

LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

①

INVENTORY

AD-A276 972



DTIC ACCESSION NUMBER

LEVEL

ASC-TR-94-5015

DOCUMENT IDENTIFICATION

Aug 93

UNCLASSIFIED
EXCLUDED FROM PUBLIC RELEASE
DISTRIBUTION UNLIMITED

DISTRIBUTION STATEMENT

DTIC ACCESSION NUMBER	
NTIS	GRAB
DTIC	TRAC
UNANNOUNCED	
JUSTIFICATION	
BY	
DISTRIBUTION/	
AVAILABILITY CODES	
DISTRIBUTION	AVAILABILITY AND/OR SPECIAL
A-1	

DISTRIBUTION STAMP

DTIC
ELECT
MAR 10 1994
C

DATE ACCESSIONED

DATE RETURNED

94-07854



94 3 9 109

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

H
A
N
D
L
E

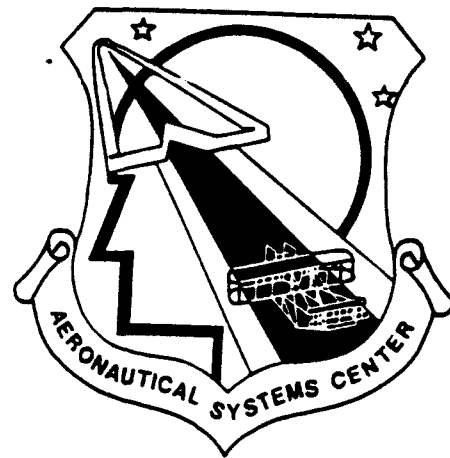
W
I
T
H

C
A
R
E

ASC-TR-94-5015

MODULAR SIMULATOR SYSTEM (MSS)

SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC
MODULAR SIMULATOR SYSTEM - PROPULSION MODULE
PROPULSION MODULE VOLUME 5



K KELLY, J BROWN,
G KAMSICKAS, W TUCKER

BOEING DEFENSE AND SPACE GROUP
SIMULATION AND TRAINING SYSTEMS
499 BOEING BLVD
HUNTSVILLE, AL 35824

AUGUST 1993

FINAL REPORT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.

DTIC QUALITY INSPECTED 1

SYSTEMS ENGINEERING DIVISION
AERONAUTICAL SYSTEMS CENTER
AIR FORCE MATERIEL COMMAND
WRIGHT PATTERSON AFB OH 45433-7126

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder, or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.



JEFFREY C. VALITON, Maj, USAF
Program Manager
Special Programs Division



JAMES D. BASINGER
Team Leader
Special Programs Division



JAMES J. O'CONNELL
Chief, Systems Engineering Division
Training Systems Program Office

If your address has changed, if you wish to be removed from our mailing list, or if the addressee is no longer employed by your organization please notify ASC/YTSD WPAFB, OH 45433-7111 to help us maintain a current mailing list.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

REPORT DOCUMENTATION PAGE			Form Approved OMB No 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204 Arlington, VA 22202-4302 and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 15 Aug 93	3. REPORT TYPE AND DATES COVERED FINAL		
4. TITLE AND SUBTITLE System Segment Specification for the Generic Simulator System-Propulsion Module Volume 5			5. FUNDING NUMBERS F33657-86-C-0149 64227F	
6. AUTHOR(S) Kelly, J. Brown G. Kamsickas, W. Tucker				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Boeing Defense and Space Group Simulation and Training Systems 499 Boeing Blvd Huntsville, AL 35824			8. PERFORMING ORGANIZATION REPORT NUMBER S495-10400D	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Aeronautical Systems Center Systems Engineering Division Bldg 11 2240 B St Ste 7 Wright-Patterson AFB, OH 45433-7111			10. SPONSORING / MONITORING AGENCY REPORT NUMBER ASC-TR-94-5015	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This is the Propulsion portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the "Modular Simulator Engineering Guide" and the "Modular Simulator Management Guide" prior to tailoring this volume.				
14. SUBJECT TERMS Modular Simulator System (MSS)			15. NUMBER OF PAGES 40	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

TABLE OF CONTENTS

Section	Page
1. SCOPE	V-1
1.1 Identification	V-1
1.2 System Overview	V-1
1.3 Document Overview	V-1
2. APPLICABLE DOCUMENTS	V-2
2.1 Government Documents	V-2
2.2 Non-Government Documents	V-3
3. SEGMENT REQUIREMENTS	V-4
3.1 Segment Definition	V-4
3.2 Characteristics	V-4
3.2.1 Performance Characteristics	V-4
3.2.1.1 Segment Modes and States	V-4
3.2.1.2 Propulsion Segment Functions	V-5
3.2.1.2.1 Propulsion Support Function	V-5
3.2.1.2.1.1 Executive Control	V-6
3.2.1.2.1.2 Initialization	V-6
3.2.1.2.1.3 MSS Virtual Network Communication	V-6
3.2.1.2.1.4 Diagnostics and Test	V-6
3.2.1.2.1.4.1 On-Line Diagnostics	V-6
3.2.1.2.1.4.2 Off-Line Diagnostics	V-7
3.2.1.2.1.4.3 Remote Controlled Diagnostics	V-7
3.2.1.2.1.5 Backdoor Interfacing	V-7
3.2.1.2.1.6 Malfunctions	V-7
3.2.1.2.1.7 Damage Assessment	V-8
3.2.1.2.1.8 Security Processing	V-8
3.2.1.2.1.9 Scoring	V-8
3.2.1.2.1.10 Other Support Function Services	V-8
3.2.1.2.2 Core Engine System Function	V-8
3.2.1.2.3 Thrust Generation System Function	V-9
3.2.1.2.4 Starting System Function	V-10
3.2.1.2.5 Engine Inlet System Function	V-11
3.2.1.2.6 Engine Fuel System Function	V-12
3.2.1.2.7 Engine Bleed Air System Function	V-13
3.2.1.2.8 Transmission System Function	V-13
3.2.1.2.9 Engine Oil System Function	V-14
3.2.1.2.10 Emergency/Auxiliary Power Unit System Function	V-15
3.2.1.2.11 Engine Exhaust System Function	V-16
3.2.2 System Capability Relationships	V-16
3.2.2.1 Segment Functional Relationships	V-16
3.2.3 External Interface Requirements	V-18
3.2.4 Physical Characteristics	V-18
3.2.4.1 Protective Coatings	V-18
3.2.5 Propulsion Segment Quality Factors	V-18
3.2.5.1 Reliability	V-18

S495-10400D
13 August 1993
Volume V of XIII

TABLE OF CONTENTS (Contd.)

Section	Page
3.2.5.2 Maintainability	V-19
3.2.5.3 Availability	V-19
3.2.5.4 Additional Quality Factors	V-19
3.2.6 Environmental Conditions	V-19
3.2.7 Transportability	V-19
3.2.8 Flexibility and Expansion	V-20
3.2.9 Portability	V-20
3.3 Design and Construction	V-20
3.3.1 Materials	V-20
3.3.1.1 Toxic Materials	V-20
3.3.2 Electromagnetic Radiation	V-20
3.3.3 Nameplates and Product Marking	V-21
3.3.4 Workmanship	V-21
3.3.5 Interchangeability	V-21
3.3.6 Safety	V-21
3.3.7 Human Engineering	V-21
3.3.8 Nuclear Control	V-21
3.3.9 System Security	V-21
3.3.10 Government Furnished Property	V-22
3.3.11 Computer Resource Reserve Capacity	V-22
3.4 Documentation	V-22
3.5 Logistics	V-22
3.6 Personnel and Training	V-22
3.7 Subordinate Element Characteristics	V-22
3.8 Precedence	V-23
4. QUALIFICATION REQUIREMENTS	V-24
4.1 Responsibility For Test and Inspection	V-24
4.2 Special Tests and Examinations	V-24
4.3 Requirements Cross Reference	V-25
5. PREPARATION FOR DELIVERY	V-26
6. NOTES	V-27
6.1 Intended Use	V-27
6.1.1 Missions	V-27
6.1.2 Threat	V-27
6.2 Propulsion Segment Acronyms	V-27
6.3 Glossary of Propulsion Segment Terms	V-28

LIST OF FIGURES

Figure	Page
1 Propulsion Segment Functional Relationships	V-17

PREFACE

This generic Modular Simulator System (MSS) segment specification has been developed in accordance with DI-CMAN-80008A, Data Item Description for System/Segment Specifications. This specification meets or exceeds the requirements for MIL-STD-490, Type A, specifications. This specification is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. Training devices may consist of Weapons System Trainers (WST), Operational Flight Trainers (OFT), Cockpit Procedures Trainers (CPT), Part Task trainers (PTT), etc.

