Update ltr 5/25/71 to Issued

SPECIFICATION NO. CP1400B1

DATE: 18 October 1968

REVISED:

DOCUMENT CONTROL
BIN: BIF-055-1316-128-2-68 PAGES 76
COPY NO. 4 OF 10 COPIES

CONTRACT END ITEM DETAIL SPECIFICATION (PRIME EQUIPMENT)

PERFORMANCE/DESIGN AND PRODUCT CONFIGURATION REQUIREMENTS

CEI NO. MOL 900AI

MISSION MODULE SIMULATION EQUIPMENT

For The

MANNED ORBITING LABORATORY (MOL) SYSTEM

OCT 30 1968

1256-286-3

END ITEM CONFIGURATION CHART

SPECIFICATION ISSUE AND DATE	ECP'S	PRODUCTION EFFECTIVITY (SERIAL NUMBER)
AI 28 Oct. 66	Incorporated ECP 23-7R	1 and subsequent
BI 18 Oct. 68		1 and subsequent

SPECIFICATION NO. CP1400BI

GENERAL ELECTRIC

MOL DEPARTMENT

As Of _____

Superseding _____

SPECIFICATION CHANGE LOG

SCN NO.	ECP NO.	SCN DATE	PAGES AFFECTED	EFFECTIVITY

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

SPECIFICATION NO. CP1400B1

PAGE I-1/2

CONTRACT END ITEM DETAIL SPECIFICATION (PRIME EQUIPMENT)

PART 1. PERFORMANCE/DESIGN AND PRODUCT CONFIGURATION REQUIREMENTS

CEI NO. MOL 904A1

MISSION MODULE SIMULATION EQUIPMENT

SYSTEM CEI REQUIREMENTS

[redacted] Approved By: _____

Manager, Program Management Section

MOL Program

General Electric Company

DATE: _____

[redacted] Approved By: _____

MOL System Program Office

DATE: _____

SECTION 1

SCOPE

SECTION I

SCOPE

This part of this specification establishes the design requirements of one mission-design-series of equipment identified as the Mission Module Simulation Equipment, hereinafter referred to as MMSE.

The MMSE shall form a part of the Mission Simulator (MS) and will operate in the Operational Test and Evaluation Facility (OTEF) at Vandenberg Air Force Base (VAFB).

MMSE performance and test requirements are documented in MMSE System CEI Specification CP1460AI. The MMSE computer programs design, test and qualification requirements are documented in Specification CG807A.

This CEI specification defines MMSE hardware. Certain equipments, indicated in this specification with a box labeled MOL900A, are also specified in CP1400B (S/SAR). Changes in CP1400B automatically require changing the requirements indicated by the appropriate box in this specification.

NOTE

The boxes will be added to this specification after the white version has been approved.

SECTION 2

APPLICABLE DOCUMENTS

SECTION 2

APPLICABLE DOCUMENTS

2.1 SAFSL EXHIBITS

The following SAFSL Exhibits , of the exact issue shown in the latest contractual version of SAFSL Exhibit 24025, Applicable Documents List, form a part of this specification in their entirety.

2.2 PROGRAM DOCUMENTS

The following documents, of the exact issue shown in the latest contractual version of SAFSL Exhibit 24025, Applicable Documents List, form a part of this specification to the extent specified herein.

CEI Specifications

CP 1400B	Mission Module Simulation Equipment (S/SAR)
CP1460AI	MMSE System CEI Requirements
CG807A	MMSE Computer Programs Design, Test and Qualification Requirements CEI Specification.

Interface Documents

IF101.11	Interface Specification, Mission Module System Segment to Photographic System, Simulation Section.
IFS-MOL-117004	Interface Specification, Laboratory Module Simulation Equipment CEI 207225B to Mission Module Simulation Equipment CEI MOL900A
ICD-MOL-117004	Interface Control Drawing, LMSE CEI 207225B to MMSE CEI MOL900A-Mechanical, LM to MP Panels.

ICD-MOL-117005	Interface Control Drawing, LMSE CEI 207225B to MMSE CEI MOL900A-Mechanical, Instructor Operator Station.
ICD-MOL-117006	Interface Control Drawing, LMSE CEI 207225B to MMSE CEI MOL900A-Mechanical, Voice Communications
ICD-MOL-117007	Interface Control Drawing, LMSE CEI 207225B to MMSE CEI MOL900A-Voice Communications
ICD-MOL-117007	Interface Control Drawing, LMSE CEI 207225B to MMSE CEI MOL900A-Electrical
(TBD)	ADC Interface Specification
IBM S/360-19 Form A22-6843-3	IBM System/360 I/O Interface, Channel to Control Unit, Original Equipment Manufacturers Information

Other Documents

General Electric Documents

(TBD)	Product Assurance Plan for MMSE Program
(TBD)	MMSE Quality Program Requirements

Specifications

MIL-C-45662A	Calibration of System Requirements
MIL-H-27894A	Human Engineering Requirements for Aerospace Systems and Equipment
MIL-I-45208A	Inspection System Requirement
MIL-Q-9858A	Quality Program Requirements
MIL-T-27474	Training Equipment - Ground, General Requirements for

Standards

MIL-STD-130B	Identification Marking of U. S. Military Property
MIL-STD-143A	Specifications and Standards-Order of Procedence for the Selection of
MIL-STD-454A	Standard General Requirements for Electronic Equipment
MS33586A	Metals-Definition of Dissimilar

Bulletins

USAF Bulletin No. 515 AM 2	Control of Non-Conforming Supplies

Other Publications

Dept. of Defense	Index of Specifications and Standards

SECTION 3

REQUIREMENTS

SECTION 3

REQUIREMENTS

3.1 PERFORMANCE

Performance requirements for the MMSE are specified in MMSE System Specification CP1460AI. The hardware specified herein, when integrated with the software specified in CG807A will provide the capabilities required by the System Specification.

3.2 CEI DEFINITION

3.2.1 INTERFACE REQUIREMENTS

The interfaces described in this section are those required to combine the MMSE with the LMSE in the Mission Simulator. They consist of a software interface between the MMSEC and the LMSEC, an electrical interface between the MMSE and the LMSE, mechanical interface between the MPS and LVSS consoles in the Simulated Laboratory Module (SLM) and mechanical interfaces between the MMSE and LMSE consoles in the Instructor Operator Station (IOS).

3.2.1.1 Interface Block Diagram

The interfaces listed in paragraph 3.3.1 are shown in Figure 3-1.

The data transfer between the MMSEC and the LMSEC is through the Channel-to-Channel Adapter Unit (CCAU). The data is transferred over a high speed multiplex channel in the IBM format specified in IBM System/360 I/O Interface Specification of bit parallel - byte serial.

Printer and Keyboard data are transferred between the MMSEC and LMSE over a standard multiplex channel.

