PERFORMANCE BASED SPECIFICATION
FOR
MULTI-ENGINE TRAINING SYSTEM

Prepared for and by:
DEPARTMENT OF THE NAVY
PROGRAM EXECUTIVE OFFICE PMA-273
NAVAL AIR SYSTEMS COMMAND
PATUXENT RIVER, MD 20670

13 Dec 2021

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Change History

The table below identifies all changes incorporated into the updated version of this document after initial approval.

Date	Revision	Change Description
13 Sep 2021	1	AV-005 revised verbiage to reference appendix B definitions. AV-027 removed relief tube. AV-092 added additional requirements and Table 3-3. AV-093 added additional requirements and changed verification method to demonstration during GAT. AV-094 modified verbiage. AV-118 modified table number. AV-130 modified table number. AV-155 added new requirement for AOA description and verification method in section 4. Appendix A added definition for AOA Indexer System
13 Dec 2021	2	Revised mission profile A figure and paragraphs 3 and 4 on page 34.

Table of Contents

Table of Figures

List of Tables

1 SCOPE

This Performance Based Specification (PBS) establishes the overall system capabilities, functionality, and equipage for the commercial airplane that is part of Multi-Engine Training System (METS). Section 2 identifies the Government and non-government documents cited in this PBS. Section 3 of this document establishes the mandatory capabilities of the system. Section 4 contains the criteria used to verify Section 3 requirements.

1.1 Overview

The mission of Chief of Naval Air Training (CNATRA) is to produce aviators and flight officers in sufficient quantity to support Naval Air Forces tasking. Since the late 1970's, CNATRA has utilized a fleet of T-44 Pegasus airplanes, six cockpit training simulators, and classroom and computer-aided instruction to conduct advanced multi-engine training at NAS Corpus Christi. Since 2007, this training has included intermediate tiltrotor training for the United States Marine Corps. Aircraft training is conducted by military instructors with simulator and academic training by both military and civilian instructors. Student naval aviators are prepared for fleet naval aviation through training in necessary skills, including, but not limited to, aircraft familiarization, radio instruments, airways navigation, visual navigation, and formation flying. The training missions require the METS airplane to operate in varying environmental and climatic conditions throughout the continental United States.

1.2 Application

This specification, including its appendices, represents the technical requirements for the METS airplane.

1.3 Specification Terms

This PBS contains three broad categories of requirements. The first category represents the minimum acceptable capabilities, functionality, interfaces, or environmental factors. The specification items contained in this first category are represented by "**shall**" statements. The second category represents desired capabilities, functionality, or interfaces that may be incorporated at the discretion of the producer. These items will be represented as "should" statements in this specification. The third category represents intent, declaration of purpose on the part of the Government. These items will be represented as "will" statements in this specification.

1.3.1 Terminology

1.3.1.1 "Shall"

Requirements throughout this document, inclusive of the appendices, that are defined using "**shall**" statements, are considered mandatory, binding and require formal verification.

1.3.1.2 "Should"

Statements using "should" express intent or desired functionality or performance above the minimum requirements.

1.3.1.3 "Will"

Statements using "will" express intent, declaration of purpose on the part of the Government. In general, "will" statements express actions done on the part of the Government to evaluate the manufacturer's compliance with the PBS.

2 DOCUMENTS

2.1 General

This PBS for the METS consists of this main body, Appendix A (Definitions), and Appendix B (Mission Profiles).

2.2 Government Documents

2.2.1 Specifications, Standards, and Handbooks

The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Defense Logistics Agency Data Services Online or ASSIST <https://quicksearch.dla.mil/qsSearch.aspx>.

