Report No. DCR-S1C-2944-00
Revision No. Original
Contract No. NAS9-12928
DRL Line Item No. 2
DRD No. MA-183T

FINAL REPORT

SKYLAB

COMMUNICATIONS CARRIER

16536G

AND

FILTER BYPASS ADAPTER ASSEMBLY

12535G

DATE: 4 March 1974

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ABSTRACT

Under Contract NAS9-12928 and its Supplemental Agreements, David Clark Co. Inc. (DCC) supplied to NASA, principally for the Skylab Missions, the following items:

(a) Communications Carrier Assemblies (CCA) DCC P/N 16536G-07

(b) Filter Bypass Adapter Assemblies (FBAA), DCC P/N 12535G-01

(c) Sub-assemblies, parts and repairs as needed

The Communications Carrier Assembly is essentially a skull cap containing soft molded earcups which supports and holds the microphone and earphone modules in the proper location. It is similar to that supplied under NASA Contract 9-7976 for the Apollo missions.

The Filter Bypass Adapter Assembly was developed to enable the filter resistor in the Communications Carrier Assembly to be bypassed during emergency use so that power requirements for satisfactory operation would be at a minimum.

This report outlines design and fabrication of these units complete with necessary data, and illustrations. It is submitted in compliance with Line Item No. 2 of the Data Requirement List of Contract NAS9-12928.

DEFINITIONS

CCA - Communications Carrier Assembly

DCC - David Clark Company Incorporated

FBAA - Filter Bypass Adapter Assembly

FIAR - Failure Investigation Action Report

GFE - Government Furnished Equipment

PGA - Pressure Garment Assembly

PPI - Pacific Plantronics, Incorporated

SA - Supplemental Agreements

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SUMMARY

The material ordered per NASA contract NAS9-12928 and its supplemental agreements include:

1. Forty-four complete Communications Carrier Assemblies (CCA), DCC P/N 16536G-07.
2. Five CCA Electrical Harness Assemblies, DCC P/N 16647G-04.
3. Six CCA Skull Cap Assemblies, DCC P/N 16535G-02.
4. Six CCA Absorption Strap Assemblies, DCC P/N 16531G-01CA000.
5. Twelve CCA Earseal Assemblies, DCC P/N 16585G-01FB000.
6. Nine Filter Bypass Adapter Assemblies (FBAA), DCC P/N 12535G-01.
7. CCA repairs as required.

The delivery requirements for the above items and the required documentation, in accordance with Section 4.0 of the Contract Statement of work, were met with a minimum of delays or serious problems.

PURPOSE

The purpose of the effort under NASA contract, NAS9-12928, was to design, fabricate, assemble, test, maintain, repair, refurbish and deliver Communications Carrier Assemblies and Filter Bypass Adapter Assemblies to be used primarily in the Skylab Flight Program.

INTRODUCTION

The CCA's used for the Skylab Flight Program were, except for the GFE microphones and earphones, basically the same units as those supplied for the Apollo Program Contract NAS9-7976, DCC P/N 16536G-04. The only change required was a slight modification to the soft molded earcups to accommodate the new GFE microphone and earphone units.

The CCA, as supplied, consists of an Electrical Harness Assembly and several soft goods assemblies. (Ref. Figure 1, Sheet 2 of 2). The Electrical Harness Assembly which consists of soft, molded earcups and a Personal Communications Assembly is comfortably held in its proper wear position by a specially designed skull cap.

The FBAA is a convenient, lightweight means of bypassing the attenuator circuit of the CCA allowing maximum signal strength when needed but at the expense of a higher level of background noise. It is designed so that it can be easily positioned between the connector on the Electrical Harness Assembly and the mating connector in the PGA and/or Skylab Module.

TECHNICAL DESCRIPTION

Communications Carrier Assembly

The Communications Carrier Assembly, DCC P/N 16536G-07 consists of an Electrical Harness Assembly and varied soft goods assemblies. (Ref. Figure 1, Page 2 of 2).