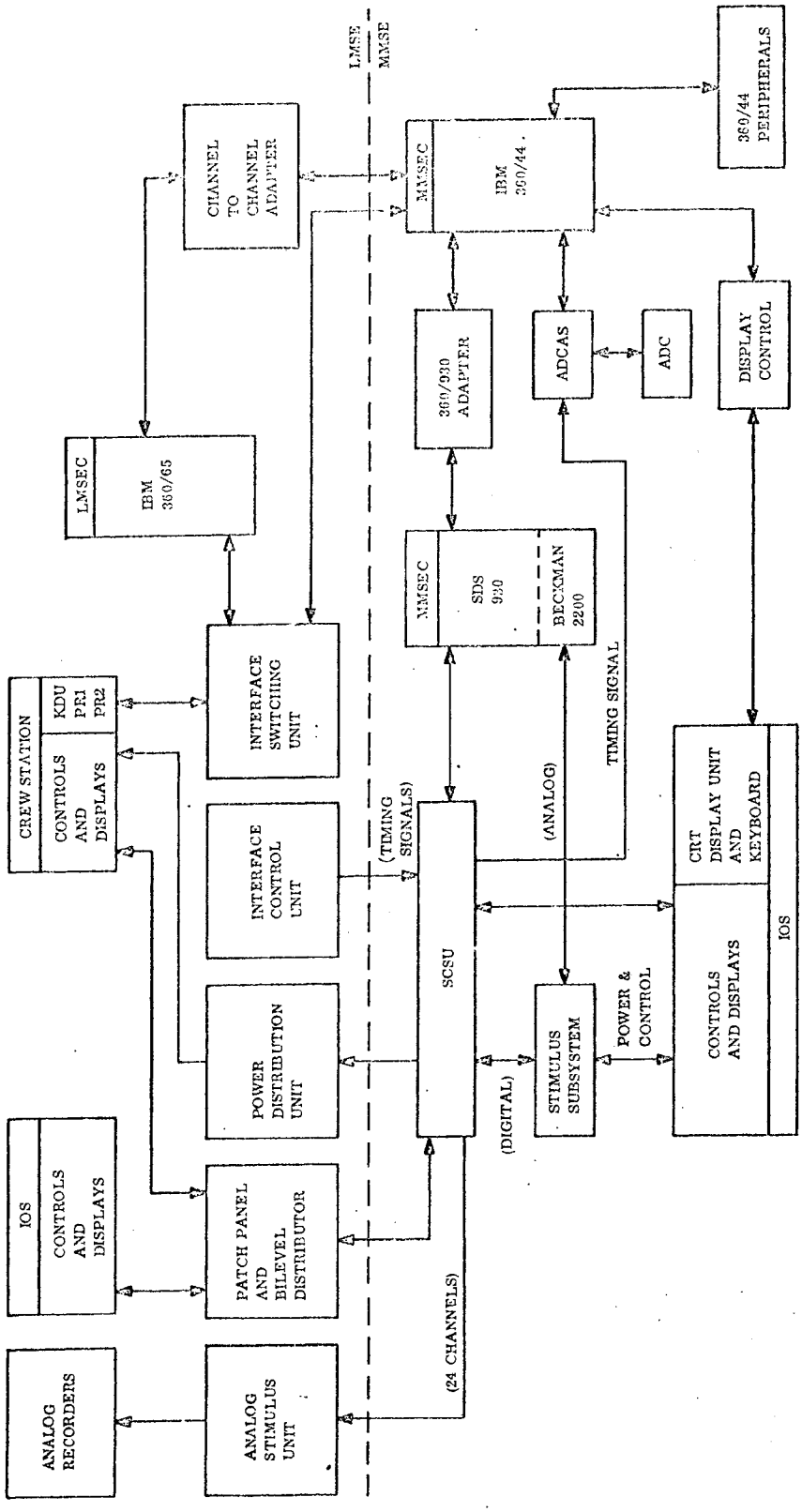

Figure 3-1. MMSE Interfaces

Timing signals are received from the LMSE through the Signal Conditioning and Switching Unit (SCSU). These timing signals shall be at a rate of 1000, 100, 10, and 1 pulses per second.

Power required for the LMSE IOS crew station monitored controls and displays which are driven by the MMSE in the segment mode shall be provided by the SCSU. This power shall be in the form of +28 vdc and +5 vdc and shall be supplied to the LMSE Power Distribution Unit (PDU).

Analog signals required for recording shall be routed to the Analog Stimulus Unit (ASU).

Additional signals from the SCSU, as specified in ICD-MOL-117007, shall be sent to the LMSE Patch Panel. The necessary conditioning of these signals shall be provided by the SCSU.

Detailed information on these interfaces is provided in ICD-MOL-117007.

The interface specifications shall ensure that the appearance of all panels and consoles of the IOS and SLM will be compatible. The detailed definition of these interfaces is described in ICD-MOL-117004, ICD-MOL-117005 and ICD-MOL-117006.

The general requirements for MMSE/LMSE interfaces are described in IFS-MOL-117004.

3.3 HARDWARE DESIGN AND CONSTRUCTION

The MMSE shall be designed and constructed in accordance with this paragraph (3.3) in order to meet the requirements delineated in paragraphs 3.1 and 3.2. This hardware development shall be coordinated with development of simulation software specified in CG807A in order to meet the performance requirements of the MMSE System CEI Specification.

The AVE configuration baseline for this Section shall be 1 March 1969.

3.3.1 GENERAL DESIGN FEATURES

The MMSE shall have five subsystems in accordance with the requirements of the CEI System Specification CP1460AI. They are:

1. Simulated Crew Station Subsystem.
2. Instructor/Operator Station.
3. Computer Subsystem.
4. Interface Subsystem.
5. Stimulus Subsystem.

The subsystems, with the exception of the Computer Subsystem and the ADCAS and 360/930 Adapters of the Interface Subsystem and the Slide Viewer System of the Stimulus Subsystem, shall be designed and fabricated in accordance with MIL-T-27474 as amended in paragraph 10.1 herein.

The Computer Subsystem consists of an Exchange Hardware Airborne Digital Computer and the commercial computer systems specified in paragraph 3.3.1.3.

3.3.1.1 Simulated Crew Station Subsystem

3.3.1.1.1 Functional Characteristics

The Simulated Crew Station Subsystem consists of the SLM consoles and equipment associated with the MPS.

3.3.1.1.2 LMSE SLM Interface Requirement

All interface requirements between the Simulated Crew Station Subsystem and the LMSE SLM are contained in IFS-MOL-117004.

3.3.1.1.3 Panel Requirements

SLM panels 2B, 2C, 2D, 8B, 8C, 8D, 8E and subpanel for the right side of 1C shall be provided. Switches, controls, and indicators on these panels shall be active in both integrated and the MMSE segment modes of operation with the exception of the LMSE event timers. All references to panel appearance apply to the external surface of the panel only.

3.3.1.1.3.1 Panel Lighting

Electroluminescence (EL) shall be used for panel lighting on those panels used in the OV. The EL method used in the MDS shall be used.

3.3.1.1.3.2 Panel Marking

Markings on all MPS panels located in the SLM shall conform to AVE markings in location, color and appearance.

3.3.1.1.3.3 Switches, Indicators, and Controls

Switches, status lights, thumb wheel potentiometers, meters, controls and special displays will closely simulate the AVE appearance and "feel". Components shall be numbered and marked as specified in ICD-MOL-117004.

3.3.1.1.3.4 Hinges

Panels shall be hinged as specified in ICD-MOL-117004.

3.3.1.1.3.5 Materials and Finishes

The materials and finishes on all panels is specified in ICD-MOL-117004.

3.3.1.1.3.6 Projection Restrictions

The projection to the rear and sides of panel mounted components shall be restricted as specified in ICD-MOL-117004.

3.3.1.1.4 Photographic Equipment

Photographic Equipment is defined as film processing and camera simulation equipment exchange hardware to be provided by EK as described in IF No. 101.11. This consists of full scale functional simulations of:

a. Camera Assemblies.

b. DRC's and Film Cassettes.

c. Primary Film Handling Assembly.

d. Film Processor.

e. Controls and Displays for the Photographic subpanel of panel 1C.

3.3.1.2 Instructor/Operator Station

3.3.1.2.1 General

The MMSE portion of the Mission Simulator (MS) IOS shall have the capability to operate the MMSE during simulation and monitor the status of the simulated MPS controls and displays in the SLM.

3.3.1.2.2 Consoles

The MMSE IOS shall consist of an assembly of consoles designed for seated operation. The MMSE IOS consoles shall be compatible with the LMSE IOS consoles to allow for integration to form the Mission Simulator IOS as specified in IFS-MOL-117004.

3.3.1.2.3 Controls and Displays

The controls and displays for similar functions on the MMSE and LMSE IOS panels shall be the same type and mutually selected by the MMSE and LMSE contractors as specified in IFS-MOL-117004. Displays on the IOS used to monitor controls and displays in the SLM shall be grouped (where practical) to correspond to the SLM panel layout.

3.3.1.2.3.1 Control Requirements

Controls shall be required for the following functions:

a. Computer Operations - These controls shall allow for start, freeze, resume, checkpoint, recycle, stop, inhibit, single step, single cycle and mode selection.

b. Power Controls - These controls shall provide the capability to apply power to the MMSE subsystems with the exception of the Computer Subsystem.

c. Simulator Checkout - These controls shall provide the capability to run a limited simulator checkout.

d. Computer Input - These controls shall provide the capability for manual inputs into the IBM 360/44 computer and shall be a peripheral device of the computer as specified in paragraph 3.3.1.3.1.1.2.

e. Communications - The design of the MMSE IOS shall provide the capability to integrate communication equipment (provided by the LMSE) at the OTEF and as specified in IFS-MOL-117004.

f. Data Recording - Capability of driving X-T recorders provided by the LMSE in segment or integrated mode will be provided.

g. SVS Restacking Control - Occurs automatically, manually initiated.