Table 2-1 Government Documents - Specifications, Standards, and Handbooks

Document Number	Government Specifications, Standards, and Handbooks
14 CFR Part 23	Airworthiness Standards: Normal Category Airplanes
14 CFR Part 91	General Operating And Flight Rules
ASTM-D1655	Aviation Turbine Fuels
FAA AC 20-153B	Acceptance of Aeronautical Data Processes and Associated Databases
FAA HF-STD-001	Human Factor Design Standard
JSSG-2001B	Joint Service Specification Guide, Air Vehicle
MIL-DTL-25959	Tie Down, Tensioners, Cargo, Aircraft
MIL-DTL-5624W	Turbine Fuel, Aviation, Grades JP-4 AND JP-5
MIL-DTL-83133K	Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)
MIL-PRF-27260	Tie Down, Cargo, Aircraft, CGU-1/B
MIL-STD-2161	Paint Schemes and Exterior Markings for U.S. Navy and Marine Corps Aircraft
MIL-STD-3013A	Glossary of Definitions, Ground Rules, and Mission Profiles to Define Air Vehicle Performance Capability
STANAG 3747	Guide Specifications (Minimum Quality Standards) for Aviation Turbine Fuels (F 24, F 27, F 34, F 35, F 37, F 40 and F 44) - AFLP-3747 Edition C
TSO-C114	Torso Restraint Systems

2.2.2 Other Government Documents, Drawings, and Publications

The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues are those in effect on the date of the solicitation. Copies of specifications, standards, handbooks, drawings, publications, and Government documents required by contractors in connection with specific acquisition functions should be obtained from the PMA-273 Program Office.

Table 2-2 Other Government Documents, Drawings, and Publications

Document Number	Other Government Documents, Drawings, and Publications
NAVAIRINST 13100.16	Designating And Naming Defense Military Aerospace Vehicles

2.2.3 Non-Government Documents

The following document(s) of the exact revision level listed below form a part of this document to the extent specified herein. Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available on the Internet, or accessible in or through libraries or other informational services.

Table 2-3 Non-Government Documents

Document Number	Non-Government Documents
SAE AS35061A	Connector, Receptacle External Electric Power, Aircraft, 28Volt DC Operating Power
SAE AS7974/3A	Connector, Plug, Attachable, External Electric Power, Aircraft, Single-Jacketed Cable Assemblies, 115/200 Volt, 400 Hertz
SAE AS8043B	Restraint Systems for Civil Aircraft

2.3 Document Tiering

This PBS, including its appendices, is a first-tier document and is contractually binding. All documents directly referenced in this first-tier specification are second tier documents and are applicable to the extent specified. All documents directly referenced in second or lower-tier documents are for guidance only, unless otherwise directed by the Government.

2.4 Document Order of Precedence

In the event of a conflict between the text of this specification and the references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations.

3 METS CAPABILITIES

3.1 Airplane

3.1.1 Airworthiness Certification

[AV-001] The METS **shall** have a current Federal Aviation Administration (FAA) Type Certification (TC) that authorizes operations under day and night visual flight rules in accordance with 14 Code of Federal Regulations (CFR) Part 23 and 14 CFR Part 91.

[AV-002] The METS **shall** have a current FAA TC or Supplemental Type Certificate (STC) that authorizes operations under instrument flight rules in accordance with 14 CFR Part 23 and 14 CFR Part 91.

[AV-003] The METS **shall** implement all requirements in this PBS in a single type/model/series aircraft configuration in accordance with NAVAIRINST 13100.16.

3.1.2 Temperature Range for Operation

[AV-004] The METS **shall** operate in temperatures ranging from -25ºF (-31.7ºC) to +110ºF (+43.3ºC) at sea level conditions and temperatures at operating altitudes of the airplane.

3.1.3 Performance

3.1.3.1 Takeoff and Landing Distance

[AV-005] The METS should execute the Appendix B missions on a runway length less than or equal to 5,000 feet in accordance with the takeoff and landing distance definitions in Appendix B.

3.1.3.2 Mission Profiles

[AV-006] The METS **shall** execute Appendix B profiles in operational day environmental conditions at or below Mission Takeoff Gross Weight (MTGW) with the Environmental Control System on (ECS-ON).

3.1.3.3 Cruise Airspeed

[AV-007] The METS cruise airspeed **shall** be greater than or equal to 195 Knots True Airspeed (KTAS) in accordance with the Appendix B profiles in operational day environmental conditions with ECS-ON.

3.1.3.4 Altitude

[AV-008] The METS **shall** have a service ceiling greater than or equal to 20,000 feet (FT) Mean Sea Level (MSL).

3.1.3.5 Endurance

[AV-009] The METS should operate for greater than or equal to 3.5 flight-hours endurance while executing Appendix B profiles.

[AV-010] The METS should have a service life of 30 years utilizing a usage spectrum that is developed with the Appendix B profiles.