Soft Goods

The skull cap, designed to provide comfortable long-term wear, also provides a stable location for the Electrical Harness Assembly. It is fabricated from teflon and lycra fabrics and conforms to the shape of the head without need for adjustment lacings or straps. Five standard sizes, small, medium, large, X-large and XX-large are available eliminating the necessity of custom fitting each crew member. Use of a chin strap or neck strap is optional. (One of each is supplied with every unit).

Ear Seals, which consist of foam inserts covered with deerskin, attach to the skull cap by means of fastener tapes.

An Absorption Strap is attached at the front of the skull cap. This strap absorbs perspiration which can accumulate on the brow of the astronaut.

Electrical Harness Assembly

The Electrical Harness Assembly consists of the earphones, microphones, earcups, cable assembly,

printed circuit board, and the connector which interfaces with the designated communications systems. (Ref. Appendix A). The microphone and earphone modules, supplied as GFE, are manufactured by PPI and are a new and improved version of the units previously supplied for the Apollo Flight Program. Fitting these new units into the Electrical Harness Assembly, however, requires only minor modification of the soft molded earcups.

Configuration Designation

The -07 configuration used for the CCA (P/N 16536G-07) incorporates:

1. The use of the new microphone and earphone modules.

2. Modifications to the Electrical Harness Assembly necessary for using the new microphone and earphone modules.

Filter Bypass Adapter Assembly

The FBAA, DCC P/N 12535G-01, consists of a housing and connector mounted back-to-back with its mating housing and connector. This construction insures a proper interface with the Electrical Harness Assembly and the designated communications systems. (Ref Appendix A). The connector pins of this unit are wired so that a normal input signal will be directed to a redundant circuit built into the Electrical Harness Assembly which bypasses the attenuator circuit.

The FBAA, a lightweight unit fabricated from standard components, is designed so that it can easily be inserted between the Electrical Harness Assembly and its mating connector in the PGA and/or Skylab Module. (Ref. Figure 2).

CONTRACT REQUIREMENTS

The contract required delivery of forty-four complete Communications Carrier Assemblies, six Electrical Harness Assemblies less soft goods and nine Filter Bypass Adapter Assemblies complete with necessary documentation. The CCA's P/N 16536G-07 include the new GFE microphone and earphone modules.

Supplemental Agreements (SA) modified the contract as follows:

1. 2S Re-encapsulate Communications Carrier Assemblies P/N 16536G-04 S/N's 270, 275, 290, 294, 296 and 297, the units used as prime and back-up CCA's for the Apollo 17 mission.

2. 3S (a) Change the delivery schedule to better meet flight requirements and reassign the soft goods assemblies from CCA S/N 406 to CCA S/N 414.

   (b) Addition of overtime premium for accelerated CCA delivery. During the first part of January 1973 it became apparent that, due to delays in GFE delivery, overtime work was necessary to catch up to the required delivery schedule.

3. 4S Soft goods for six CCA's were ordered.

4. 5S The closing date for the contract was extended from 22 July 73 to 31 December 73. This extension was necessary to complete product delivery and keep a channel open for any repair or rework needed during the Skylab flights.

5. 6S During the time span of this contract it became standard practice to use SI (metric units) for all measurements. This SA, therefore, directed DCC to use metric units on the final report with conventional units shown in parenthesis.

Additional instructions from the NASA-JSC technical monitor (per SA No. 3S) informed DCC that GFE for CCA S/N 406 had been shipped directly to NASA-Houston and DCC would not be required to produce the Electrical Harness Assembly for CCA S/N 406.

TEST REQUIREMENTS

Extensive testing during manufacture and prior to delivery was implemented due to the critical use of the CCA and FBAA.

Test and inspection procedures were established at critical points in the manufacture of the CCA and FBAA to reveal any problems that might occur during manufacture.

Final Pre-delivery Acceptance tests were made using both voice and tone generator signals to assure DCC and the responsible government inspector that each unit, as shipped, met all performance and engineering criteria.

DISCUSSION OF PROBLEMS

Relatively few major problems were encountered in the performance of this contract. They are outlined in the following paragraphs.

Modification of delivery schedules was caused by delays in delivery of connectors and labels for the FBAA and circuit boards and GFE for the CCA.