3.3.1.2.3.2 Display Requirements

a. Simulator Status - These displays shall indicate equipment status of the Simulator Subsystems.

b. Event Annunciator - These displays shall indicate events during the simulation exercise which require some action.

c. MPS Controls and Display Status - These displays shall monitor the simulated MPS controls and displays on the crew station panels. The displays shall be designed as specified in paragraph 3.1.1.1.3 of IFS-MOL-117004.

d. Stimulus Subsystem Image - The image presented through the Stimulus Subsystem MO and each ATS eyepiece shall be monitored by TV displays mounted in the IOS.

e. Display Output - This display shall be a peripheral device of the IBM 360/44 computer as specified in paragraph 3.3.1.3.1.1.2. The display shall be mounted in one of the IOS Consoles.

3.3.1.3 Computer Subsystem

The Computer Subsystem shall consist of the Mission Module Simulator Equipment Computers and an exchange hardware Airborne Digital Computer (ADC).

3.3.1.3.1 Hardware Requirements

3.3.1.3.1.1 MMSEC

The MMSEC hardware shall provide processing capability sufficient to provide for the system requirements defined in Specification CP1460AI, and the simulation software requirements specified in CG807A. This hardware shall provide inputs to, and accept outputs from, the Stimulus Subsystem, the MMSE portion of the SLM, the MMSE IOS, and the ADC. In addition, the MMSEC shall be interfaced with the Laboratory Module Simulation Equipment Computer (LMSEC), an IBM 360/65, through a Channel-to-Channel Adapter Unit (CCAU) of the LMSEC during Mission Simulator (MS) integrated mode operations. It shall further interface with the Interface Switching Unit (ISU) of the LMSE during both MS integrated and MMSE segment mode operations for driving the DCSG Printers and Keyboard and Display Unit (KDU) in the SLM. It shall be capable of normal computer input/output (I/O) operations, MMSE initialization, and simulation data recording. The MMSEC shall provide for all digital and analog computation requirements of the MMSE (other than those performed by the ADC) as specified in CG807A.

3.3.1.3.1.1.1 IBM System/360 Model 44 Computer

Primary simulation control by the MMSEC shall be performed by a standard commercial IBM System/360 Model 44G computer configured as follows:

P/N	Name	Quantity
2044G	Processing Unit, Model G	1
4427	Floating Point Arithmetic	1
4583	High Speed General Registers	1
4455	High Resolution Timer	1

P/N	Name	Quantity
6415	Second Internal Disk	1
2315	Disk Cartridge	3
7531	Store and Fetch Protection	1
7532	Store and Fetch Protection	1
7533	Store and Fetch Protection	1
5248	Multiplexor Channel	1
4598	High Speed Multiplexor Channel	1
4560	High Speed Multiplexor Subchannel (additional)	1
4599	High Speed Multiplexor Channel	1
4565	High Speed Multiplexor Subchannel (additional)	1
2803-1	Magnetic Tape Controller	1
2401-3	Magnetic Tape Unit (1-7 track, 3-9 track)	4
7125	Seven Track Compatibility	1
2821	Control Unit	1
2540	Card Read Punch	1
1403-2	Printer	1
1052-7	Printer Keyboard	1
2841	Storage Control	1
2311	Disk Storage Drive	1
1316	Disk Pack	3
1990	Column Binary Feature	1
3228	Data Conversion Feature	1

3.3.1.3.1.1.2 CRT Display Unit

The CRT Display Unit and Keyboard of the MMSE IOS shall be peripheral devices of the IBM 360/44. They shall be capable of data displays on the CRT by the 360/44 with simultaneous display of keyboard inputs. The system shall consist of the following Sanders Associates, Inc., commercial, 360 compatible components:

Model No. Feature Code	Description	Quantity
722A-3	Keyboard	1
708B-1H	Display Unit	1
MQR 091	Split Screen Features	1
701B-1	Control Unit	1
FC1703	Edit Module	1
FC1705	Memory Module	1
FC1712	I/O Module	1
713D-1	Equipment Rack	1
731 Mod O	Display Communications Buffer	1
FC1731	Transmission Control	1

3.3.1.3.1.1.3 SDS 930/Beckman 2200 Hybrid Computer

The MMSEC shall include an SDS 930/Beckman 2200 commercial Hybrid Computer System. The system shall consist of the following components:

SDS 930 Digital Computer Components and Features

Model No.	Name/Characteristics	Quantity
930	General Purpose Digital Computer	1
92160	16,384 words Core Memory (24-bit words)	1
93220	Additional Time-Multiplexed Comm. Channel	1
91210	Memory Interlace Control Unit (one for each TMCC)	2
93280	Interrupt Control System	1
93290	Priority Interrupt (two levels)	7
9152	Card Reader and Coupler (400 cpm)	1
9379	Buffered Line Printer (600 lpm)	1
9548	Magnetic Tape Control Unit	1
9546	Magnetic Tape Transport	3
9234	Keyboard/Printer and Coupler	1
9230	Photoelectric Paper/Tape Reader	1
9134	Paper Tape [illegible]	1

Beckman 2200 Analog Configuration

Name	Quantity
Integrator Summer Amplifiers	72
Summing Amplifiers	48
Iterative Controller	1
Quarter Square Multipliers	40
Positional Resolvers	5
Dual Feedback Limiters	32
Servo Set Pots	200
3-Terminal Pots	24
Electronic-Capacitors	24
Form "C" Function Relays	32
Eleven Segment Diode Function Generators	20
Patchable Logic Counter	1
Preset Decade Counters	4
Trunk Lines	200
Control Interface	1
Noise Generator (Model 52.5)	

Hybrid Interface

1	Parallel Input/Output Units with: 40 sample and hold A/D units; 40 Registers (double buffered) with D/A units

3.3.1.3.1.2 Airborne Digital Computer (ADC)

The MMSEC shall include a DCSG Airborne Digital Computer (ADC). It shall be either a Production Prototype or Production model. It shall be connected to the MMSEC 360M44 by means of the Airborne Digital Computer Adapter Simulator (ADCAS) of the Interface Subsystem.

3.3.1.3.1.3 ADC Cooling

The MMSE shall include the necessary equipment to provide liquid cooling for the ADC. Coolant and cooling specifications are contained in the ADC Interface Specification.

3.3.1.3.1.4 Keypunch

The MMSEC shall include an IBM Model 029 Keypunch.

3.3.1.4 Interface Subsystem

3.3.1.4.1 Functional Characteristics

The Interface Subsystem supplies the necessary signal conditioning, signal conversion and signal routing between the other subsystems of the MMSE, between the various computers of the Computer Subsystem, and with certain LMSE units. The components of this subsystem are the Signal Conditioning and Switching Unit (SCSU), the Airborne Digital Computer Adapter Simulator (ADCAS) and the IBM 360/SDS 930 Computer Adapter.

3.3.1.4.2 Signal Conditioning and Switching Unit (SCSU)

3.3.1.4.2.1 Description

The SCSU shall be designed using the MDS Digital Interface Unit (DIU) design, where practical, and additional elements required for the LMSE interface.

The Interface Subsystem shall be of modular construction. Patchboard arrangements shall be included to provide flexibility in input/output signal routing. Self-test features shall be provided for ease of maintenance.

The SCSU shall consist of the following major elements of sufficient quantity to provide signal conditioning and distribution for the MMSE:

a. Signal Conditioners.

b. Patchboards.

c. Selection Gates.

d. Buffer Registers.

e. Control Logic.

f. Fault Detection Logic.

g. Power Supplies.

3.3.1.4.2.2 LMSE Interface

The SCSU shall interface with the LMSE devices as described in IFS-MOL-117004.

3.3.1.4.2.3 MMSE Interface

The SCSU interfaces the subsystems of the MMSE as follows:

a. Provide the MMSEC interface with the SLM and IOS for all digital and discrete signals other than the Display Unit CRT and Keyboard.

b. Provide timing pulses to the ADCAS adapter and SDS computer of the MMSEC.

c. Provide a system junction box for analog and digital patching flexibility. This box shall be designed to patch output registers to signal loads, and signal sources to input registers.

