is not used. In lieu of the BACL10T type fastener select a quarter turn quick release winged head fastener.

A retrofit for existing cover dividers is in order. One method would be to replace the BACL10T type fastener with a quarter turn quick release winged head fastener. Another more economical method would be to drill a through hole in both the cover divider and cover lip, and install a small quick release pin retained to the divider with a head chain. If required more than one quick release pin may be specified.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4491-1 Date February 6, 1963 Page 1 of 3
 Prepared by Ralph L. Stearns M/S 50-66 phone 6-6263
 Figure A No. 4491 Nomen Start-Up Unit, Launch Facility, OA/GSM-62
 Dwg. No. 25-33549 Serial No. 7
 Observed Event T.O. Verification Location Malmstrom AFB-F6 Date 1-25-63
 Title or Description T.O. Verification
 T.O. Procedures T.O. 21-SM80A-2-3 Paragraph 2-67

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	N/A	14	Lines and Cables	4
2	Standardization	3	15	Fasteners	4
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	N/A	17	Disposable Modules	N/A
5	Accessibility	4	18	Test Equipment	N/A
6	Work Space	4	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	N/A	20	Tools	N/A
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	4	22	Technical Order	3
10	Labels, Marking	3	23	Figure A	N/A
11	Controls	3	24	Form B/C	N/A
12	Work Aids	3	25	Specifications	N/A
13	Connectors, Connections	3	26	Personnel Requirements	N/A

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 2.** The power cable from the power pack, used with the Start-Up Unit, has a connector with a fine thread nut and plug.

Recommendation:

The connector and plug should be of the coarse thread, quick release type used on other Minuteman cabinets.

- Item 10.** The cable storage suitcase does not have a cable inventory and cable location placard.

Recommendation:

To minimize the loss and damage of cables a cable inventory and cable location placard should be fastened to the cover of the cable storage suitcase.

- Item 11.** The "ON-OFF" control for the start-up power to the G&C gyrosopes consists of connecting and disconnecting the power pack cable.

Recommendation:

An "ON-OFF" power control switch should be installed on the power pack.

- Item 12.** A head set must be used and VRSA must be interrogated three times during start-up.

Recommendation:

With a fault code placard attached to VRSA the same results could be accomplished by use of the selector switches and indicator lights. This would eliminate the need for a head set and the interrogation of VRSA.

- Item 13.** See Item 2.

- Item 16.** The cover to the test set suitcase can be installed only one way but due to symmetry, has no readily identifiable method of indicating the correct way.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4491-2 Date February 18, 1963 Page 1 of 5
 Prepared by Ralph L. Stearns M/S 50-66 phone 6-6263
 Figure A No. 4491 Nomen Start-Up Unit, Launch Facility, OA/GSM-62
 Dwg. No. 25-33549 Serial No. 1
 Observed Event Evaluation Location EDL Laboratory Date February 15, 1963
 Title or Description _____
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation	4	14	Lines and Cables	4
2	Standardization	4	15	Fasteners	3
3	Interchangeability	4	16	Covers, Cases, Shields	3
4	Packaging, Mounting	3	17	Disposable Modules	N/A
5	Accessibility	3	18	Test Equipment	N/A
6	Work Space	4	19	Servicing, Handling, Equip.	N/A
7	Testing, Servicing	4	20	Tools	4
8	Displays	4	21	Platforms, Stands, Shelters	N/A
9	Handles	3	22	Technical Order	N/A
10	Labels, Marking	3	23	Figure A	3
11	Controls	4	24	Form B/C	3
12	Work Aids	4	25	Specifications	N/A
13	Connectors, Connections	4	26	Personnel Requirements	N/A

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

Item 4, Packaging, Mounting:

- A. The two suitcases, used to house the figure A equipment, are fragile and may not be capable of withstanding the rough field handling.

Recommendation:

The suitcases should be changed to the Zero Modular Packaging System type per catalog E59 or similar.

- B. When the top chassis is removed for service it is fastened to the lower module by a wire bundle. This makes the units very hard to handle and no doubt will result in damage to both the chassis and the wire bundle.

Recommendation:

The top chassis could be fastened to the lower unit by a hinge. If this is not practical the wire bundle should be made in two sections which would plug together when assembled.