Two CCA's, S/N 400 and S/N 443 failed because of problems with GFE. After being repaired, the CCA's were returned to NASA-JSC.

During the final Apollo flight some of the wiring between the connector and the right earcup failed due to twisting action. Since the CCA being supplied for Skylab is of the same type of construction, NASA-JSC requested that a twist test be performed to determine how much twisting the unit would withstand before failure occurred. The results of this test (Ref. Test Report, DCR-S1C-2912-00) indicate that the CCA, for all expected uses, had adequate resistance to failure due to twisting.

Two minor problems occurred concerning the wire used for the Electrical Harness Assembly. These problems were resolved with the full knowledge and approval of NASA.

1. Some discoloration was found on the inner insulation. The manufacturer advised that this discoloration would not affect the function or reliability of the wire but suggested we should avoid soldering in this area. This advice was followed.

2. The new shipment of wire delivered for this contract had a slightly larger outside diameter than previous shipments but was still within specified tolerances. To prevent interference, the opening of the connector housing was enlarged.

FAILURE INVESTIGATION ACTION REPORT (FIAR)

A failure of CCA S/N 443 occurred at Cape Kennedy during Pre-Installation Acceptance testing. The failure was traced to the cancellation of the output signal from the right microphone due to a signal phasing problem. First investigations indicated the most likely area of failure to be the printed circuit board connections in the Electrical Harness Assembly. However, as reported in FIAR No. S1C-1, the problem was finally located in the right microphone assembly of the GFE unit.

DOCUMENTATION

Documentation as required by paragraph 1.1.7 of the contract Statement of Work was completed. A documentation report, listing of all documents submitted, is attached as Appendix B.