Tailoring will be necessary to meet specific application requirements. The tailoring must be accomplished so as not to violate the goals and intent of the MSS concept. It is assumed that the user of this document has a familiarity with the MSS design concepts and architecture, the application aircraft training requirements, and general working knowledge of aircraft training systems. It is suggested that the user read the "Modular Simulator System Engineering Design Guide (D495-10440-1) and the "Modular Simulator System Management Guide" (D495-10439-1 prior to tailoring this specification. These guides provide an overview of the MSS architecture, an in-depth discussion on its application, and lessons learned from previous applications.

Each segment in the MSS architecture provides a portion of the overall system functionality. Similar functions and operations were grouped in each segment based on past experience, areas of design expertise, and management of intersegment communication. To promote reuse of the segments and gain the maximum benefits of using the MSS approach, it is suggested that the user adhere to the generic functional allocation. Interfaces between the segments should remain relatively constant from application to application. The application vehicle is considered to be an aircraft (e.g. fixed wing, variable geometry, or rotary wing), although the MSS architecture and concepts may be applied to either ground or sea vehicles.

This specification contains specific tailoring instructions for each paragraph. The instructions are contained within the paragraphs, and are identified by blank spaces and/or italicized text. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. Paragraphs which do not apply to a particular application should not be deleted. They should be identified as "Not Applicable" to maintain paragraph numbering consistency between volumes and various MSS applications.

1. SCOPE

1.1 Identification. This segment specification establishes the requirements for the Propulsion segment of the _____ (*insert application aircraft type*) Modular Simulator System (MSS). This volume is one of _____ (*insert number of volumes in the application system/segment specification*) volumes which comprise the system/segment specification for the _____ (*insert application aircraft type*) MSS. Volume I of this specification contains system level requirements such as MSS structure, communication architecture, network interface performance, system level diagnostic and test requirements, Ada programming language applicability, adaptability and expansibility, and other requirements which pertain to all volumes.

1.2 System Overview. The Propulsion segment provides for the simulation, stimulation, and/or emulation of the ownship propulsion functions within the _____ (*insert application aircraft type*) MSS. The Propulsion segment provides for the simulation of the core engine function, thrust generation function, starting system function, engine inlet function, engine fuel function, engine bleed function, transmission function, engine oil function, emergency/auxiliary power unit function and engine exhaust gas functions throughout the flight envelope of the ownship. The Propulsion model is based on engine design data, flight test data, and derived data for the propulsion system that is installed on the _____ (*insert application aircraft type*). The Propulsion segment interfaces with the other MSS segments as described in the _____ (*insert application aircraft type*) MSS Interface Design Document (IDD) _____ (*insert IDD document number*). Each of the Propulsion segment functions identified are processed within the Propulsion segment.

1.3 Document Overview. This segment specification defines Propulsion segment unique requirements for the _____ (*insert application aircraft type*) MSS. It contains requirements for the functions performed within the segment including communication interface requirements, segment performance requirements, segment diagnostic and test requirements, and expansibility and adaptability requirements as applicable to the Propulsion segment.

2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The Government documents which are applicable to the entire _____(*insert application aircraft type*) MSS are listed in Volume I of the system segment specification. The following Government documents are in addition to those documents and specifically applicable to the _____(*insert application aircraft type*) Propulsion segment.

SPECIFICATIONS:

Federal - (*Identify applicable federal specifications*)
Military - (*Identify applicable military specifications*)
Other Government Agency - (*Identify applicable government specifications*)

STANDARDS:

Federal - (*Identify applicable federal standards*)
Military - (*Identify applicable military standards*)
Other Government Agency - (*Identify applicable government standards*)

DRAWINGS: (*Identify applicable drawings*)

OTHER PUBLICATIONS:

Manuals - (*Identify applicable manuals*)
Regulations - (*Identify applicable regulations*)
Handbooks - (*Identify applicable handbooks*)
Bulletins - (*Identify applicable bulletins*)

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer.

(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The non-Government documents which are applicable to the entire _____ (*insert application aircraft type*) MSS are listed in Volume I of the System Segment Specification. The following non-Government documents are in addition to those documents and specifically applicable to the _____ (*insert application aircraft type*) Propulsion segment.

SPECIFICATIONS: (*Identify applicable non-government specifications*)

STANDARDS: (*Identify applicable non-government standards*)

DRAWINGS: (*Identify applicable non-government drawings*)

OTHER PUBLICATIONS: (*Identify applicable non-government publications*)

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the secondary document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

3. SEGMENT REQUIREMENTS

3.1 Segment Definition. The Propulsion segment is one of _____ (insert number of segments to be used in the application simulation) unique segments which comprise the _____ (insert application aircraft type) MSS. The Propulsion segment shall provide the modes, states, and functions as defined in this specification volume and Volume I.

The Propulsion segment shall provide real-time simulation of the engine and engine system operation and control representative of the _____ (insert application aircraft type) MSS propulsion system in both normal and degraded states. The Propulsion segment shall provide the simulation/ stimulation of the engine core, thrust generation, engine inlet, engine fuel, engine bleed air, engine oil, engine exhaust, engine starting system, engine power transmission system, and the auxiliary power units.

(This paragraph should be tailored to convey the exact top level functions required of the segment. If this segment is to be used/reused on several devices within a family of trainers, that should be stated here with any unique performance requirements.)

3.2 Characteristics

3.2.1 Performance Characteristics. Performance of the Propulsion segment shall be as specified herein and in accordance with the _____ (insert application aircraft type) propulsion system design criteria. The Propulsion segment shall simulate functions associated with the aircraft propulsion systems. The fidelity of the Propulsion segment shall be sufficient to provide the necessary level of training as specified in Volume I, paragraph 6.1 of this specification.

(Several considerations must be addressed in this paragraph:

- a. Availability of specific and traceable engine design and engineering data*
- b. Manufacturer of the engine*
- c. Number of engines required*
- d. Location of engine(s) on airframe, etc.*

Additional text should be added to this paragraph to identify the design criteria and specific engine to be simulated. A general statement with respect to the fidelity of the simulation should be added.)

3.2.1.1 Segment Modes and States. The Propulsion segment shall support the system modes and states as described in Volume I of this specification. Additional requirements, or operations specific to the Propulsion segment shall not cause degradation of the system nor violate the intent of the system level mode or state.

(Introduction of new modes is prohibited. Functions should be accomplished within the established modes and states. This paragraph should be tailored to describe the segment's specific response to a given mode or state. Subparagraphs should be added to identify and define unique segment requirements for each mode and state.)

3.2.1.2 Propulsion Segment Functions. Functions characterized as "Implemented" shall be implemented to the extent described by the paragraphs dedicated to those functions. Functions characterized as "Not Applicable" shall not exist in this simulation of the _____ (*insert application aircraft type*), and are not required to be implemented in any form within the Propulsion segment.

a. Propulsion Support Function	Implemented
b. Core Engine System Function	(Implemented, N/A)
c. Thrust Generation System Function	(Implemented, N/A)
d. Starting System Function	(Implemented, N/A)
e. Engine Inlet System Function	(Implemented, N/A)
f. Engine Fuel System Function	(Implemented, N/A)
g. Engine Bleed Air System Function	(Implemented, N/A)
h. Transmission System Function	(Implemented, N/A)
i. Engine Oil System Function	(Implemented, N/A)
j. Emergency/Auxiliary Power Unit System Function	(Implemented, N/A)
k. Engine Exhaust System Function	(Implemented, N/A)

(Each function listed should be characterized as "Implemented" or "Not Applicable (N/A)").