3.3.1.4.2.4 Spares and Growth

Spares and Growth design goal of the SCSU shall be 20 percent at completion of LMSE interfacing. The spare capability will be completed except for insertion of logic cards.

3.3.1.4.3 Airborne Digital Computer Adapter Simulator (ADCAS)

The Airborne Digital Computer Adapter Simulator (ADCAS) shall provide the interfaces required to operate an Airborne Digital Computer (ADC) as part of the Mission Module

Simulation Equipment (MMSE). The ADC shall be functionally identical to the AVE. The requirements for ADCAS are to:

1. Provide an interface to channel LDAU and MDAU data including interrupts between the IBM 360/44 and the ADC.
2. Provide the interface with the ADC for Printer and Keyboard Display Unit data.
3. Provide the interface with the ADC for the Master Control Console controls and displays signals.
4. Provide the timing interface required for operation of the AVE software in the ADC.
5. Provide the capability to simulate malfunction of devices which are associated with the ADC in the vehicle.
6. Provide ADCAS status indicators to the MMSEC.

3.3.1.4.4 IBM 360/SDS 930 Computer Adapter

The 360/930 adapter shall be a special purpose channel-to-channel adapter for transferring data between the two commercial digital computer systems of the MMSEC. The adapter shall enable data transfers in both directions and can be ordered by either computer. Data shall be transferred in blocks each iteration. The adapter will incorporate self-check features to enable limited maintenance without the assistance of both computer systems.

3.3.1.4.5 Interconnecting Cables

Interconnecting power and signal cables to interface the subsystems specified in paragraph 3.3 of this document shall be provided by the MMSE.

3.3.1.5 Stimulus Subsystem

The Stimulus Subsystem shall consist of the equipment necessary to provide simulated images for the Acquisition, Main Optics and Cue Subsystems.

3.3.1.5.1 Acquisition

3.3.1.5.1.1 General Description

Paragraphs 3.3.1.5.1.2 through 3.3.1.5.1.4.5 below delineate the performance requirements for the Slide Viewing Subsystem (SVS). The equipment will consist of the Source Holding and Selection System, an Optical Processing and Relaying System, and the Electrical Driving System.

3.3.1.5.1.2 Source Holding and Selecting System

The source material is 9 inc. x 9 in. diapositive film plates. Two holder and changer systems are required on the bay No. 2 ATS and one on the bay No. 8 ATS. The bay No. 8 ATS shall have the capability to incorporate the second holder/changer. Each holder must hold 70 9 in. x 9 in. diapositives. Each changer system must be able to change to the next slide within one second. Furthermore, the changers must be so designed as to be commanded to any diapositive forward or reverse of the present position and to operate the two elevators independently. The time response for indexing five positions will be within two seconds. The changer design shall provide the capability to recall the previously viewed slide within one second if it (the slide) has not been rejected. An automatic restacking capability shall be provided.

3.3.1.5.1.3 Optical Processing and Relaying System

The Optical Processing and Relaying System in the SVS shall perform various optical functions on an input image and transmit this processed image to an eyepiece. The purpose of this system is to optically process an input image by dynamic change of image intensity, dynamic change of image size, dynamic change of image perspective, dynamic change in image orientation, and dynamic optics center selection.

3.3.1.5.1.3.1 Image Intensity

The image intensity shall have a variable light level range of 50:1 with the upper level at 500 foot/lamberts open gate at the eyepiece. The color balance of the light shall be between 3000 and 6000°K, remair

 changed.

3.3.1.5.1.3.2 Image Size

The angular magnification of the objective shall be by a continuous zoom technique. The range of change is 7.2:1. This magnification change shall be presented in an exit pupil so that the field presented will subtend an apparent 60 degree (± 1 degree) field-of-view. Further, when the image is at the lowest magnification, the exit pupil shall be 4 mm and, as the magnification increases, the exit pupil will decrease to 2 mm.

3.3.1.5.1.3.3 Image Perspective

Anamorphic optics will provide image perspective by distorting an input to simulate various slant angles of view. The amount of image perspective provided will be determined by the initial stimulus geometry and scale. For all stimulus provided, it shall be possible to simulate stereo angles from + 45 degrees to -40 degrees, and to change stimulus roll angle by at least ±10 degrees. These conditions shall be met if the target original stereo angle is 15 degrees or less.

3.3.1.5.1.3.4 Optical Center Selection

The center of the optical axis with respect to the diapositive shall be continuously variable to at least ± 4 inches in two orthogonal directions.

3.3.1.5.1.4 Electrical Drive System

This discusses the response characteristics required for the various optical components to meet the dynamic time and accuracy specification.

3.3.1.5.1.4.1 Brightness Control

A filter modulator drive will cause a brightness change of 16 percent within one second. The drive must be real-time to simulate brightness change caused by Sun angle, slant angle and ranging.

A fast response capability will also be available to set the filter modulator to any command position within the brightness range within one second.

Control accuracy shall be within ± 10 percent of a commanded foot lambert setting.

3.3.1.5.1.4.2 Magnification Control

The spherical zoom control will cause magnification change to be continuous over the operating range and will simulate the 2:1 magnification change within 0.5 second. The switching time from one ATS source to another will be one second or less.

3.3.1.5.1.4.3 Anamorphic Control

The dynamic perspective change shall be provided by an anamorphic lens assembly. The anamorphic azimuth shall be continuously varied on command from 0 to 360 degrees within one second and to an accuracy of ± 15 arc minutes.

3.3.1.5.1.4.4 Image Rotation

The image rotation shall be continuously varied on command from 0 to 360 degrees within one second and to an accuracy of ± 30 arc minutes.

3.3.1.5.1.4.5 Position Selection

TBD 3

NOTE

The requirements noted by " ∇ " replace the requirements of the draft copy of this specification, dated 5 April 1968. GE does not concur that the requirements noted " ∇ " can be met with current design until completion of a study due 31 Dec 1968. (See AF TWX No. [redacted] 0990, 14 May 1968 for details of AF/GE understanding.)

The drive to place the diapositives on an optics scanner to a selected portion of the objective shall have the following performance characteristics:

a. The center of the optics chain shall have a position accuracy of ± 0.00590 inches with a repeatability of position to ± 0.00040 inches.

b. The minimum position change is 0.00040 inches.

c. The optical center shall be capable of position change at a rate from 0 to 4.61 inches per second. Simultaneously, positioning commands will contain accelerations from 0 to 38 inches per second square.

d. Overall system position precision shall meet the requirements of the MMSE System CEI Specification No. CP1460A.

3.3.1.5.2 Main Optics

3.3.1.5.2.1 General Description

Paragraphs 3.3.1.5.2.2 through 3.3.1.5.2.4.4 below delineate the performance requirements for a version of the SVS (described in paragraph 3.3.1.5.1) to be used for Main Optics simulation.

3.3.1.5.2.2 Source Holding and Selecting System

The source material is 9 in. x 9 in. diapositive film plates. One holder and changer system is required and must hold 70 9 in. x 9 in. diapositives. The changer system must be able to change to the next slide within one second. Furthermore, the changer must be so designed as to be commanded to any diapositive forward or reverse of the present position and to operate the two elevators independently. The time response for indexing five positions will be within two seconds. The system shall have the capability of operating in either a forward or reverse mode with equal speeds.

3.3.1.5.2.3 Optical Processing and Relaying System

The optical processing and relaying system in the SVS shall perform various optical functions on an input image and transmit the processed image to an eyepiece. The purpose of this system is to optically process an image by change of image intensity, change of image size, change in image orientation, and optics center selection.

3.3.1.5.2.3.1 Image Intensity

The image intensity shall have a variable light level range of 50:1 with the upper level at 10 foot lamberts when the system is evaluated with a dispositive of 50 percent transmission in the chain. The color balance of the light shall be between 3000 and 6000 ^{o}K, remaining constant ± 25 mireds with changing intensity.