3.1.4 Human Factors

3.1.4.1 Personal Aircrew Gear

[AV-011] All requirements of this specification **shall** be satisfied with mission aircrew equipped with the following personal aircrew gear:

- Flight suit, gloves, boots, and jacket
- Communication headset

[AV-012] The METS **shall** be equipped with a communication headset with active noise reduction and microphone for operation at both pilot stations and the student jump seat.

3.1.4.2 Electronic Kneeboard (EKB)

[AV-013] The METS **shall** be equipped with electrical charging provisions for the EKB.

[AV-014] The METS **shall** provide a storage area suitable for flight information publications and EKB at each pilot station.

3.1.4.3 Emergency Egress

[AV-015] The METS **shall** meet emergency egress requirements for pilots, student pilot, and passengers equipped with personal aircrew gear.

3.1.4.4 Pilot Seating

[AV-016] The METS **shall** provide side-by-side seating for two pilots.

[AV-017] The METS **shall** be operable from either pilot seat.

[AV-018] The METS should meet the anthropometric attributes shown in Table 3-1.

Table 3-1 Anthropometric Attributes

Attribute	Minimum	Maximum
Sitting Eye Height	≥ 27.5	N/A
Thumb Tip Reach	≥ 28.5	N/A
Buttock-Knee Length	≥ 21.0	≤ 28.4
Sitting Height	≥ 32.0	≤ 40.9
NOTE: Units are in inches. Attributes defined in FAA HF-STD-001		

3.1.4.5 Jump Seat

[AV-019] The METS **shall** be equipped with one jump seat for the student pilot.

[AV-020] The METS jump seat **shall** be adjustable permitting the student pilot to view the cockpit instruments and displays and then stow the seat.

3.1.4.6 Passenger Seating

[AV-021] The METS **shall** be equipped with seating for a minimum of two passengers.

3.1.4.7 Seating Emergency Landing Conditions

[AV-022] The METS seating systems **shall** provide crashworthy protection.

[AV-023] The METS pilot and jump seats **shall** meet the requirements of TSO-C114 and SAE-AS8043.

3.1.4.8 Storage

[AV-024] The METS **shall** provide storage for 200 pounds of baggage.

3.1.4.9 Cockpit Controls and Displays

[AV-025] The METS physical controls and displays **shall** be within human performance limitations, while wearing a glove, with respect to actuation, dimensions, resistance, displacement, separation, orientation, color, and illumination.

[AV-026] The METS automated systems **shall** provide information to keep the aircrew continuously informed of each system's operating mode, intent, function, output, automation failures, and potentially unsafe modes being manually selected.

3.1.4.10 Lavatory

[AV-027] The METS **shall** be equipped with a lavatory.

3.1.4.11 Furnishings

[AV-028] The METS **shall** be equipped with integrated sunshades for the passenger windows and removable sunshades for cockpit windows.

[AV-029] The METS **shall** be equipped with a 6-person life raft in a stowed location.

3.1.5 Autopilot

[AV-030] The METS **shall** be equipped with an autopilot with controls accessible from either pilot position.

[AV-031] The METS autopilot **shall** capture and hold attitude, altitude, airspeed, vertical speed, course, and heading.

[AV-032] The METS autopilot **shall** be integrated with the flight management system to control the approach modes.

3.1.6 Flying Qualities

[AV-033] All flying quality requirements **shall** apply to both pilot stations.

[AV-034] The METS **shall** incorporate independent, mechanically linked controls between the pilot stations for pitch, roll, and yaw axes of control.

[AV-035] The METS **shall** have a stall warning system.

[AV-036] The METS should have stall warning buffet furnished through the inherent aerodynamic qualities of the airplane.

3.1.7 Environmental Control System

[AV-037] The METS **shall** be equipped with an ECS.

[AV-038] The METS ECS should maintain the cockpit and cabin temperature ranges identified in Figure 3-1.

3.1.7.1 Pressurized Compartments

[AV-039] The METS **shall** pressurize the cockpit and cabin to less than 10,000 FT MSL at 30,000 FT altitude.