3.2.1.2.1 Propulsion Support Function. The Propulsion support function shall provide the segment unique support services required for the operation of the Propulsion segment in the MSS environment. The Propulsion support function services shall include the functions listed below, and be as described in the following paragraphs.

- a. Executive Control
- b. Initialization
- c. MSS Virtual Network (VNET) Communication
- d. Diagnostics and Test
- e. Backdoor Interfacing
- f. Malfunctions
- g. Damage Assessment
- h. Security Processing
- i. Scoring
- j. Other Support Function Services

(Service functions are usually incidental to the simulation but no less critical. Examples are overhead and I/O functions. Additional services may be added as necessary to meet specific

application requirements. If so, corresponding subparagraphs need to be added below. Do not reuse paragraphs for support services that are not applicable.)

3.2.1.2.1.1 Executive Control. The executive control support service shall provide operational control for the Propulsion segment. This control shall include: execution sequencing of all software, mode and state control, and communication between the simulation software and the VNET.

(For most applications this paragraph will require no tailoring. If additional or specific executive control functions are required, they should be identified in this paragraph.)

3.2.1.2.1.2 Initialization. The initialization support service shall control initial hardware and software states for the Propulsion segment. System initialization shall occur during power-up and system resets, as defined in Volume I of this specification. The initialization function shall also access mission initialization data, and transfer the data to other segment functions for mission initialization.

(Initialization requirements unique to the application aircraft Propulsion segment should be specified in this paragraph. Initialization refers to setting initial hardware and software states during power-up and system resets as defined in Volume I. Instrument scale factors and default instrument settings (usually powered off) are typically initialized by this function. A second initialization function is to access mission initialization data (for example from disc) to pass to other segment functions for mission initialization.)

3.2.1.2.1.3 MSS Virtual Network Communication. The MSS VNET communication support service shall provide the Propulsion segment interface to the MSS VNET. It shall allow communication with other segments in the _____ *(insert application aircraft type)* MSS. The Propulsion segment shall communicate with the MSS VNET in accordance with the protocol requirements defined in the IDD _____ *(insert MSS IDD document number)*.

3.2.1.2.1.4 Diagnostics and Test. The diagnostics and test support service shall provide control for the diagnostic and test functions incorporated into the Propulsion segment. Diagnostic and test requirements shall be in accordance with the requirements specified herein.

(Based upon the specific simulator diagnostic requirements, all or part of the three types of diagnostic capabilities may be required. "Not Applicable" should be inserted if the specific diagnostic type is not required for the application MSS. Specific diagnostics and their requirements should be listed in each paragraph when applicable.)

3.2.1.2.1.4.1 On-Line Diagnostics. On-line diagnostics shall be provided for the Propulsion segment. These diagnostics shall be self initiating during start-up and/or as a background function

during training mode.

(On-line Diagnostics are those diagnostics that executed while the training system is in the real-time training mode. These diagnostics may run as a background task. An example that would be used in an MSS environment might be a segment functional diagnostic. Each segment would tell the IOS segment that it is still functioning on a periodic basis (say once a minute). If the IOS does not receive the message then it assumes the segment is not functioning properly and provides a message to the instructor.)

3.2.1.2.1.4.2 Off-Line Diagnostics. Off-line diagnostics shall be provided by the Propulsion segment. Off-line diagnostics shall be executed when the _____ (insert application aircraft type) MSS is not engaged in a system mode.

(Off-line Diagnostics are those diagnostics that are performed on a segment in the stand-alone or segment mode. Typical off-line diagnostics would include; hardware self tests, software tests, I/O debug programs, Daily Readiness at a segment level, etc.)

3.2.1.2.1.4.3 Remote Controlled Diagnostics. Remote Controlled Diagnostics shall be provided for the Propulsion segment. These diagnostics shall be executed from the Instructor Operator Station (IOS) when the MSS is in the Remote Controlled Diagnostic mode.

(Remote Controlled Diagnostics are those diagnostics that run in the special remote controlled diagnostic mode. These diagnostics require the system to be up and running and the segments communicating. An example of a Remote Controlled Diagnostic would be a real-time debugger.)

3.2.1.2.1.5 Backdoor Interfacing. The backdoor interface support service shall provide the means to support external interfaces to the Propulsion segment. All ownship propulsion system Input/Output (I/O) unless specifically identified in the _____ (insert application aircraft type) MSS IDD shall interface via the MSS VNET. Backdoor interfaces shall not be utilized for normal intersegment communication.

(Specific backdoor external interfaces should be identified in this paragraph. Backdoor interfaces may include a 1553 bus to communicate with installed aircraft avionics or a specialized interface to drive a Heads Up Display (HUD). A backdoor interface may not be utilized to transmit intersegment data.)

3.2.1.2.1.6 Malfunctions. The malfunctions support service shall provide the control for the processing and execution of the Propulsion segment malfunctions. The system response shall be in accordance with the aircraft design criteria.

(The Propulsion segment malfunctions should be defined in a program unique Malfunction Description Document.)

3.2.1.2.1.7 Damage Assessment. The damage assessment support service shall provide for the processing and implementation of any damage simulation for which the Propulsion segment is responsible. This shall include the degradation of the appropriate systems within the Propulsion segment based upon the evaluation of the damage severity and location.

(Based upon the training requirements of the application aircraft MSS, any specific damage assessment and system degradation requirements should be specified in this paragraph.)

3.2.1.2.1.8 Security Processing. The Propulsion segment security processing support service shall provide for the processing of the security requirements of the _____ (insert application aircraft type) MSS propulsion segment.

(This paragraph should be expanded to clearly specify which government directives apply, and to what extent, consistent with security considerations. Security processing could include Memory Erase Mode if required and any other security considerations such as removable memory or special encoding devices.)

3.2.1.2.1.9 Scoring. The scoring support service shall provide the ability to collect specific data for the assessment of a student's performance in his utilization of the _____ (insert application aircraft type) Propulsion system. The Propulsion segment scoring data shall be provided to the IOS segment via the MSS VNET.

(Application specific scoring data requirements for the Propulsion segment shall be listed in this paragraph. If large amounts of data are required it may be advisable to provide this to the IOS as a non-real-time activity.)

3.2.1.2.1.10 Other Support Function Services. Not Applicable.

(If there are other support functions unique to this segment they should be listed here, otherwise identify this paragraph as "Not Applicable". Intrasegment communication is an example of a function that might be listed in this paragraph. Before defining new functions, be sure the function cannot be incorporated as a variant of an existing function.)

3.2.1.2.2 Core Engine System Function. The core engine system function shall simulate the pressures and temperatures throughout the engine, compressor and turbine sections of the aircraft engine. The core engine system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the aircraft engine performance, operations, or characteristics.

The core engine system function shall incorporate a model appropriate for the aircraft engine. The core engine system function shall calculate engine temperatures, pressures, turbine, fan and compressor speeds. The temperature, pressure, and speed characteristics shall be determined using engine performance curves which are parametric functions of ambient pressure, ambient temperature, Mach number and engine controls. These variables are provided both internally and from the MSS Virtual Network.

Temperatures in the core engine shall be modeled. These temperatures shall include the compressor inlet temperature, and the turbine inlet temperature.

Engine pressures in the core engine shall be modeled. These pressures shall include compressor inlet and discharge pressures, combustion chamber pressure, and turbine exhaust pressure.

Compressor and fan speed of the engine shall be modeled. These shall include high compressor speed and low compressor speed.

The core engine system function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by this function.