3.3.1.5.2.3.2 Image Size

The angular magnification of the objective shall be a continuous zoom technique. The range of change available is 7.2:1. Two ranges of stimulus material can be used to cover the full magnification range. The required scale ranges are shown below:

Mag Range	Stimulus Scale Range
125X, [redacted]	10240:1 to 18500:1
[redacted]	5120:1 to 9250:1

This magnification change shall be presented in an exit pupil so that the field presented will subtend an apparent 40 degrees (± 1 degree) field-of-view. Further, when the image magnifies, the exit pupil dimension will decrease as described below:

Magnification	Exit Pupil
125X	6.4 mm
[redacted]	6.4 mm
	3.5 mm
	1.75 mm

3.3.1.5.2.3.3 Image Perspective

Image perspective shall be static.

3.3.1.5.2.3.4 Optical Center Selection

The center of the optical axis, as to its orientation to the diapositives, shall be continuously variable in two orthogonal directions to ± 4.06 inches from the center of the diapositive objective.

3.3.1.5.2.4 Electrical Drive System

Paragraphs 3.3.1.5.2.4.1 through 3.3.1.5.2.4.4 below discuss the response characteristics required for the various optical components to meet the dynamic time and accuracy specification.

3.3.1.5.2.4.1 Brightness Control

A filter modulator drive will cause a brightness change of 16 percent within one second. The drive must be real-time to simulate brightness change caused by Sun angle, slant angle and ranging.

A fast response capability will also be available to set the filter modulator to any command position within the brightness range within one second.

Control accuracy shall be within ± 10 percent of a commanded foot lambert setting.

3.3.1.5.2.4.2 Magnification Control

The spherical zoom control will simulate AVE magnification step change over the operating range.

3.3.1.5.2.4.3 Image Rotation

The image rotation shall be continuously varied on command from 0 to 360 optical degrees within one second and to an accuracy of ± 30 arc minutes.

3.3.1.5.2.4.4 Position Selection

V TBD 3

NOTE

The requirements noted by " V " replace the requirements of the draft copy of this specification, dated 5 April 1968. GE does not concur that the requirements noted " V " can be met with current design until completion of a study due 31 Dec 1968. (See AF TWX No. [redacted]0990, 14 May 1968 for details of AF/GE understanding.)

The drive to place the diapositives on an optics scanner to a selected portion of the objective shall have the following performance characteristics:

The center of the optics chain shall have a position accuracy of ± 0.00590 inches with a repeatability of position to ±0.00040 inches. The minimum position change is 0.00040 inches. The optical center shall be capable of position change at a rate from 0 to 4.61 inches per second. Simultaneously, positioning commands will contain accelerations from 0 to 38 inches per second square.

3.3.1.5.3 Cue

Cue presentations shall be provided for each of the two simulated reconnaissance consoles. The cue presentations will appear on a rear projection screen. The presentation system will be a functional prototype of the VDP. The ability to change from this system to a 35 mm system, as provided in the MDS, will be provided.

3.3.2 SELECTION OF SPECIFICATIONS AND STANDARDS

All standards or specifications, other than those established and approved for use by the Air Force, must be approved by the procuring agency prior to incorporation into this specification (ref. MIL-STD-143A).

3.3.3 MATERIALS, PARTS, AND PROCESSES

No materials, parts or processes shall be used which will adversely affect the appearance, strength, endurance, or wear resistance of the system.

3.3.4 STANDARD AND COMMERCIAL PARTS

MS and AN standard parts shall be used wherever possible. When standard parts are not available, maximum use shall be made of commercially available parts.

3.3.5 MOISTURE AND FUNGUS RESISTANCE

Materials subject to damage by moisture, or that are nutrients for fungi, shall not be used except as otherwise permitted by MIL-T-27474 as amended in Section 10 herein.

3.3.6 CORROSION OF METAL PARTS

Corrosion-resistant metals shall be used in the construction of the equipment wherever protective finishing is not practicable. Contact of dissimilar metals, as defined in MS33586A, shall be avoided wherever possible. Where such contact is unavoidable, and if practicable, the metals shall be electrically insulated with paint, non-metallic washers, or anodization.

3.3.7 INTERCHANGEABILITY AND REPLACEABILITY

Design shall incorporate maximum interchangeability of parts. As required by MIL-T-27474, paragraph 3.5.12, the design shall permit easy assembly, disassembly, location of trouble sources, and maintenance with tools and equipment normally available commercially by service maintenance personnel with a minimum of training.

3.3.8 WORKMANSHIP

The equipment shall be fabricated and finished in accordance with MIL-T-27474 as amended in Section 10 herein.

3.3.9 ELECTROMAGNETIC INTERFERENCE

Minimization of interference shall be a prime consideration in the basic design of the equipment. The equipment shall be designed to operate satisfactorily either as independent units or in conjunction with other similar equipment mounted close by. Basic characteristics shall be such that their operation is not adversely affected by radio interference voltages or magnetic fields from surrounding external sources, nor will they provide source for such interference which will in any way cause adverse effect on other equipment. The radiated or conducted interference of equipment shall be kept to a minimum consistent with the performance requirements specified herein.

3.3.10 IDENTIFICATION AND MARKINGS

Assemblies and parts shall be marked for ease of identification per MIL-STD-130B.

SECTION 4

QUALITY ASSURANCE PROVISIONS

SECTION 4

QUALITY ASSURANCE PROVISIONS

Quality assurance provisions for the MMSE are as defined in the Product Assurance Plan for MMSE Program and MMSE Quality Program Requirements. The Systems Effectiveness Exhibit (SAFSL Exhibit 24013, except paragraph 4.2.1j) is applicable and shall be implemented. Quality Efforts shall be subject to the surveillance of the AFPRO and appropriate data made available upon request.

4.1 SUBSYSTEM TEST

4.1.1 ENGINEERING TEST AND EVALUATION

Not Applicable

4.1.2 PRELIMINARY QUALIFICATION TESTS

Not Applicable

4.1.3 FORMALQUALIFICATION TEST

Not Applicable

4.1.4 RELIABILITY TEST AND ANALYSES

Not Applicable

4.1.5 ENGINEERING CRITICAL COMPONENT QUALIFICATION

Not Applicable

4.1.6 DESIGN VERIFICATION

4.1.6.1 Inspection

The following requirements of Section 3 shall be verified by inspection:

paragraph	
3.3.1	General Design Features
3.3.1.1	Simulated Crew Station Subsystem
3.3.1.2	Instructor/Operator Station
3.3.1.3.1.1.1	IBM System/360 Model 44 Computer
3.3.1.3.1.1.2	CRT Display Unit
3.3.1.3.1.1.3	SDS 930/Beckman 2200 Hybrid Computer
3.3.1.3.1.2	Airborne Digital Computer
3.3.1.3.1.3	ADC Cooling
3.3.1.4.2.1	Description
3.3.1.4.2.4	Spares and Growth
3.3.3	Materials, Parts and Processes
3.3.4	Standard and Commercial Parts
3.3.5	Moisture and Fungus Resistance
3.3.6	Corrosion of Metal Parts
3.3.7	Interchangeability and Replaceability
3.3.8	Workmanship
3.3.10	Identification and Marking

4.1.6.2 Analysis

Not Applicable

4.1.6.3 Demonstration

Not Applicable

4.1.6.4 Test

4.1.6.4.1 Test Types

Test Types shall include the following:

1. Major Subcontractor Component Tests
2. Major Subcontractor Subsystem Tests
3. Subcontractor Tests

4.1.6.4.2 Component Tests

The following requirements of Section 3 shall be verified by test at the component or subsystem level:

paragraph	
3.3.1.5.1	Acquisition (and all subparagraphs)
3.3.1.5.2	Main Optics (and all subparagraphs)
3.3.1.5.3	Cue

4.2 SYSTEM TESTS

This test shall be performed as an integrated system test of the MMSE. The following requirements of Section 3 shall be verified by system test, confirmation being by subjective evaluation or numerical measurement:

paragraph	
3.1	Performance
3.2.1.1	Interface Block Diagram
3.3.1.1.1	Functional Characteristics
3.3.1.1.3	Panel Requirements
3.3.1.2.1	General
3.3.1.2.3	Controls and Displays (IOS Control/Display Location)
3.3.1.2.2.1	Control Requirements
3.3.1.2.2.2	Display Requirements
3.3.1.3.1.1	MMSEC
3.3.1.3.1.1.2	CRT Display
3.3.1.4.2.2	LMSE Interface
3.3.1.4.2.3	MMSE Interface
3.3.1.4.3	Airborne Digital Computer Adapter Simulator
3.3.1.4.4	IBM 360/SDS 930 Computer Adapter
3.3.9	Electromagnetic Interference

SECTION 6

NOTES

SECTION 6

NOTES

6.1 BACKUP ADC

The MMSEC shall include the DG-3 Engineering Prototype ADC as a backup spare for the on-line ADC. This DG-3 ADC will be made available for MMSEC after completion of its initial testing utilization at GE and subsequent IBM checking and adjustment.