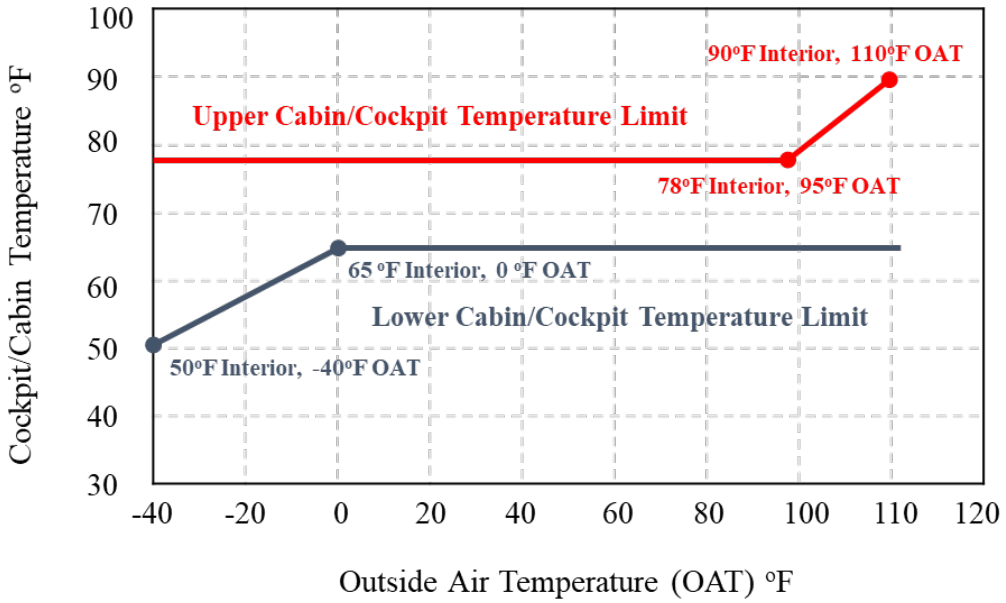
3.1.7.2 Oxygen System

[AV-040] The METS **shall** provide oxygen to the cockpit and cabin.

[AV-041] The METS **shall** be equipped with full-face, quick-donning oxygen masks for both pilot stations and the jump seat station.

[AV-042] The METS oxygen masks **shall** permit internal and external communication on the radios and Intercommunication System (ICS).

Figure 3-1 Interior Temperature Limits



3.1.8 Cabin Cargo

[AV-043] The METS **shall** provide a reconfigurable cabin permitting seating or space for loading and securing cargo to attachment points.

[AV-044] The cargo attachment points should restrain cargo to the following static limit load factors: 3G Forward, 2G Aft, 2G Lateral, 2G Vertical-Up, each one applied independently at the center of gravity of the load.

[AV-045] The cargo attachment points should be compatible with a MIL-DTL-25959 tie down tensioner or a MIL-PRF-27260 tie down assembly.

3.1.9 Power and Propulsion System

3.1.9.1 Engine

[AV-046] The METS **shall** have two engines with non-centerline thrust.

[AV-047] The METS **shall** execute the Appendix B profiles with a simulated single engine failure during climb-out, cruise, holding, approach, and landing phases of flight.

[AV-048] The METS **shall** be equipped with fire extinguishing system in each engine compartment.

3.1.9.2 Fuel System

3.1.9.2.1 Fuels

[AV-049] The METS **shall** be authorized to use all primary fuels specified in Table 3-2.

Table 3-2 Primary Fuel

FLIP CODE	US MIL CODE	NATO CODE	COMM-ERCIAL	SPEC	COMMENTS
J5	JP-5	F-44	NONE	MIL-DTL-5624	
J8	JP-8	F-34	NONE	MIL-DTL-83133	
A++	F-24	F-24	NONE	ASTM D1655 STANAG 3747	
A1	NONE	F-35	JET A-1	ASTM D1655	**
A	NONE	NONE	JET A	ASTM D1655	

Comments:

** - For Jet A & A1, ASTM D1655 permits the fuel to be provide with or without the approved additives, therefore all fuel wetted components (i.e.; fuel, propulsion) **shall** be compatible with these fuels both with or without the additives.

3.1.9.3 Electric Power

[AV-050] The METS **shall** accept external electrical power.

[AV-051] The METS external power receptacle **shall** be in accordance with SAE AS35061A or SAE AS7974/3A, for direct current or alternating current powered aircraft, respectively.

[AV-052] The METS electrical wiring **shall** permit inspection and repair per the original equipment manufacturer's manuals.

3.1.10 Flight in Icing Conditions

[AV-053] The METS **shall** be certified for flight into known icing conditions.