(This paragraph should be tailored to indicate the specific type of engine (Pratt-Whitney F100-PEE-200, JT3D, etc.) to be modeled for the application aircraft. The following considerations should be addressed concerning the specification of the core engine system simulation

- a. Engine controllers used on the engine (main engine fuel controller, core speed controller, fan speed controller turbine blade temperature controller, etc)*
- b. Engine fidelity requirements on the engine controller*
- c. Throttle drive method requirement (Drivable, None)*
- d. Autothrottle capability requirements*
- e. Engine core response requirements (transient, steady state or static)*
- f. Core degraded modes of operation requirements (battle damage and/or malfunctions)*
- g. Engine core observables required to be presented to the aircrew (core speed, fan speed, fuel flow, turbine blade temperature, exhaust pressure ratio, exhaust gas temperature, cautions and warnings, etc.)*

The fidelity of the simulation may vary with the targeted training objective. The degree of accuracy required for engine temperatures, pressures, and compressor speeds should be included in this paragraph. The range of ambient conditions that the engine will be required to operate in should also be specified.)

3.2.1.2.3 Thrust Generation System Function. The thrust generation system function shall simulate the thrust

characteristics of the _____ (*insert application aircraft type*) engine. The thrust generation function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the application aircraft performance, operations, or characteristics.

The thrust generation function shall incorporate an engineering model appropriate for the aircraft engine. The thrust generation function shall calculate engine thrust due to main engines and afterburners where applicable.

The thrust generation function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by the function.

(The following considerations should be addressed concerning the specification of the thrust generation system simulation.

- a. Type of engine thrust responses required (static, transient or steady state)*
- b. Reheater system requirements (type and controller)*
- c. Thrust generation degraded modes of operation required (malfunctions and/or battle damage)*
- d. Type of thrust directionality required (ported, vectored or reversible)*
- e. Thrust observables required to be presented to the aircrew (thrust vector angle, thrust port statuses, thrust output, reheat alight status , cautions and warnings, etc.)*

The degree of accuracy required for the listed observables and for the computed thrust/torque output should also be specified in this paragraph.

This paragraph should be tailored with training objectives in mind. Such as, in an aircraft procedures training environment, an accurate simulation of the thrust generation characteristics is a must where all indications in the cockpit should be "as aircraft". However, in a combat training environment these characteristics may or may not be required. Timing and accuracy requirements should be addressed also.)

3.2.1.2.4 Starting System Function. The starting system function shall simulate the operation and functional characteristics of the _____ (*insert application aircraft type*) engine starting system. The starting system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The starting system function shall incorporate a model appropriate for the engine starting system of the aircraft engine. The starting system function shall calculate starting torque, gear speeds and engine status.

The starting system function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the application aircraft equipment simulated by this function.

(The following considerations should be addressed concerning the specification of the engine starting system simulation .

- a. Type of engine start responses required (transient or steady state)*
- b. Starting system degraded modes of operation requirements (malfunctions and/or battle damage)*
- c. Engine starting method requirements (APU, mechanical crank, ground cart, cartridge, inter-engine or quick start)*
- d. Engine starting crew observables requirements (engine ignition, APU/EPU run lights, cautions and warnings, etc) requirements*

This paragraph should be tailored with training objectives in mind. A quick-start function may be all that is necessary for certain types of training (such as combat training) where rapid start-up times are required. However, in an aircraft procedures training environment, an accurate simulation of the start up characteristics is a must where all indications in the cockpit should be "as aircraft". Timing and accuracy requirements should be addressed also.)

3.2.1.2.5 Engine Inlet System Function. The engine inlet system function shall simulate the operations and functional characteristics of the _____ *(insert application aircraft type)* engine inlet and compressor inlet variable vanes. The engine inlet system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The engine inlet system function shall incorporate a model appropriate for the aircraft engine inlet system. The engine inlet system function shall calculate variable inlet geometry and provide air temperatures, pressures and speeds to other Propulsion segment functions. Standard atmospheric data will be provided via the MSS VNET. The engine inlet system function shall model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by this function.

(The following decisions should be made concerning the specification of the engine inlet system simulation.

- a. Inlet system degraded modes of operation requirements (malfunctions and/or battle damage)*
- b. Type of inlets requirements (fixed ,variable, inlet guide vane controller)*
- c. Anti-icing system*

- d. *Inlet system crew observable requirements (engine ice, inlet lip position, and/or caution and warnings)*

This paragraph should be tailored to provide tolerances for the air temperatures, pressures, and speeds as computed by this function. The engine anti-ice system is simulated in this function. Depending on the training mission environment, modeling of the anti-ice system may or may not be a requirement.

This paragraph should be tailored with training objectives in mind. Such as, in an aircraft procedures training environment, the accurate simulation of the engine inlet characteristics is a must where all indications in the cockpit should be "as aircraft". However, in a combat training environment these characteristics may or may not be required. Timing and accuracy requirements should also be addressed also.)

3.2.1.2.6 Engine Fuel System Function. The engine fuel system function shall simulate the operations and functional characteristics of the _____ (insert application aircraft type) engine. The engine fuel system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The engine fuel system function shall incorporate a model appropriate for the aircraft engine internal fuel system. The engine fuel system function shall calculate fuel flow for the engines and the afterburners where applicable.

The engine fuel system function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by this function.

(The following considerations should be addressed concerning the specification of the engine fuel system simulation.

- a. *Type of engine fuel responses required (static, transient and/or steady state)*
- b. *Fuel system degraded modes of operation requirements (malfunctions and/or battle damage)*
- c. *Fuel system ancillaries requirements (fire detection and/or fire extinguishing)*
- d. *Fuel system crew observables requirements (engine core/reheater fuel flows, total fuel flow, and/or cautions and warnings)*

This paragraph should be tailored with training objectives in mind. Such as, in an aircraft procedures training environment, the accurate simulation of the engine fuel system characteristics is a must where all indications in the cockpit should be "as aircraft". However, in a combat training environment these characteristics may or may not be required. Timing and accuracy requirements should be addressed. The portion of the fuel system that this function simulates must be identified. Typically this function would simulate the fuel system downstream

of the engine fuel cutoff valves.)

3.2.1.2.7 Engine Bleed Air System Function. The engine bleed air system function shall simulate the operations and functional characteristics of the _____ *(insert application aircraft type)* engine bleed air system. The engine bleed air system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The engine bleed air system function shall incorporate a model appropriate for the aircraft engine. The engine bleed air system function shall calculate engine bleed air temperatures and pressures.

The engine bleed air system function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by this function.

(The following considerations should be addressed for the specification of the engine bleed air system simulation.

- a. Bleed air degraded modes of operation requirements (malfunction and/or battle damage)*
- b. Bleed air leak detection system requirements*
- c. Available bleed air sources requirements (engine stages, APU, and/or ground cart)*
- d. Bleed air crew observables requirements (malfunctions, cautions and warnings)*

This paragraph should be tailored to provide the degree of accuracy required for the bleed air temperatures and pressures as computed by the bleed air function. This is an area where the fidelity of the simulation can vary based on training objectives. Bleed effects would add no training value in the battlefield scenario, but may be required for pilot training. The bounds of the bleed air simulations should be identified between this function and the Environmental Controls simulation provided by the Flight Station segment.)

3.2.1.2.8 Transmission System Function. The transmission system function shall simulate the operations and functional characteristics of the _____ *(insert application aircraft type)* accessory drive gearbox system. The transmission system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The transmission system function shall incorporate a model appropriate for the aircraft engine. The transmission system function shall calculate gear box and power takeoff shaft speeds.

The transmission system function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by this function.

(The following considerations should be addressed in the specification of the transmission system simulation.

- a. Transmission degraded modes of operation requirements (malfunction and/or battle damage)*
- b. Transmission system ancillaries requirements (pressure, temperature, etc)*
- c. Type of transmission requirements (gearbox, direct drive, or clutching)*
- d. Type of torque controller requirements (blade torque, or shaft torque)*
- e. Type of gearbox loads requirements (hydraulic pumps, generators, gearbox, etc)*
- f. Transmission system crew observables requirements (transmission torque, blade torque, cautions and warnings, etc)*

This paragraph should be tailored for the type of aircraft and the training objectives. For a rotary wing aircraft, the transmission simulation will be more complex than that of a fixed wing aircraft. The gearbox and power takeoff shaft speed tolerances should be specified.)