6.2 GLOSSARY

ACTS	Attitude Control and Translation System
A/D	Analog to Digital
ADC	DCSG Airborne Digital Computer
ADCAS	ADC Adapter Simulator
AMU	Auxiliary Memory Unit
AN	Alteration Notice (to Engineering Drawings)
ATS	Acquisition/Tracking Scopes
AVE	Aerospace Vehicle Equipment
AWAR	Area Weighted Average Resolution
CCAU	Channel-to-Channel Adapter Unit
CCB	Configuration Control Board
CEI	Contract End Item
CMD	Contract Management Division, Contract Management District, Configuration Management Division
CSC	Computer Subsystem Controller
D/A	Digital-to-Analog
DACO	Douglas Aircraft Company
DASG	Data Acquisition Subsystem Group (AVE)
DCSG	Data Computation Subsystem Group (AVE)

GLOSSARY (Cont)

DRC	Data Recovery Capsule
DRV	Data Recovery Vehicle
EP&SD	Electrical Power and Signal Distribution
FCEI	Facility Contract End Item
FOV	Field-of-View
GE	General Electric Company
GMT	Greenwich Mean Time
HPA	High Power Acquisition
IFS	Interface Specification
IMS	Image Motion Control
I/O	Input/Output
IOS	Instructor Operator Station
IVS	Image Velocity Sensor
KDU	DCSG Keyboard and Display Unit
LDAU	Laboratory Data Adapter Unit
LMSE	Laboratory Module Simulation Equipment
LMSEC	Laboratory Module Simulation Equipment Computer
LOS	Line-of-Sight
lp	line pair
LPA	Low Power Acquisition
LV	Laboratory Vehicle
LVSS	Laboratory Vehicle System Segment
MAS	Monitor and Alarm System
MDAU	Mission Data Adapter Unit
MDS	Mission Development Simulator
MMSE	Mission Module Simulation Equipment
MMSEC	Mission Module Simulation Equipment Computer
MMSS	Mission Module System Segment

MO	Main Optics
MPS	Mission Payload System
MRB	Material Review Board
MS	Military Standard Mission Simulator
OTEF	Operational Test and Evaluation Facility
OV	Orbiting Vehicle
PCM	Pulse Code Modulation
PDU	Power Distribution Unit
PPAC	Principal Payload Associate Contractor
PR	DCSG Printer
RV	Re-entry Vehicle
SCF	Satellite Control Facility (Sunnyvale)
SCSU	Signal Conditioning and Switching Unit
SGLS	Space-Ground Link System
SLM	Simulated Laboratory Module
SMG	Stimulus Material Generator
S/S	Stimulus Subsystem
STC	Satellite Tracking Center
TLM	Telemetry
TM	Telemeter
TT&C	Telemetry, Tracking, and Command
TV	Television
vdc	Volts DC
VDP	Visual Display Projector
VFSTC	GE Valley Forge Space Technology Center
VO	Visual Optics
V/R	Velocity/Range

SECTION 10

APPENDIX

SECTION 10

APPENDIX

10.1 WORKMANSHIP AND DESIGN PRACTICES

The provisions of MIL-T-27474 "Training Equipment, Ground, General Requirement for" dated 22 August 1960, as amended by the clarifications and deviations contained within this Section, shall apply to the equipment of this CEI:

Paragraph 2.1 - Applicable Documents:

Change Paragraph 2.1, Applicable Documents, as follows:

a. Delcte Federal Specifications TT-E-489, TT-P-636, TT-S-176 and MIL-P-8585.

Rationale: Specification not pertinent. Epoxy to be used in lieu of materials specified (ref. deviations to paragraphs 3.14.1 and 3.14.2).

b. Delcte MIL-S-6872, add MIL-STD-454A, Section 5 (5 Jan 1965)

Rationale: The MIL-S-6872A, Amendment 1, dated 12/14/65 has been replaced by MIL-STD-454.

c. Add MIL-W-81044A, 22 Dec. 1967, "Wire, Electrical, Crosslinked Polyalkene Insulated Copper".

Rationale: MIL-W-81044 wiring requirements to be used in conjunction with MIL-W-16878.

d. Delcte MIL-P-26441, "Printed Wiring Boards", add MIL-P-55110A, 29 July 1965 "Printed Wiring Boards".

Rationale: MIL-P-55110A supersedes MIL-P-26441.

e. Change ANA Bulletin 143 to read MIL-STD-143.

Rationale: To reflect proper identification.

f. Delete MIL-S-3644, "Shaft, Flexible Tuning"

Rationale: Not applicable, none used.

g. Delete MIL-E-4682, "Electron Tubes and Transistors, Choice and Application of"

Rationale: Not applicable, preferred parts lists applies.

h. Delete MIL-T-9107, "Test Reports, Preparation of"

Rationale: Preproduction tests not applicable (ref. deviation paragraph 3.5.2.1).

i. Delete MIL-R-25717, "Reliability Assurance Program for Electronic Equipment".

Rationale: SAFSL 24013 "Systems Effectiveness Exhibit" applies, except paragraph 4.2.1.j.

j. Delete MIL-P-27259, "Preparation of USAF Training Devices Characteristics Formats (Orange Book), USAF Guide No. 4".

Rationale: Not applicable, delivery (DD250) data applies.

k. Delete MIL-STD-681, "Identification Coding and Application of Hookup Wire".

Rationale: MIL-STD-130B applies.

l. Delete MIL-STD-803, "Human Engineering Criteria for Aircraft, Missiles and Space Systems GSE". Add MIL-H-27894, "Human Engineering Requirements for Aerospace Systems and Equipment, 9 January 1963, para 3.8".

Rationale: (Ref. deviation, para. 3.4.2)

m. Delete MIL-N-18307 Nomenclature and Nameplates for Aeronautical and Associated Equipment.

Rationale: MIL-STD-130B applies.

n. Delete MIL-T-7928 "Terminal, Lug and Splices, Crimp Style, Copper".

Paragraph 3.2.1 Specifications

Deviation: Delete paragraph as written

Rationale: System Specification applies

Paragraph 3.3.1 Fungus-proof Materials

Clarification: Change to read: "Materials that are nutrients for fungi shall not be be used except as otherwise permitted by MIL-STD-454 Requirement 4".

Rationale: CEI Specification applies. (Inserted for clarity)

Paragraph 3.3.5 Non-Metals, clarification:

Add to last sentence: "over the total range of required operating temperatures".

Rationale: The term "temperature resistant" requires clarification. At elevated temperatures virtually no materials are temperature resistant (ref. para. 3.3.5.1, toxic fumes)

Paragraph 3.3.5.1 Flame Resistant Materials:

Clarification: Change to read: "Where practicable, flame-resistant materials shall be used. Where necessary to use flammable materials, they shall be rated as self-extinguishing in air when tested to the applicable ASTM material specification or shall meet the combustion rate requirements imposed for similar applications in MOL AVE, or meet the reuqirements of MIL-STD-454A, Requirement 3."

Rationale: The requirement of the specification that "no toxic fumes will be liberated: needs clarification. All metallic and hydrocarbon combustion products are toxic to some degree. Toxicity as interpreted today in manned applications is grossly different than it was in 1960 when the specification was written.

Paragraph 3.4.1 Design Characteristics, clarification:

Delete: Sentence which reads , "It shall be possible for the student to perform all functions and observe all phenomena normally encountered when using the operational equipment or system".

Substitute: "It shall be possible for the student to perform the functions as specified in the System Specification".