3.1.11 Windshield Rain Removal/Rain Repellent Systems

[AV-054] The METS **shall** provide clear visibility for both pilots during taxi, takeoff, approach, and landing conditions during moderate to heavy rain.

3.1.12 Landing Gear

[AV-055] The METS **shall** be equipped with retractable landing gear in a tricycle configuration.

[AV-056] The METS landing gear **shall** permit taxiing over the E-28 shore-based emergency arresting gear cable.

3.1.13 Avionics Systems

[AV-057] The METS avionics **shall** be approved under the aircraft's TC or an STC.

[AV-058] The METS avionics equipment controls **shall** be accessible from either pilot position.

[AV-059] The METS cockpit **shall** provide an integrated crew vehicle interface through independent, digital cockpit Multi-Function Displays (MFD).

[AV-060] The METS **shall** be equipped with an MFD at each pilot station and a third MFD positioned between them.

[AV-061] The METS MFDs **shall** display primary flight information at each pilot station.

[AV-062] The METS avionics equipment output **shall** be within the field of view for both pilots.

[AV-063] The control and indications of METS avionics equipment **shall** be integrated in the MFDs.

[AV-064] The METS **shall** be equipped with an emergency standby attitude indicator within the field of view of both pilots.

3.1.13.1 Radio Configuration

[AV-065] The METS **shall** be equipped with one Very High Frequency (VHF) radio and one combined VHF and Ultra High Frequency (UHF) commercial radio.

[AV-066] The METS **shall** permit each pilot to transmit and receive over the radios.

[AV-067] The METS **shall** be equipped with a dedicated antenna for each independent radio.

3.1.13.1.1 VHF Radio

[AV-068] The METS VHF radios **shall** be equipped with 8.33 kHz and 25 kHz selectable channel spacing with VHF guard frequency capability.

3.1.13.1.2 UHF Radio

[AV-069] The METS UHF radio **shall** be equipped with 50 kHz or less channel spacing with UHF guard capability.

3.1.13.2 ICS

[AV-070] The METS **shall** be equipped with an ICS receive and transmit capability for each pilot and jump seat station.

3.1.13.3 VHF Omnidirectional Range (VOR) Distance Measuring Equipment (VOR/DME)

[AV-071] The METS **shall** be equipped with a VOR/DME.

[AV-072] The METS **shall** support VOR/DME approaches.

3.1.13.4 Instrument Landing System (ILS)

[AV-073] The METS **shall** support ILS approaches in accordance with FAA standards for category I weather minima.

3.1.13.5 Global Positioning System (GPS)

[AV-074] The METS **shall** be equipped with an integrated GPS wide area augmentation system receiver.

[AV-075] The METS **shall** support GPS approaches to localizer performance with vertical guidance minima.

3.1.13.6 Required Navigation Performance Area Navigation (RNP RNAV)

[AV-076] The METS **shall** support Performance Based Navigation functionality to include Enroute (RNP 2.0), Terminal (RNP 1.0), and RNAV(GPS) Approach (RNP 0.3).

[AV-077] The METS system should include all ARINC 424 leg types required for RNP RNAV departure and arrival procedures.

3.1.13.7 Automatic Dependent Surveillance-Broadcast (ADS-B)

[AV-078] The METS **shall** be equipped with ADS-B Out capability.

[AV-079] The METS should be equipped with ADS-B In capability.

[AV-080] The METS should display ADS-B In flight information services-broadcast weather and aeronautical information to the pilots.

3.1.13.8 Mid-Air Collision Avoidance System

[AV-081] The METS **shall** be equipped with a mid-air collision avoidance capability which provides cues and warning to the aircrew of conflicting air traffic.

[AV-082] The METS should allow the user to mute aural alerts.

[AV-083] The METS **shall** be equipped with a radar beacon transponder with Mode 3/A, Mode C, and Mode S capability.

3.1.13.9 Crash Survivable Cockpit Voice and Flight Data Recorder

[AV-084] The METS **shall** be equipped with a crash survivable cockpit voice and flight data recorder system.

[AV-085] The METS crash survivable cockpit voice and flight data recorder system **shall** store greater than or equal to 25 flight hours of data.

3.1.13.10 Emergency Locator Transmitter (ELT)

[AV-086] The METS **shall** be equipped with a 406 MHz ELT integrated with GPS geolocation data that automatically activates during a crash.