3.2.1.2.9 Engine Oil System Function. The engine oil system function shall simulate the operations and functional characteristics of the _____ *(insert application aircraft type)* engine oil system. The engine oil system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The engine oil system function shall incorporate a model appropriate for the aircraft engine including the calculation of oil quantity, temperature and pressure.

The engine oil system function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand for the aircraft equipment simulated by this function.

(The following considerations should be addressed for the specification of the engine oil system simulation.

- a. Type of engine oil system response requirements (transient or steady state)*
- b. Oil system crew observables requirements (oil pressure, oil temperature, oil quantity, and cautions and warnings)*
- c. Oil system degraded modes of operation requirements (malfunctions and/or battle damage)*

This paragraph should be tailored with training objectives in mind. Such as, in an aircraft procedures training environment, the accurate simulation of the engine oil system characteristics

is a must where all indications in the cockpit should be "as aircraft". However, in a combat training environment these characteristics may or may not be required. Timing and accuracy requirements should be addressed also.

Tolerances should be provided for the computed oil quantity, oil temperature, and oil pressure.)

3.2.1.2.10 Emergency/Auxiliary Power Unit System Function. The emergency/auxiliary power unit system function shall simulate the operations and functional characteristics of the Emergency Power Unit (EPU) or Auxiliary Power Unit (APU) onboard the _____ *(insert application aircraft type)*. The emergency/auxiliary power unit system function shall produce outputs to the cockpit indicators and other segments such that the pilot shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The emergency/auxiliary power unit function shall incorporate a model appropriate for the aircraft engine. The emergency/auxiliary power unit system function shall calculate fuel flow, shaft speed, engine gas temperature, oil and bleed air system parameters.

The emergency/auxiliary power unit function shall also model electrical current demand, hydraulic pressure demand, and pneumatic pressure demand by the aircraft equipment simulated by this function.

(The following considerations should be addressed for specification of the EPU/APU system simulation.

- a. APU/EPU system degraded modes of operation requirements (malfunctions and/or battle damage) .*
- b. Number of APU/EPU's installed*
- c. APU ancillaries requirements (fire detection and/or fire extinguishing)*
- d. APU Controller requirements*
- e. APU/EPU system observables requirements (run status, RPM, cautions and warnings, etc)*

This paragraph should be tailored for the application aircraft EPU or APU. The model number and manufacturer of the auxiliary power unit being simulated should be noted. Performance characteristics such as the required accuracy of the computed fuel flow, shaft speed, engine gas temperature, and oil and bleed parameters should be given. If a full simulation is required, any performance characteristics less than "as aircraft" should be identified.

This paragraph should be tailored with training objectives in mind. Such as, in an aircraft procedures training environment, the accurate simulation of the engine EPU or APU characteristics is a must where all indications in the cockpit should be "as aircraft". Timing and accuracy requirements should be addressed also.)

3.2.1.2.11 Engine Exhaust System Function. The engine exhaust system function shall simulate the operations and functional characteristics of the _____ (*insert application aircraft type*) engine exhaust system. The engine exhaust system function shall produce outputs to the cockpit indicators and other segments such that the crew shall not perceive any difference between the simulation and the actual aircraft performance, operations, or characteristics.

The engine exhaust system function shall incorporate a model appropriate for the aircraft engine exhaust system. The engine exhaust system function shall model the exhaust nozzle configuration and shall calculate exhaust gas temperature, and exhaust nozzle position.

(The following considerations should be addressed for specification of the engine exhaust system simulation.

- a. Type of exhaust nozzles required (fixed or variable)*
- b. Type of exhaust nozzle responses requirements (static, transient or steady state)*
- c. Nozzle exit area controller requirements*
- d. Exhaust degraded modes of operation requirements (malfunctions and/or battle damage) .*
- e. Engine exhaust crew observables requirements (exit nozzle area, cautions and warnings, etc)*

This paragraph should be tailored with training objectives in mind. Such as, in an aircraft procedures training environment, the accurate simulation of the engine exhaust characteristics is a must where all indications in the cockpit should be "as aircraft". However, in a combat training environment these characteristics may or may not be required. Timing and accuracy requirements should be addressed also.)

3.2.2 System Capability Relationships. The Propulsion segment shall support the capability relationships defined in Volume I of this specification. Propulsion segment functional relationships shall be as described in the following paragraphs.

(Define any Propulsion segment unique capability relationships. In general, the capability relationships specified in Volume I will suffice for this segment.)

3.2.2.1 Segment Functional Relationships. The top level, typical, Propulsion segment functional relationships are depicted in FIGURE 1. Each function shall operate in a manner which will allow the segment, as a system, to satisfy the timing requirements described in Volume I of this specification. Functions implemented within the Propulsion segment shall operate in such a manner which will allow the segment to meet both segment and system level requirements without degradation.