FOLDOUT FRAME 1

FOLDOUT FRAME 2

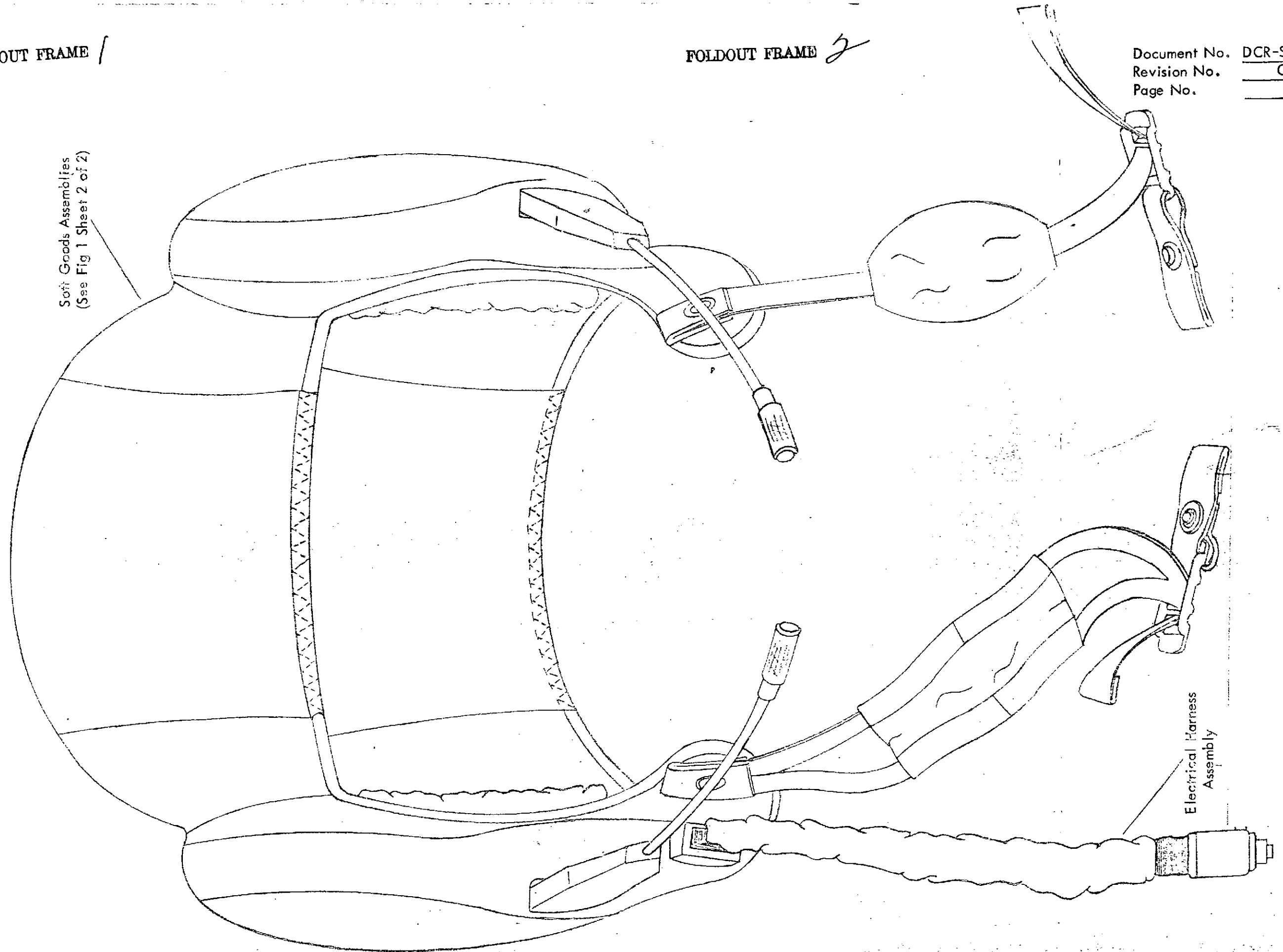

Figure 1 Communications Carrier Assembly (Sheet 1 of 2)

SOFT GOODS ASSEMBLIES

for

COMMUNICATIONS CARRIER ASSEMBLY

DCC P/N 16536G-07

Neck Strap Assembly	16566G-01FA000
Absorption Strap Assembly	16531G-01CA000
Chin Strap Assembly	16532G-02FA000
Skull Cap Assembly	16535G-02FA000
Earseal Assembly	16585G-01FB000

Figure 1 Communications Carrier Assembly (Sheet 2 of 2)