- C. To remove the lower chassis from the suitcase the top unit must be held by one man, a second man must hold the suitcase in place, and a third man must lift the lower chassis out of the suitcase.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.5.2 "Where possible, cases shall be designed to lift off units rather than units lifted out of cases."

- D. To assemble the two chassis and the suitcase, drift pins must be used to align the three units.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.7.5 "Guide pins or their equivalent shall be provided on units for alignment during mounting."

- E. There is no easy way to discern the orientation of the two chassis and the suitcase.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.5.1 "The proper orientation of a unit within its case shall be made obvious, either through design of the case or by means of appropriate labels."

- F. The spare fuses for the modules in the test set suitcase are mounted in the cable storage suitcase.

Recommendation:

The spare fuses should be mounted in the same suitcase, readily accessible, and adjacent to the working fuses.

- G. To use either the self-test set or the break-out-box the maintenance man must remove them from the suitcase.

Recommendation:

By mounting the connector receptacle on the tops of these modules this requirement would be eliminated.

Item 5, Accessibility:

Wire bundles located directly over terminal boards TB1, TB3, TB4, TB5, TB6, TB7, and TB8 make the terminals inaccessible.

Recommendation:

Relocate the wire bundles so the terminals are accessible.

Item 9, Handles:

During removal the lower chassis tends to twist because the handles are not located over the center of gravity.

Recommendation:

Per MIL-STD-803 paragraph 10.4.3.2.2 "Whenever possible, handles or grasp areas shall be located over the center of gravity of the unit so that when the unit is lifted it does not swing or tilt.

Item 10, Labels, Marking:

- A. The label for transformer "T 1" is obscured by mounting board "A 1".

Recommendation:

Change the location of the transformer label.

- B. It is difficult to locate the right positioning guide for the plug-in circuit boards.

Recommendation:

Label the correct positioning guides.

- C. It is difficult to determine which plug-in circuit board goes into which receptacle.

Recommendation:

Label the circuit boards and the receptacles with reference designations.

- D. The abbreviation of "pounds" on the suitcases is "lbs."

Recommendation:

The abbreviation "lb" should be used per MIL-STD-12B, paragraph I.3.4.

- E. The name plates, on the test adapter and break-out-box chassis, are not visible when the modules are in their correct mountings.

Recommendation:

Locate the name plates so they are visible.

Item 15, Fasteners:

- A. The circuit card retaining cover is held in place by phillips screws with flat washers under the heads.

Recommendation:

As the washers are not required and will be discarded by field personnel money can be saved by not using them.

- B. Phillips head screws and bolts are used through out the test set. This type of head is susceptible to ruin while being removed.

Recommendation:

Use hex-head screws and bolts in place of phillips head.

- C. The mountings for capacitors C2 and C3 are held in place by bolts and nuts. This requires the use of a holding tool and a turning tool to remove a part.

Recommendation:

When a nut is required use a captive type nut.

Item 16, Covers, Cases, Shields:

The cover to the test set suitcase can be installed only one way but due to symmetry has no readily identifiable method of indicating the correct way.

Recommendation:

The cover and the case should be marked so maintenance personnel can readily discern the correct installation position.

Item 23, Figure A:

The Figure A does not contain any Maintainability Design Requirements. In accordance with AFBSD exhibit 61-56 Maintainability Design Requirements must be included in the Figure A's for all OGE and MGE Minuteman equipment for which Boeing is responsible.

Recommendation:

When the Figure A is revised Maintainability Design Requirements should be added.

Item 24, Form B/C:

- A. Line 4C of the Form C reads "blowers." There is only one blower.

Recommendation:

On the next revision of the Form C change line 4C to read "blower."

- B. Line 4a of the Form C instructs the maintenance personnel to remove the test set case. The Form C does not instruct the maintenance personnel to put the test set back in the case.

Recommendation:

On the next revision of the Form C correct this condition.