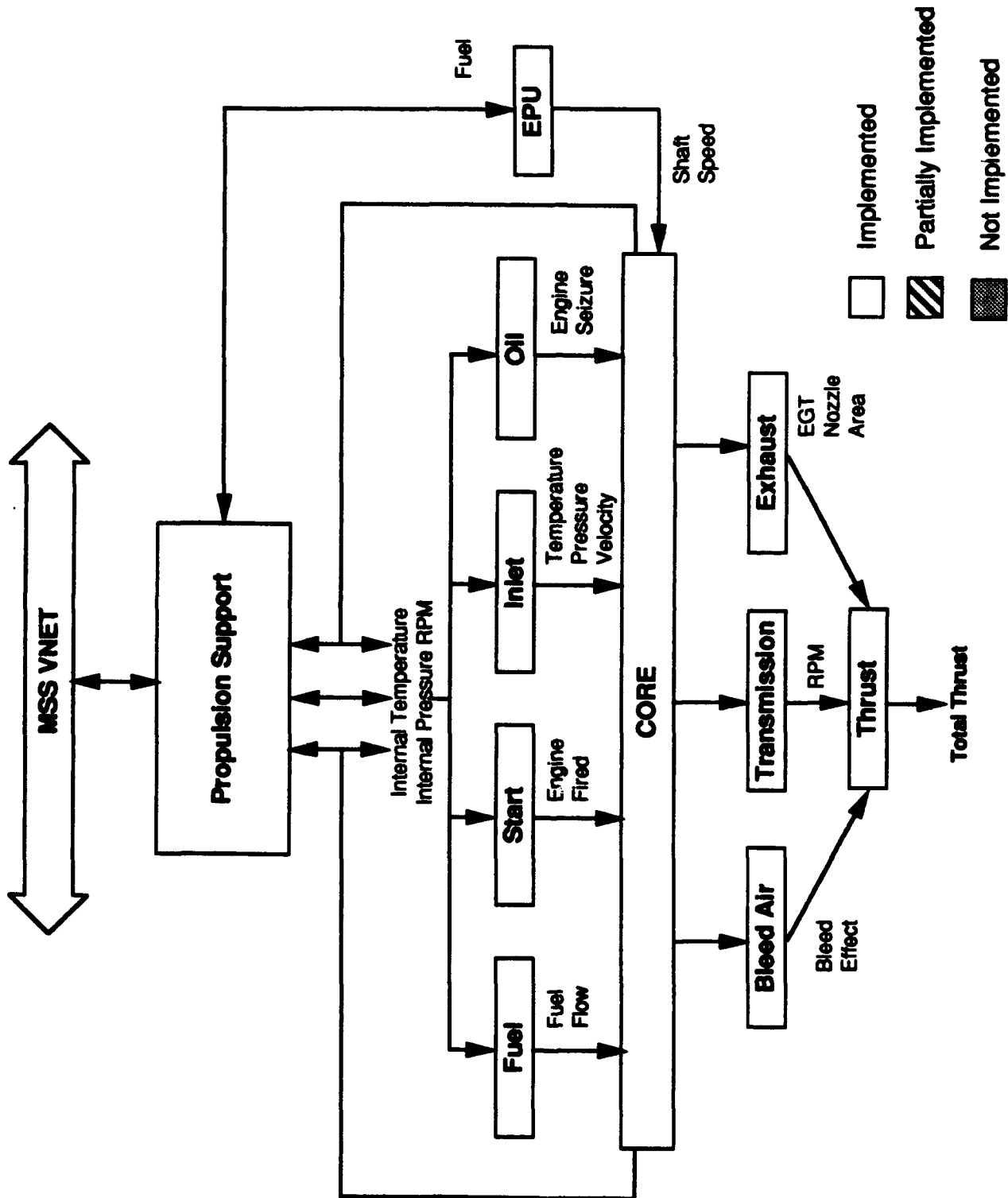


FIGURE 1 PROPULSION SEGMENT FUNCTIONAL RELATIONSHIPS

(There are two approaches to describing inter-segment interfaces: all functions communicate through the support function, or all functions communicate directly with other functions. FIGURE 1 in all segments may have the same structure. For this segment, functions which are not implemented should be shaded out. If desired, functions which are only partially implemented may be graphically represented with cross hatching. Note that the intent of this diagram should be to identify "required" internal relationships and not to specify the segments internal design. The tailoring of this paragraph should be done very carefully.)

3.2.3 External Interface Requirements. The Propulsion segment shall support the external interface requirements defined in Volume I of this specification and the _____ (insert application aircraft type) MSS Interface Requirements Specification (IRS). External interfaces comprises data passed between Propulsion segment functions and the functions of other MSS segments. With the exception of the dedicated interfaces for the cockpit, all other external interfaces which shall be used for the Propulsion segment are specified in the _____ (insert application aircraft type) MSS IRS.

(Define any Propulsion segment unique external interface requirements. External facility interfaces for primary power, cooling, floor space, etc., should be identified here or specifically referenced in Volume I.)

3.2.4 Physical Characteristics. The physical characteristics of the Propulsion segment shall meet the requirements as specified in Volume I of this specification. The Propulsion segment physical characteristics shall be of such design as to interface with the other MSS segments via the MSS VNET.

(Physical characteristics requirements for the Propulsion segment, other than those provided by the Propulsion segment computational system and its interface to the MSS Virtual Network shall be defined in this paragraph. Physical characteristic requirements may include backdoor interface hardware to connect Propulsion segment (I/O) to the application aircraft cockpit. In addition, any weight or size considerations applicable to the Propulsion segment should be considered.)

3.2.4.1 Protective Coatings. Propulsion segment protective coatings shall be as defined in Volume I of this specification.

(Additional protective coating requirements which are required for the Propulsion segment may be defined in this paragraph. In general, the requirements of Volume I should suffice for the entire system.)

3.2.5 Propulsion Segment Quality Factors

3.2.5.1 Reliability. The system level reliability requirements applicable to all segments in the MSS are defined in Volume I of

this specification. The Propulsion segment reliability must be _____ % to satisfy the system level reliability requirements. The Mean Time Between Critical Failure (MTBCF) shall not be less than _____ hrs.

(A specific allocation of reliability (e.g. MTBCF) for this segment should be specified in this paragraph. Reliability should be allocated to each segment in such a way that system level reliability requirements will be met. Normally this means that segment reliability will be higher than system reliability.)

3.2.5.2 Maintainability. The system level maintainability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Propulsion segment shall have a mean corrective maintenance time, of _____ minutes, and a 90th percentile maximum corrective maintenance time of _____ minutes to satisfy the system level maintainability requirements.

(Maintainability requirements such as Mean Time to Repair (MTTR) should be allocated to each segment in such a way that system level maintainability requirements will be met. Normally this means that segment MTTR will be higher than system MTTR. System level requirements will include isolation to a faulty segment.)

3.2.5.3 Availability. The system level availability requirements applicable to all segments in the MSS shall be as defined in Volume I of this specification.

(Usually, availability applies only to the system level. Reliability and Maintainability (MTBF and MTTR) should be allocated to each segment in such a way that system availability requirements will be met. It would be unusual to impose an availability requirement at the segment level.)

3.2.5.4 Additional Quality Factors. The additional quality factors, as defined in Volume I of this specification, shall apply to Propulsion segment.

(Additional Propulsion segment unique quality factors may be defined in this paragraph. In general, the system level additional quality factors will suffice for the Propulsion segment.)

3.2.6 Environmental Conditions. The environmental conditions requirements, as defined in Volume I of this specification, shall apply to Propulsion segment.

(Identify any Propulsion segment unique environmental requirements. In general, the system level environmental conditions will suffice for the Propulsion segment.)

3.2.7 Transportability. The transportability requirements, as defined in Volume I of this specification, shall apply to Propulsion segment.

(Identify any Propulsion segment unique transportation requirements. There may exist unique transportation requirements to ship the segment from the segment contractors facility to the prime contractors facility. In general, the system level transportability requirements will suffice for the Propulsion segment.)

3.2.8 Flexibility and Expansion. The flexibility and expansion requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Unique requirements for this segment may include spare memory, spare time, spare mass storage, I/O channels by type, chassis expansion slots, etc. Expansion requirements should consider the likelihood this segment will need to change as well as the cost of including capability now versus cost to change later. Reuse of the segment in future applications should also be considered and specified.)

3.2.9 Portability. The portability requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Except for field transportable trainers portability of hardware is usually not a requirement. Portability of software may be a concern for future changes which may include upgrading the computer Hardware Configuration Item (HWCI) are considered likely. Use of a standard higher order language such as Ada is usually adequate to assure software portability.)

3.3 Design and Construction. The design and construction requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique design and construction requirements. In general, the system level design and construction requirements will suffice for the Propulsion segment.)

3.3.1 Materials. The materials requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique materials requirements. In general, the system level materials requirements will suffice for the Propulsion segment.)

3.3.1.1 Toxic Materials. The toxic materials requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique toxic materials requirements. In general, the system level toxic materials requirements will suffice for the Propulsion segment.)

3.3.2 Electromagnetic Radiation. The electromagnetic radiation requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique electromagnetic radiation requirements. In general,

the system level electromagnetic radiation requirements will suffice for the Propulsion segment.)

3.3.3 Nameplates and Product Marking. The nameplate and product marking requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique nameplate and product marking requirements. In general, the system level nameplate and product marking requirements will suffice for the Propulsion segment.)

3.3.4 Workmanship. The workmanship requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique workmanship requirements. In general, the system level workmanship requirements will suffice for the Propulsion segment.)

3.3.5 Interchangeability. The interchangeability requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique interchangeability requirements. In general, the system level interchangeability requirements will suffice for the Propulsion segment.)

3.3.6 Safety. The safety requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique safety requirements. In general, the system level safety requirements will suffice for the Propulsion segment.)

3.3.7 Human Engineering. The human engineering requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique human engineering requirements. In general, the system level human engineering requirements will suffice for the Propulsion segment.)

3.3.8 Nuclear Control. The nuclear control requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique nuclear control requirements. In general, the system level nuclear control requirements will suffice for the Propulsion segment.)

3.3.9 System Security. The system security requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique system security requirements. In general, the system level system security requirements will suffice for the Propulsion segment.)

3.3.10 Government Furnished Property. Government Furnished Property (GFP) shall be as identified in Volume I of this specification.

(Identify any Propulsion segment unique GFP requirements. In general, the system level GFP requirements will suffice for the Propulsion segment.)

3.3.11 Computer Resource Reserve Capacity. The system level reserve capacity requirements applicable to all segments in the MSS are defined in Volume I of this specification.