3.1.13.11 Radar Altimeter

[AV-087] The METS **shall** be equipped with a radar altimeter that displays from zero to a minimum of 2000 feet above ground level with an adjustable low altitude alert to the pilots.

3.1.13.12 Weather Radar

[AV-088] The METS **shall** be equipped with a color weather radar and displayed on the MFDs.

3.1.13.13 Tactical Air Navigation (TACAN)

[AV-089] The METS **shall** be equipped with a TACAN.

[AV-090] The METS **shall** support TACAN approaches.

[AV-091] The METS **shall** have TACAN air-to-air ranging capability.

3.1.13.14 Angle of Attack (AOA) Indexer System

[AV-155] The METS **shall** be equipped with an AOA system that contains a sensor, two indexers, and two indicators.

[AV-092] The METS **shall** be equipped with an AOA indexer on the glare shield above the instrument panel for each pilot that displays the symbology and color coding for the aircraft conditions in Table 3-3.

Table 3-3 AOA Indexer Symbology

Aircraft Condition	AOA Color Coding	Indexer Symbol
SLOW	GREEN	
SLIGHTLY SLOW	GREEN AND AMBER	
ON-SPEED (OPTIMUM)	AMBER	
SLIGHTLY FAST	AMBER AND RED	
FAST	RED	

[AV-093] The METS **shall** be equipped with an AOA indicator for each pilot with a circular scale that displays the AOA value, the AOA on-speed mark at the three o'clock position, and the AOA impending stall mark above the on-speed mark.

[AV-094] The METS AOA indicator should be integrated into the avionics system and displayed on the MFDs to each pilot.

[AV-095] The METS AOA indexer should be recorded on the crash survivable memory unit.

3.1.13.15 Terrain Awareness and Warning System (TAWS)

[AV-096] The METS **shall** be equipped with a TAWS that alerts a potentially hazardous terrain situation to each pilot.

3.1.14 Flight Management System (FMS) Navigation

3.1.14.1 FMS

[AV-097] The METS **shall** be equipped with an integrated FMS.

[AV-098] The METS FMS **shall** retain the navigation data settings after loss or interruption of electrical power without manually saving to a removable data storage medium.

3.1.14.2 FMS Flight Path Steering

[AV-099] The METS FMS **shall** determine steering commands necessary to maintain the defined path for all supported flight plan legs in an active flight plan.

[AV-100] The METS FMS **shall** determine steering commands necessary to fly coupled ILS and GPS approaches.

[AV-101] The METS FMS **shall** provide steering commands to the autopilot and be displayed to both pilots.

3.1.14.3 Aeronautical Database

[AV-102] The METS FMS **shall** accept and use navigation data from the authorized aeronautical database that is compliant with FAA AC 20-153B.

[AV-103] The METS should display on the MFDs Department of Defense (DOD) flight information program instrument approach plates or supplement commercial package that includes military approach plates.

[AV-104] The METS **shall** display on the MFDs information from the digital obstacle file.

[AV-105] The METS aeronautical navigation database **shall** be read-only.

[AV-106] The METS should display the effective date of the aeronautical navigation database.

[AV-107] The METS should display the expiration date of the aeronautical navigation database.

3.1.14.4 Flight Plans Database

[AV-108] The METS FMS **shall** create and store flight plans.

[AV-109] Each METS flight plan database **shall** hold a minimum of 200 waypoints.

3.1.14.5 Reference Points/Waypoints Database

[AV-110] The METS **shall** store user defined reference points, waypoints, and mark points that are independent of the flight plans in addition to those contained in the aeronautical database.

3.1.14.6 Digital Moving Map (DMM)

[AV-111] The METS **shall** be equipped with a DMM system to store, select, and display map data and graphics on the MFDs.

[AV-112] The METS DMM **shall** present an independent digital map display at each pilot station.

[AV-113] The METS DMM **shall** provide the ability to selectively overlay on any map display, the active flight plan, obstacle database, any navigation aid, any airfield, any fix, and any reference point or waypoint contained in the aeronautical database.

3.1.14.7 Declutter

[AV-114] The METS FMS **shall** provide each pilot the ability to declutter the MFD.

3.1.14.8 Exterior and Cockpit Lighting

[AV-115] The METS **shall** be equipped with exterior and interior lighting.