MAINTAINABILITY EVALUATION/OBSERVATION REPORT

Report No. EO-4491-3 Date 2-27-63 Page 1 of 2
 Prepared by A. H. Smith M/S 6207-1 phone 866-3761
 Figure A No. 4491 Nomen Start Up Unit, Launch Facility OA-3966/GSM-62
 Dwg. No. 25-33549-1 Serial No. 3
 Observed Event Evaluation Location Vafb Date 2-27-63
 Title or Description Static Evaluation
 T.O. Procedures _____

MAINTAINABILITY CHECKLIST				
1	Fault Isolation	N/O	14	Lines and Cables
2	Standardization	4	15	Fasteners
3	Interchangeability	4	16	Covers, Cases, Shields
4	Packaging, Mounting	3	17	Disposable Modules
5	Accessibility	4	18	Test Equipment
6	Work Space	N/A	19	Servicing, Handling, Equip.
7	Testing, Servicing	N/E	20	Tools
8	Displays	4	21	Platforms, Stands, Shelters
9	Handles	4	22	Technical Order
10	Labels, Marking	3	23	Figure A
11	Controls	4	24	Form B/C
12	Work Aids	N/E	25	Specifications
13	Connectors, Connections	4	26	Personnel Requirements

CHECKLIST RATINGS

4	Good Maintainability	N/A	Not Applicable
3	Satisfactory Maintainability	N/O	No Observation Possible
2	Unsatisfactory Maintainability	N/E	Not Evaluated
1	Poor Maintainability		

Rating analyses are provided on succeeding pages, for all checklist items rated 3 or lower.

- Item 4. a. The cable stowage cable-retaining lid is flimsy and bows outwards; this causes the three fasteners to disengage, making it impossible to fasten the lid down.

Recommendation.

The lid should be ribbed or flanged to stiffen it, and the fasteners should be mounted one sixteenth of an inch closer to the edge of the lid.

- b. The cable retaining lid does not hold itself open but must be held up with one hand while working amongst the cables.

Recommendation.

A small section of the lid should be removed from each corner on the hinged side. This would prevent the lid from stopping against the curved corner of the case and would allow the lid to fall back far enough to remain open.

- Item 10. Three spare fuses mounted in the cable storage box are not labelled. It is necessary to remove and inspect each one to find the correct rating.

Recommendation.

A label identifying fuse ratings should be affixed adjacent to each spare fuse holder.

- Item 15. The over-center fasteners holding the bottom of the start-up unit case fall shut if an attempt is made to remove the unit in the upright position.

Recommendation.

The bottom lid fasteners should be turned around so that they fall open when disengaged, or alternatively they should be of a sprung variety that would hold itself open.

- Item 16. One connector has a loose plastic dust cap, while all others have captive caps.

Recommendation.

A captive dust cap should be provided for J 4 of the start-up assembly.

"MAINTAINABILITY EVALUATION/OBSERVATION REPORT"

Report No. 4523-1 Date May 23, 1963 Page 1 of 2

Prepared by Philip Giles and Wilbur Lohss M/S 50-66 Phone 656-6263

Figure A No. 4523 Title Power Supply PP-3267/GSM

Part No. 25-29137-1 Serial No. 000 066

Demonstration Event Unscheduled Location Ellsworth CSA Date May 8, 1963

T.O. Procedures _____

MAINTAINABILITY CHECKLIST					
1	Fault Isolation and Repair	N/R	14	Lines and Cables	N/R
2	Standardization		15	Fasteners	
3	Interchangeability	N/R	16	Covers, Cases, and Shields	
4	Packaging and Mounting	3	17	Disposable Modules	
5	Accessibility	N/R	18	Test Equipment	
6	Work Space		19	Servicing and Handling Equipment	
7	Testing and Servicing		20	Tools	
8	Displays		21	Platforms, Stands, and Shelters	
9	Handles		22	Technical Order	
10	Labels and Marking		23	Figure 'A'	
11	Controls		24	Form B/C	
12	Work Aids		25	Specifications	
13	Connectors and Connections	N/R	26	Personnel Requirements	N/R

CHECKLIST RATINGS

- 1 Good Maintainability 3 Marginal Maintainability N/A Not Applicable
 2 Fair Maintainability 4 Poor Maintainability N/R Not Rated

Rating analyses are provided on attached pages, for checklist items rated 3 or 4.

COMMENTS: Noted while evaluating Fig. A 4152