(In addition to the computer resource reserve capacity identified in Volume I, the specific reserve capacity for the Propulsion segment may include the computational system hardware and software required to design, develop, and test the Propulsion segment. System considerations such as spare (time, memory, storage, I/O channels) for growth unique to this segment should be imposed here. If this paragraph requires subparagraphs they should follow the numbering and topics used in Volume I.)

3.4 Documentation. The documentation requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique documentation requirements. Documentation requirements for the Propulsion segment may include interface specifications and design data for interfacing to an embedded piece of cockpit equipment. In general, the system level documentation requirements will suffice for the Propulsion segment.)

3.5 Logistics. The logistics requirements for the Propulsion segment shall be as specified in Volume I of this specification, paragraph 3.5, and all subparagraphs of paragraph 3.5.

(Unique support requirements for this segment should be described here. These may include special tools and jigs for installation, alignment and calibration; special environmental conditions for operation and repair such as a clean-room for component repairs; levels and types of spares required.)

3.6 Personnel and Training. The system level personnel and training requirements, defined in Volume I of this specification, shall apply to the Propulsion segment.

(Identify any Propulsion segment unique personnel and training requirements. In general, the system level personnel and training requirements (number, skills and training for maintenance personnel.) will suffice for the Propulsion segment.)

3.7 Subordinate Element Characteristics. Not Applicable.

(This volume defines requirements for a subordinate element of the MSS. In general, there will be no subordinate elements of a segment.)

3.8 Precedence. The precedence requirements for the Propulsion segment shall be as specified in Volume I of this specification.

4. QUALIFICATION REQUIREMENTS

4.1 Responsibility For Test and Inspection. The _____ (insert application aircraft type) MSS responsibility for test and inspection requirements are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Propulsion segment.

(This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Propulsion segment)

4.2 Special Tests and Examinations. The system level general qualification events, levels, and methods of testing for the Propulsion segment are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Propulsion segment.

(Clearly identify which test events defined in Volume I apply to this segment. Be particularly explicit about the segment builder's responsibility during system integration and test. In some cases, verification can only be achieved in the integrated mode. A clear definition of the segment supplier's responsibility during systems integration should be contained in the SOW.

This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Propulsion segment. The following list contains examples of special tests that may be required depending on the application aircraft specific verification requirements.

- a. *Flight Dynamics, Flight Controls, Physical Cues and Propulsion Segments Subjective Integrated Test: Although thorough and complete design data will reduce the amount of subjective tuning and testing that may be required, a subjective test to confirm proper integration of the Flight Dynamics, Flight Controls Physical Cues and Propulsion systems may still be required.*
- b. *Autotests: These tests are initiated from the IOS for the purpose of segment and integrated performance testing. Autotest provides repeatable results in a much shorter period of time than pilot in the loop tests. This may be for acceptance testing or simulator certification. The types and extent of test to be included will be driven by the support concept and availability requirements of the system and their allocation to this segment. Autotest may be used for acceptance by the procurement agency and certification by the user or FAA (SIMCERT/AC120-40). Consideration must also be given whether or not design criteria only or design criteria plus subjective tuning will be used when determining pass/fail criteria for autotest.*

Responsibility for integrated tests should be minimized at the segment level. If the segment is required to pass an integrated test, as part of its acceptance, that test(s) should be called out here. Additional tests might include segment compliance tests which can only be performed with the segment installed as part of a system. These should be identified here and the requirements

detailed by adding subparagraphs.)

4.3 Requirements Cross Reference. A requirements compliance cross reference matrix shall be developed to ensure requirement traceability. The requirements cross reference matrix shall be included as part of the _____ MSS Prime Item Development Specification (PIDS).

5. PREPARATION FOR DELIVERY. The _____ (*insert application aircraft type*) MSS preparation for delivery requirements, as defined in Volume I of this specification, shall apply to the Propulsion segment.

(Segment unique requirements may include packaging the segment for shipment to the integration location which could be different than packaging the system for shipment to the installation site. If requirements are imposed here, there may be test requirements for verification which must be added to Section 4.)

6. NOTES

6.1 Intended Use. The _____ (insert application aircraft type) MSS shall be used as an integral part of the _____ (insert application aircraft type) aircraft training system.

6.1.1 Missions. The Propulsion segment shall support the mission requirements, as described in paragraph 6.1.1 of Volume I of this specification. It shall provide the Propulsion portion of simulation and training in cockpit familiarization, flight characteristics, operating procedures, and mission procedures for the _____ (insert application aircraft type) MSS. The Propulsion simulation shall assist in allowing the trainee to become familiar with the cockpit configuration and flight characteristics of the aircraft, gain proficiency in executing normal procedures, in recognizing malfunctions/abnormal indications and executing the corresponding emergency procedures, and in executing mission procedures. Normal procedures and emergency procedures specified herein shall be taken from the aircraft Technical Orders (T.O.s) for the _____ (insert application aircraft type). The trainees may range in experience from newly designated aviators undergoing initial training to experienced aviators undergoing refresher training.

(The Propulsion segment mission is to support the trainer mission as described in Volume I. Any mission specific information should be described in this section. An example would be a segment intended to support a family of trainers such as a procedures trainer, part-task trainer, flight trainer, or weapons system trainer.)

6.1.2 Threat. Not applicable

(This paragraph shall describe the threat which the system is intended to neutralize. In this context, this paragraph is not applicable to most simulators, and will generally remain "Not applicable".)

6.2 Propulsion Segment Acronyms. The acronyms contained in this paragraph are unique to the Propulsion segment and are in addition to the MSS acronyms contained in Volume I of this specification, paragraph 6.2.

APU	Auxiliary Power Unit
DOD	Department of Defense
EPU	Emergency Power Unit
GFP	Government Furnished Property
H/W	Hardware

S495-10400D
13 August 1993
Volume V of XIII

IDD	Interface Design Document
I/O	Input/Output
IOS	Instructor/Operator Station
IRS	Interface Requirements Specification
MSS	Modular Simulator System
MTBCF	Mean Time Between Critical Failure
N/A	Not Applicable
PIDS	Prime Item Development Specification
T.O.s	Technical Orders
VNET	Virtual Network

6.3 Glossary of Propulsion Segment Terms. The terms contained in this paragraph are unique to the Propulsion segment and are in addition to the MSS terms contained in Volume I of this specification, paragraph 6.3.

ANCILLARY SYSTEMS - The systems which function in a supporting capacity to the more prolific systems (such as flight dynamics and propulsion) of an air vehicle device.

AUXILIARY POWER UNITS - A system powered by a small turbine engine used to supply air flow, provide main engine starting torque, provide generator drive and/or hydraulic pump drive during normal or emergency operation.

CORE ENGINE SYSTEM - The function which simulates the pressure, temperature and mass flows through the engine compressors, combustors and turbines as well as the compressor and turbine speeds.

CREW STATION - The area of the vehicle in which the aircraft flight or operation crew resides.

DAMAGE ASSESSMENT - The evaluation of injury and the appropriate degradation of the system affected.

DYNAMIC PRESSURE - The air pressure caused by the movement of a body through the air.

EMERGENCY POWER UNIT (EPU) - A self contained unit for providing emergency electrical and hydraulic power to the aircraft. The EPU uses engine bleed air or hydrazine for operation.

ENGINE BLEED AIR SYSTEM - The function which calculates the mass airflow capability of the engine and computes the effects upon the engine due to these airflow off-takes.

ENGINE DYNAMICS - The steady state and transient responses of the engine compressors and turbines to changes such as the environment, fuel flows, air vehicle attitude or power off-takes.

ENGINE EXHAUST SYSTEM - The function simulating the control, pressure, temperature and thrust of the engine exhaust system including exit nozzle and exhaust ports.

ENGINE FUEL CONTROLLER - The engine subsystem that regulates fuel flow to the engine core, combustor and/or afterburner.

ENGINE FUEL SYSTEM - The function that simulates the operation and characteristics of the engine fuel controller and engine fuel system throughout the engine operating envelope.