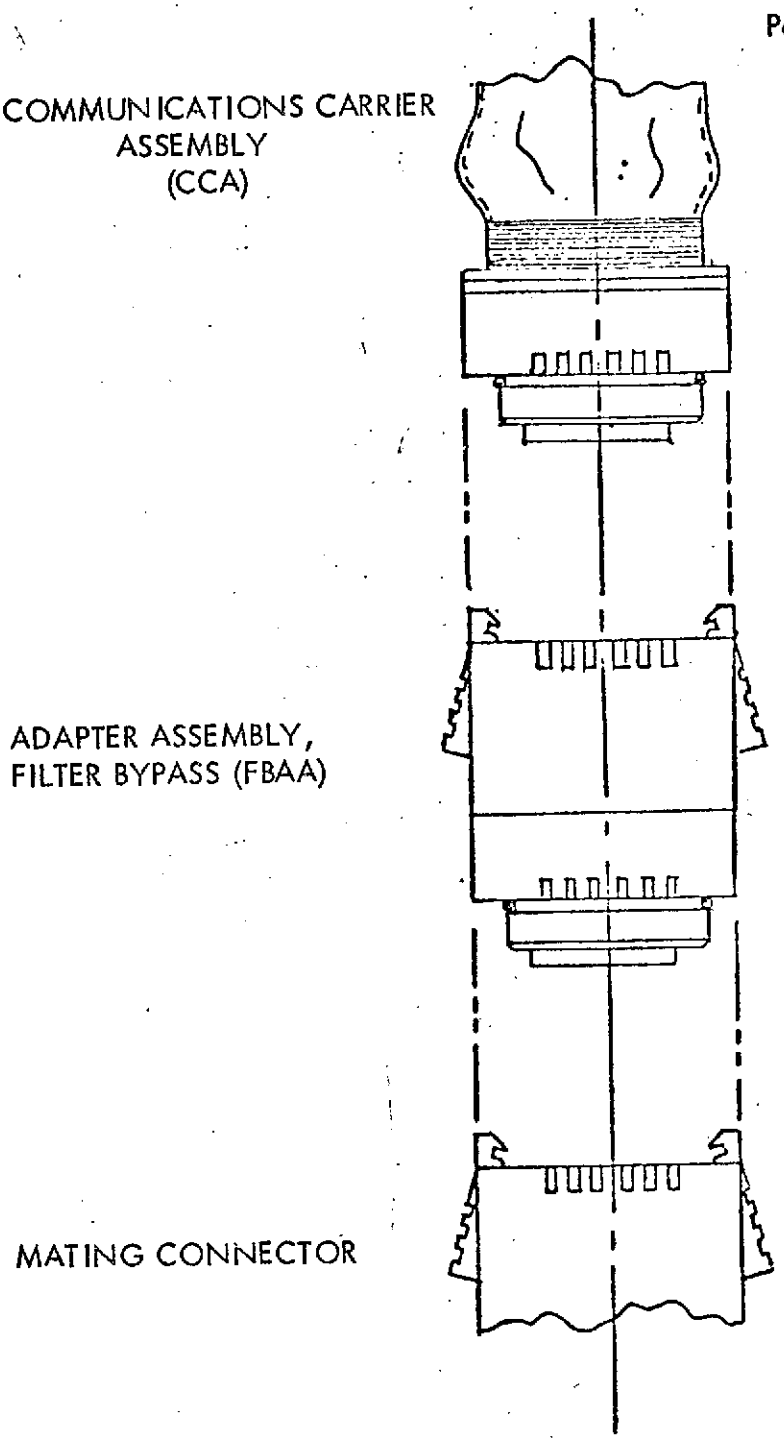

Figure 2 Filter Bypass Adapter Assembly Shown in Proper Location

APPENDIX A

INTERFACE REQUIREMENTS

Prelaunch, check out and spacecraft operations involve mechanical and electrical interface with the following:

(a) CWG Harness (Constant Wear Garment Harness) at point of Electrical Connector

(b) LCCU (Lightweight Crewman Communications Umbilical) - control head

(c) Suit Harness at point of Electrical Connector

APPENDIX B

DOCUMENTATION REPORT

Document Type	Document Number	Rev.	Status	Description	DRL Line No.
1	DCP-S1C-2914	03	Released 13 Nov.73	Master Program Plan	1
2	DCR-S1C-2909	18	Submitted 1 Feb. 74	Progress Report	5,8, 29,30
2	----------		Submitted 1 Sept. 72	FACI baseline Documentation Package For Filter Bypass Adapter Assembly, Dr. No. 12535G	9
2	----------		Submitted 27 Oct.72	FACI Summary Report For Filter Bypass Adapter Assembly Dr. No. 12535G	11
1	DCS-S1C-2910	00	Released 20 Nov. 72	Cleaning, Preserving, Packaging, Handling, Shipping, and Storing Procedures For Filter Bypass Adapter Assembly Dr. No. 12535G	13
1	DCS-S1C-2913	00	Released 13 Dec. 72	Contract End Item Detail Specification For Filter Bypass Adapter Assembly (Parts I and II)Dr. No. 12535G	18,19
2	----------		Submitted 27 Oct.72	Engineering and Technical Data (CTR Information) For Filter Bypass Adapter Assembly Dr. No. 12535G	23
2	DCM-S1C-2922	00	Released 16 Nov. 72	Failure Mode, Effects, and Criticality Class Analysis For Filter Bypass Adapter Assembly Dr. No. 12535G	26
1	DCP-S1C-2924	00	Released 16 Nov. 72	List, Material Review Board Members	31
1	DCR-S1C-2923	00	Released 16 Nov. 72	Single Point Failure Summary For Filter Bypass Adapter Assembly Dr.No. 12535G	35
2	DCR-S1C-2931	15	Submitted 1 Feb. 74	Skylab Documentation Status Report	--