Rationale: Cannot simulate many functions or phenomena (e.g., zero-g). The credibility of the simulation is subject to individual approval by the customer at the time of approval of the Experiment Plans.

Paragraph 3.4.2 Human Factors Requirement

Deviation: Delete MIL-STD-803, add MIL-H-27894A para. 3.8, 9 Jan 1963

Rationale: Since the 111 is closely related to AVE, the human factors requirements are more appropriately reflected via MIL-H-27894A.

Paragraph 3.4.2.1.1 Layout Rationale

Deviation: Delete requirement

Rationale: System specification applies, CDR item.

Paragraph 3.4.2.1.2 Efficiency of Training

Deviation: Delete requirement

Rationale: System specification applies

Paragraph 3.4.2.1.3 Transfer of Training

Deviation: Delete requirement.

Rationale: System specification applies.

Paragraph 3.4.2.1.4 Measures of Proficiency

Deviation: Delete requirement.

Rationale: System Specification applies.

Paragraph 3.4.3 Reliability

Deviation: Delete requirement.

Rationale: SAFSL 24013 "Systems Effectiveness Exhibit for MOL" except paragraph 4.2.1j applies. (Paragraph 4.2.1j pertains to piece part traceability and lot control.)

Paragraph 3.4.4.1 Safety Considerations

Deviation: Delete sentence, "Cabinets and enclosed racks having access doors or removable panels for maintenance purposes shall have protective interlocks to eliminate the hazardous potentials".

Add sentence, "Cabinets and enclosed racks having access doors or removable panels for maintenance purposes shall have warning labels affixed to or adjacent to such openings to indicate the hazardous potentials. Such warnings shall indicate 'remove power before opening' when applicable."

Rationale: There are troubleshooting considerations which require power to be on while access doors or panels are removed.

Paragraph 3.4.5.1 Power Considerations

Clarification: Delete sentence "Batteries shall not be used as part of, or in connection with, the power supply equipment".

Rationale: Batteries may be used for emergency lighting in the event of power failure. This is a "safety to personnel" consideration.

Paragraph 3.4.5.4 Power Considerations

Deviation: Delete sentence, "Lamp indicators shall be used so that fuse failures are visually indicated".

Rationale: Not industry-wide commercial practice. Extensive commercial equipment (computers, adapters, buffers) used on program.

Paragraph 3.4.9.2 Trainee Environment

Deviation: Delete Requirement.

Rationale: Range of lighting desirable.

Paragraph 3.4.10.3 Flexible Shafts

Clarification: Delete requirement.

Rationale: Not applicable, none used.

Paragraph 3.5.1.6 Test Points

Deviation: Delete requirement as written.

Add: "Test points shall be incorporated in power conditioning equipment for maintenance purposes. Other equipment shall be designed for easy access to test points.

Rationale: Complexity and design density of equipment makes installation of all test points accessible from outside impractical. Service and access provisions of paragraph 3.5.1.2 apply.

Paragraph 3.5.1.9 Specific Tools and Test Equipment

Deviation: Delete second sentence -- add, "When a need for special tools and test equipment exists, these tools shall be kept in the same area as the training equipment and shall be made available for use during maintenance and repair".

Rationale: The objectives of the original requirement will be met; however, as a matter of access and working space around the simulator it is more practical not to securely attach the tool kit to the simulator.

Paragraph 3.5.2.1 Wire

a. Change second sentence to read, "MIL-W-16878 or MIL-W-81044".

Rationale: To permit additional flexibility. MIL-W-81044 widely used in industry.

b. Delete MIL-P-26441; add "MIL-P-55110A, except paragraphs 3.7 through 3.14 and paragraphs related to pre-production testing. The inspection tests shall be limited to visual and dimensional examination as specified in paragraph 4.8.1 (Table III, Group A tests only)."

Rationale: MIL-P-55110 supersedes MIL-P-26441. Paragraphs 3.7 through 3.14 apply to pre-production testing of the wiring boards. The wiring board material used in the simulator is purchased as Plastic Sheet, Laminated Copper Clad per MIL-P-13949 Type FL. (MIL-P-13949 is a first-tier applicable specification of MIL-P-55110A.) The wiring board material goes through no process subsequent to receipt that would degrade or affect the essential properties (e.g., insulation, moisture resistance, adhesion, etc.). The pre-production testing specified in MIL-P-55110A is considered to be redundant with the testing required under the purchase specification MIL-P-13949. This deviation is requested as a matter of cost effectiveness.

Paragraph 3.4.10.4 Control Knobs and Handles

Clarification: Delete paragraph.

Rationale: 111 controls shall be similar to AVE controls.

Paragraph 3.4.10.5 Operating Controls

Add sentence to read, "In cases where the training equipment is to simulate operational equipment, the controls and indicators that contribute to the training objective shall be of similar layout as the operational equipment".

Rationale: to provide for developing and evaluating AVE designs and training.

Paragraph 3.4.10.6 Controls

Add sentence to read, "In cases where the training equipment is to simulate operational equipment, the controlled characteristics shall be similar to the operational equipment".

Rationale: Same as for 3.4.10.5 deviation.

Paragraph 3.4.10.7 Calibrated Dials

Deviation: Waive for commercial equipment.

Rationale: Not standard commercial practice.

Paragraph 3.4.13 Running Time Meters

Deviation: Change to read, "Running time meters shall be installed to indicate accrued operating time on assemblies classified as limited life equipment."

Rationale: The total system operating time (power on time) does not necessarily reflect the on-time for all assemblies. The accrued time of specific assemblies is more important from reliability and cost-effectiveness standpoints.

c. MIL-P-55110A: Change reference to MIL-STD-275 to read, "MIL-STD-275, except paragraph 5.2.1.1."

Rationale: Paragraph 5.2.1.1 states that "the terminal areas shall completely surround and abut on the mounting holes:. In the case of high density mounting of transistors on the printed wiring board, the drilled holes for the transistor leads may break through the edge of the terminal area (e.g., 2N3908 transistors on the 2 in. x 2 in. DIU boards). This condition does not affect the functionality of the assembly nor does it represent a degradation in performance or reliability in this application. The fabrication permitted by deleting the requirement is in common use in commercial equipment.

Paragraph 3.5.2.5 Shielding

Clarification: Add sentence: "Tieing or lacing of shields to a common ground via a grounding stud or bar to chassis ground is permissible".

Rationale: To provide for grounding in high density units (e.g., junction boxes).

Paragraph 3.5.2.6 Wiring Practice

Deviation: Delete 10 percent requirement.

Rationale: Spares are available. However, design changes have utilized some original spares such that the 10 percent capability does not presently exist.

Paragraph 3.5.2.8 Solderless Type Terminals

Deviation: Waive paragraph for commercial equipment only.

Rationale: Not industry wide standard commercial practice.

Deviation: Delete reference to MIL-T-7928.

Rationale: MIL-T-7928 specifies the use of MS type terminals. In addition, it specifies the maximum allowable voltage drop for the connection and specifies tensile (pull test) requirements.

Commercial equipment does not conform to the MIL-T-7928 requirements.

The General Electric method is to control the fabrication by Process Control Instructions. These instructions specify the specific crimping tool to be used, the contact

size to be used for a given wire size and the tensile test requirements. The tensile test requirements in the Process Control Instructions meet or exceed the MIL-T-7928 requirements. Recent representative tests of contacts fabricated for 106 indicate that the crimp joints fabricated met the voltage drop tests and withstood far in excess of the minimum tensile test requirements, some joints having failed at loads slightly below the rated strength of the wire. This deviation is requested as a matter of standardization, since the current practices are well controlled and result in products which meet or exceed the MIL specification requirements.

Paragraph 3.5.2.9 Terminal Strips

Deviation: Waive for commercial equipment.

Rationale: (Same as for 3.5.2.8. System is operated in controlled environment, High humidity not a problem.)

Paragraph 3.5.2.10.1 Cabling

Deviation: Waive for commercial equipment only.

Rationale: Internal harnessing between components/assemblies not contained within plastic or synthetic rubber covering.

Paragraph 3.5.2.10.2 Cabling

Deviation: Delete reference to Table I.

Rationale: In general, 10 percent spares have been designed into cables. For point-to-point wiring practices, this ratio is considered adequate.