ENGINE INLET SYSTEM - The function that simulates the operation and characteristics of engine air intake system including inlet geometry and inlet guide vane positioning.

ENGINE OIL SYSTEM - The function that simulates the operation and characteristics of the engine lubricating system including oil pressure, temperature and quantity calculations throughout the engine operating envelope.

ENGINE OPERATING ENVELOPE - A family of cross plotted engine operational limits that establish boundaries for nominal engine operation. The plotted boundaries produce an operating envelope within which the engine may only operate. Operational limits include such things as Mach, aircraft attitude, ambient temperature and ambient pressure.

ENGINE STARTING SYSTEM - The function that simulates the operation and characteristics of the engine start system including torque generation, gear speeds, and type of start, (i.e. APU crank, Air Turbine, Air Start)

ENGINE TRANSMISSION SYSTEM - The function which simulates the accessory drive gearbox and all of it's associated transmission paths. The transmission paths modeling is Bi-directional, (i.e. engine driven gearbox or gearbox driven engine), to simulate engine starting and/or accessory drive from the engine.

FUEL MANAGEMENT SYSTEM - A system which is comprised of the fuel components of a vehicle. In the simulation environment, this would include modeling the characteristics of the fuel feed to the engine, fuel transfer, fuel dump and fuel quantities.

HYDRAULIC SYSTEM - A system which is comprised of the hydraulic components of a vehicle. In the simulation environment, this would include modeling the pumps, valves, and characteristics such as bleeds, flows, and quantities.

INSTRUCTOR/OPERATOR STATION - Provides the central point of control for the entire air vehicle trainer. The primary user of the IOS is the training instructor. Secondary users may consist of students and maintenance technicians. The IOS segment provides the capabilities for simulator status and control, controls disagreement and crew (trainee) performance monitoring and measurement. Simulator status and control capabilities will include ownship, navigation/communication, environment, and missions. The IOS may be responsible for the control and monitoring of either one or many simulation devices depending on the specific application.

JET FUEL STARTER SYSTEM - A gas turbine which is operated on aircraft fuel and is used for ground starting or assisting air starts. The JFS is started by power from hydraulic accumulators.

MACH NUMBER - The ratio between the aircraft velocity and the speed of sound at the same conditions.

MALFUNCTION - The simulated erroneous operation or behavior of a system, instrument, device, or process.

MOMENTS OF INERTIA - Forces resistive to rotation acting within a body due to its own mass distribution about its own body axes.

PARAMETER - A variable or element used to represent a real world value in a mathematical or logical expression.

PNEUMATIC SYSTEM - The system which is comprised of the pneumatic components of a vehicle. In the simulation environment, this would include modeling the cabin air conditioning and cabin pressurization characteristics.

POWER EXTRACTION - The power take-off from the engines due to mechanical and/or thermodynamic loads. Mechanical loading comes from such things as hydraulic pumps and generators while thermodynamic loads come from bleed air take-offs.

POWER TRANSMISSION PATHS - The paths by which engine torques may be applied to the accessories or the paths by which engine starting torques may be applied to the engine.

PROPULSION - The simulation of the engines and thrust generation capabilities for the application aircraft.

STRUCTURAL LIMITS - A threshold, which if surpassed, would result in structural failure to the vehicle. The threshold limits are most often expressed as loads imposed on the air vehicle.

SUPPORT - Provides the segment unique services required for the operation of the segment in the simulator environment. This includes executive control, initialization, communication with other segments, devices, and systems, malfunctions, security, and trainee scoring.

THRUST - The propulsive force produced by a jet engine or a unit of measure of the propulsive force.

THRUST FORCES - Forces acting on a body normally generated by a propulsive device such as a jet engine.

THRUST GENERATION SYSTEM - The function that simulates the characteristics of the application aircraft engine's thrust producing system. The thrust is calculated as the summation of engine core thrust, afterburner thrust and installation losses.

VECTORED THRUST - An aircraft system for effective guidance control by changing the flow pattern of engine exhaust.

WIND TUNNEL DATA - Substantiating or design data obtained directly from wind tunnel testing on a prototype or scale model.

ACTIVE PAGE RECORD											
PAGE NO.	REV LTR	ADDED PAGES				PAGE NO.	REV LTR	ADDED PAGES			
		PAGE NO.	REV LTR	PAGE NO.	REV LTR			PAGE NO.	REV LTR	PAGE NO.	REV LTR
V-1	D										
V-2	D										
V-3	D										
V-4	D										
V-5	D										
V-6	D										
V-7	D										
V-8	D										
V-9	D										
V-10	D										
V-11	D										
V-12	D										
V-13	D										
V-14	D										
V-15	D										
V-16	D										
V-17	D										
V-18	D										
V-19	D										
V-20	D										
V-21	D										
V-22	D										
V-23	D										
V-24	D										
V-25	D										
V-26	D										
V-27	D										
V-28	D										
V-29	D										
V-30	D										
V-31	D										
V-32	D										
V-33	D										
V-34	D										

REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
A	BMAC-STS-86-303-1 Total revision required to incorporate changes required by testing/validation efforts and Government comments.	90/01/11	S. Clem
		90/01/11	Prepared By S. Clem
		91/01/14	Checked By J. B...
		90/01/11	Dwg. Qual. S. Clem
		91/01/15	Supervised By W. Tucker
			Approved By W. Tucker
B	CCP HSV-H91-008 Total revision required to incorporate changes resulting from addition of two new specifications and new functional allocation. Damage Assessment and Scoring were added to the module support function.	91/06/26	J. Thibault
		91/06/26	Prepared By B. J...
		91/06/26	Checked By J. B...
		91/06/27	Dwg. Qual. S. Clem
		91/06/27	Supervised By W. Tucker
			Approved By W. Tucker

91/01/17

91/07/05

DO-6000-4530 ORIG. 12/87

REVISIONS

REVISIONS															
LTR	DESCRIPTION	DATE	APPROVAL												
C	CCP HSV-H91-008 Total revision required to incorporate Government comments on document.	91-09-26	K. Kelly												
			Prepared By												
		91-09-26	SM Hunter												
			Checked By												
		91/09/26	B. [Signature]												
			Reg. Qual.												
		91-09-26	SM Hunter												
			Supervised By												
		91 10-08	WV Tucker												
			Approved By												
D	CCP HSV-H91-017 This specification volume has been totally revised to: 1. Change the format to comply with DI-CMAN-80008A. 2. Incorporate the tailoring instructions into the body of the text. The incorporation of tailoring instructions into each specification volume has caused a change in the number of specification volumes from fourteen to thirteen. Prior to this change, all tailoring instructions were provided in Volume XIII and Volume XIV contained the Tactical and Natural Environment segment specification. The content of Volume XIII has been integrated into the other specification volumes. The change is summarized as follows: <table><tr><td><u>Volume</u></td><td><u>IS</u></td><td><u>WAS</u></td></tr><tr><td>I through XII</td><td colspan="2">Titles for these volumes are unchanged</td></tr><tr><td>XIII</td><td>Environment</td><td>Tailoring Instructions</td></tr><tr><td>XIV</td><td>"Deleted"</td><td>Tactical and Natural Environment</td></tr></table>	<u>Volume</u>	<u>IS</u>	<u>WAS</u>	I through XII	Titles for these volumes are unchanged		XIII	Environment	Tailoring Instructions	XIV	"Deleted"	Tactical and Natural Environment	93-08-23	D. B. [Signature]
		<u>Volume</u>	<u>IS</u>	<u>WAS</u>											
		I through XII	Titles for these volumes are unchanged												
		XIII	Environment	Tailoring Instructions											
		XIV	"Deleted"	Tactical and Natural Environment											
			PREPARED												
93-08-23	J. A. Arnold														
	CHECKED														
		93-08-23	SM Hunter												
			SUPERVISED												
		93/08/29	WV Tucker												
			APPROVED												

01/01/90

FEI: [Signature] 93-08-23

DD-5000-4530 ORIG. 12/87