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DOCUMENTATION REPORT

Document Type	Document Number	Rev.	Status	Description	DRL Line No.
1	DCC-2834	00	Released 16 Nov. 72	Configuration Management Plan	6
2	DCC-S1C-2930	01	Revised 29 Jan. 73	Matrix For MSCM 8080 Manned Spacecraft Criteria & Standards	23
1	DCT-S1C-2911	01	Released 30 Jan. 73	Pre-delivery & Pre-Installation Acceptance Test Plan & Procedure	28,40
2	DCS-S1C-2932	01	Submitted Mar. 74	Non-Metallic Materials List For Filter Bypass Adapter Assembly	32
1/2	----------	--	Revised 22 Feb. 73	Engineering, Source & Specification Drawings & Indentured Parts List For Filter Bypass Adapter Assembly	15,21
1	DCM-S1C-2919	00	Released 24 Jan. 73	Cleaning, Preserving, Packaging, Shipping, and Storing Procedures For Communications Carrier Assembly Dr. No. 16536G	13
1	DCP-S1C-2915	00	Released 10 Jan. 73	Reliability Program Plan	25
2	DCM-S1C-2921	00	Released 15 Jan.73	Failure Mode, Effects, and Criticality Class Analysis For Skylab Communications Carrier Assembly P/N 16536G-07	26
1/2	----------	--	Revised 9 Aug. 73 Revision Submitted 7 Sept. 73	Engineering, Source & Specification Drawings & Indentured Parts List For Communications Carrier Assembly	15,21
1	DCS-S1C-2934	00	Released 23 Mar. 73	Contract End Item Detail Specification For Communications Carrier Assembly (Parts I & II) Dr. No. 16536G	18,19

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DOCUMENTATION REPORT

Document Type	Document Number	Rev.	Status	Description	DRL. Line No.
1	DCP-S1C-2916	00	Released 14 Feb.73	Quality Control Program Plan Skylab Communications Carrier 16536G and Filter Bypass Adapter 12535G	27
2	DCM-S1C-2926	00	Released 16 Feb.73	EEE Parts Usage List For Communications Carrier Assembly 16536G & Filter Bypass Adapter Assembly 12535G	37
2	DCC-S1C-2935	00	Released 16 Feb.73	Non-Metallic Materials List For Communications Carrier Assembly 16536G	32
1	DCR-S1C-2936	00	Released 4 Apr.73	Single Point Failure Summary For Communications Carrier Assembly 16536G	35
2	DCR-S1C-2912	00	Submitted 15 May 73	Test Report Harness Cable - Twist Test	23
1	FIAR NO. S1C-1	--	Submitted 25 July 73	Failure Investigation Action Report	34
2	----------	--	Submitted 24 July 73	Summary of New Technology Review Activities	4
2	----------	--	Submitted 4 Jan. 74	Summary of New Technology Review Activities - Final Report	4
1	DCR-SIC-2944	00	Released 4 Mar 74	Final Report - Skylab - Communications Carrier 16536G and Filter Bypass Adapter Assembly 12535G	2
2	----------		Submitted 28 Dec. 72	Engineering and Technical Data (CTR Information) For Communications Carrier Assembly Dr. No. 16536G	23

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DOCUMENTATION REPORT

Document Type	Document Number	Rev.	Status	Description	DRL. Line No
2	DCS-A3C-007	02	Submitted Mar. 74	Quality Requirements for Hand-Soldering Electrical Connections	20
2	DCS-A3C-075	02	Submitted Mar. 74	Technical Specifications for Communications Carrier Assembly	20
2	DCD-A3C-070	01	Submitted Mar. 74	Government Furnished Equipment - Microphones-Receiving Inspection	20
2	DCP-S1C-2918	00	Submitted Mar. 74	In-Process Test and Inspection Procedures	20
2	DCP-S1C-2917	00	Submitted Mar. 74	Process Control Procedures	20
2	DCC-2928	00	Submitted Mar. 74	Preparation and Use of Potting Compound Using Sealant Adhesive DCC P/N 9127P-20CA and Curing Agent DCC P/N 9128P-06	20
2	DCP-S1C-2920	00	Submitted Mar. 74	Parts Program Plan	20
2	DCC-2925	00	Submitted Mar. 74	Chemical Treatment for Aluminum Surfaces (Alodine)	20
2	DCM-S1C-2937	00	Released Mar. 74	System Hazard Analysis and Operational Hazard Analysis	Para. 2.10