Paragraph 3.5.2.10.4 Insulating Tubing

Deviation: Waive for commercial equipment only.

Rationale: Not standard commercial practice.

Paragraph 3.5.2.12a Slack

Deviation: Change "at least two times", to "once".

Rationale: Due to the compact packaging required within the DIU and to eliminate the electrical interference which the extra slack might induce, good design practice dictates reducing the slack to the extent only one repair capability exists.

Paragraph 3.5.3 Soldering Processes

Delete: MIL-S-6872, add MIL-STD-454A, Section 5, 5 Jan 1965

Rationale: To reflect the cancellation of MIL-S-6872A for Air Force use and to impose its replacement (ref. Amendment 1 to MIL-S-6872A).

Paragraph 3.5.3.3 Soldering Processes

Deviation: Delete sentences, "In no case where flexible wires are used shall electrical connections be made solely by clamping wires between metal parts. Such a connection shall be soldered or soldering lugs may be used in lieu thereof".

Add sentence: "In no case where flexible wires are used shall electrical connections be made solely by clamping wires between metal parts unless specific applications employing solderless termination techniques have been approved for use by the contractor and are referenced on the assembly drawings".

Rationale: Introduction of new solderless termination techniques for high density packaging which have been developed and are being used throughout the industry since issuance of this specification (22 August 1960).

Paragraph 3.5.3.5 Soldering Processes

Deviation: Delete requirement.

Rationale: Provisions and techniques of paragraph 3.5.3.3 shall apply.

Paragraph 3.6.1 Selection of Electronic Devices

Deviation: Delete last sentence.

Rationale: Preferred parts lists governs selection of piece parts.

Paragraph 3.6.5 Relays

Deviation: Delete requirement for self-wiping contacts. Delete paragraph when applied to commercial equipment.

Rationale: Relays to conform to dust-proof requirements. Simulators are used in controlled environment. Computer commercial equipment contains non-dustproof type relays.

Paragraph 3.6.6 Servos

Deviation: Change paragraph to read, "All servos shall be designed to be driven either direction to aid in maintenance procedures or for determination of performance. Protection against the overdriving of servos shall be provided."

Rationale: The equipment is designed to provide test signals to the servos via potentiometers to check performance of the servos. The servos are protected against overdrive; however, switches for locking are unnecessary due to the test drive capability and could interfere with experiment operations if included. Since locks are unnecessary, the indicator requirements do not apply.

Paragraph 3.8 Interchangeability

Deviation: Provisions not applicable to commercial equipment.

Rationale: GE-designed equipment will comply with requirement. However, not all commercial equipment is designed to comply with MIL-D-70327 interchangeability requirements.

Paragraph 3.13 Color Standards

Deviation: Delete requirement.

Rationale: Paragraph 3.13.1 applies.

Paragraph 3.13.1 Color Standards

Clarification: Add sentence: "Equipment which does not simulate AVE equipment shall conform to No. 25109 blue or gray No. 16473 per FED-STD-595 on the exterior of consoles, storage cabinets, equipment racks and simulator support structures. The interior of consoles, storage cabinets and equipment racks may be painted Pale Aqua Blue (Color No. 17 ca) or Celadon Green (Color No. 24 ge) or gray No. 16473."

Rationale: To obtain greater contrast and color harmony (special MOL shades) for human factors purposes and to increase the reflectivity of interior surfaces while performing work within the racks and cabinets.

Paragraph 3.14.1 Finishes and Protective Coating

Deviation: To allow the use of epoxy paints (product improvement).

Rationale: A study was made by GE to determine the best method of marking the control consoles. A GE VFSTC Division facility has been set up and is available with special arrangements to do this work professionally. Concurrent with these developments S&T considered the developments at Pittsfield Ordnance in introducing a similar improvement on Polaris Fire Control Equipment. As at GE X-Ray Department the best silk screen ink (paint) was sought. It was concluded that Wornow Epoxy Inks (paint) is highly resistant to abrasion and is most suitable for this application. Preferred application of the lettering is on a background of the same material previously cured. In addition, because of the extended checkout and usage of the equipment in a showcase manner, high resistance to the degrading appearance of scuffs, scratches, nicks, etc., is most desirable. The epoxy paint fills these requirements significantly better than alkyd base paints.

These epoxy paints conform with:

O. D. 14301 (Be Ord) Part No. and Inspection Base Marking (Permanent Ink)

O. S. 11773 (Bu Weps) Paint, catalyzed, plastic base

O. S. 7446B (Bu Ord) Marking ink, silk screen, permanent

MIL-E-5272A, Procedure 1 fungus resistance

MIL-E-8261, Fungus resistance

GE MSD specs are available for proper control of both painting and silk screen application of this material. Proper application of this material is upon a clean ferrous surface or an alodined aluminum surface. Its coverage is considered excellent.

Paragraph 3.14.2 Wood Surfaces

Deviation: Delete paragraph. Add "The provisions of paragraph 3.14.1 shall apply".

Rationale: For consistency.

Paragraph 3.14.3 and subparagraphs thereof

Deviation: Delete requirement, substitute: "Protection of aluminum and aluminim alloy surfaces shall be in accordance with GE Standards which shall be subject to procuring agency approval prior to use."

Rationale: Alodine process per GE Standard 118A1600 applies.

Paragraph 3.14.4 Finishes, steel parts

Clarification: Add sentence, "The provisions of this paragraph shall not apply in cases where the painting or plating of precision close tolerance surfaces shall interfere with the functioning of the equipment."

Rationale: There are isolated instances where precision design requirements preclude the use of paint or plating on surfaces. Such uses shall be inspected frequently for oxidation.

Paragraph 3.15.2.1 Internal Wiring

Deviation: Delete requirements.

Rationale: Commercial equipment fabrication does not comply with MIL-STD-681.

Paragraph 3.15.2.2 External Wiring

Clarification: Delete requirement. Add sentence: "External wiring shall be marked in accordance with GE Standard which shall be subject to procuring agency approval prior to use."

Paragraph 3.15.2.3 Electronic Parts Identification

Deviation: The provisions of this paragraph do not apply to the identification of parts within purchased commercial equipment or to high density assemblies (e.g., miniaturized printed wiring boards) where such identification is impractical.

Rationale: It is not industry-wide standard commercial practice to identify parts in accordance with the provisions of this paragraph. General Electric will comply with the provisions of this paragraph except in cases of high packaging densities or where advances in the state-of-the-art in miniaturization make it impractical.

Paragraph 3.15.2.3.1 Electronics Parts Identification

Clarification: Electronic and electrical symbols shall be in accordance with MIL-STD-15.

Rationale: For standardization.

Paragraph 3.15.2.3.2 Electronic Parts Identification

Deviation: The provisions of this paragraph do not apply to commercial equipment.

Clarification: Electronic and electronic symbols shall be in accordance with the provisions of MIL-STD-15.

Rationale: (Same as for 3.15.2.3 and 3.15.2.3.1)

Paragraph 3.15.2.4.1 Circuit Diagrams

Clarifications: Symbols shall be per GE Standard which shall be subject to procuring agency approval prior to use.

Rationale: MIL-STD-15 is used as basis for GE Standard. The GE Standard is document actually used for control.

Paragraph 4.3.1 Individual Tests

Clarification: Delete paragraph as written, substitute, "The acceptance tests shall be as defined in the Acceptance Test Plan which shall be subject to approval of the procuring agency".

Paragraph 4.5.3 Subassembly, Assembly and Unit Performance

Same clarification as for paragraph 4.3.1.

Paragraph 4.5.4 Subparagraphs thereof: Reliability

Clarification: Delete paragraph as written, substitute: The Realibility Plan shall be per "SAFSL 24013, "Systems Effectiveness Exhibit for MOL" except paragraph 4.2.1j."

Rationale: To clarify and eliminate dual requirements.

Paragraph 4.5.5 Human Factors Evaluation

Deviation: Delete paragraph.

Rationale: MIL-H-27894A Human Factors Specification applies.

Paragraph 4.6 to 6.3.2 Preproduction Testing and Notes

Deviation: Delete paragraphs.

Rationale: Preproduction testing not applicable. The testing of the equipment shall be per the Acceptance Test Plan. The ordering date, configuration data, shall be in accordance with MIL-D-70327.