3.1.15 Design and Construction

3.1.15.1 External Appearance

[AV-116] The METS **shall** have a high visibility paint scheme and marking in accordance with MIL-STD-2161C. The Government will approve the final paint drawings before implementation.

3.1.15.2 Corrosion Protection

[AV-117] The METS **shall** be equipped with corrosion protection design features.

3.2 Sustainment

3.2.1 Readiness

[AV-118] The METS should achieve the readiness performance in Table 3-4.

Table 3-4 Readiness Performance Metrics

Metric	Performance
Full mission capable	≥ 75%
Partial mission capable supply	≤ 5%
Partial mission capable maintenance	≤ 10%
Non-mission capable maintenance	≤ 5%
Non-mission capable supply	≤ 5%

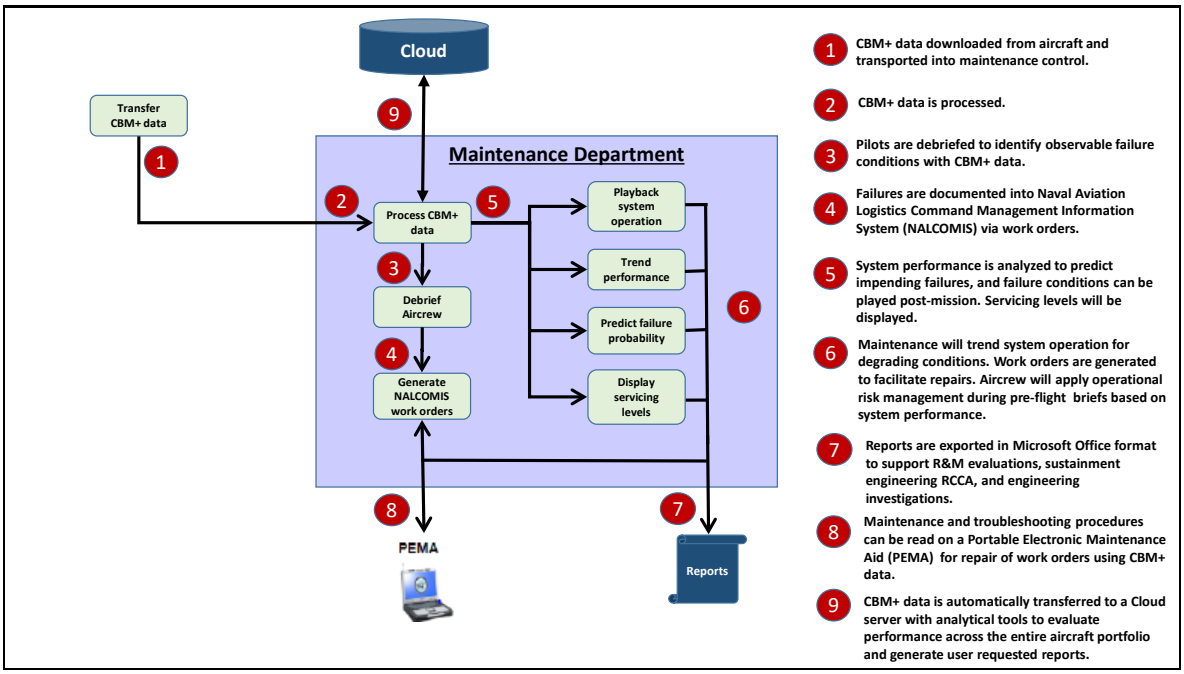
3.2.2 Maintenance and Flight Data

[AV-119] The METS should record maintenance and flight data in Naval Aviation Logistics Command Management Information System - Optimized Organizational Maintenance Activity.

3.2.3 Condition Based Maintenance Plus (CBM+)

The METS CBM+ requirements will support the sustainment Concept of Operations (CONOPS) in Figure 3-2.

Figure 3-2 CBM+ Sustainment CONOPS



[AV-120] The METS should be equipped with CBM+ to perform an operational check of aircraft health before flight and monitor system health during flight.

[AV-121] The METS should have a probability of fault detection of greater than or equal to 90 percent.

[AV-122] The METS should have a probability of fault isolation of greater than or equal to 85 percent.

[AV-123] The METS should present current status, fault detection and isolation results, fault data, and degraded functions on the MFDs or EKBs.

[AV-124] The METS CBM+ data should be recorded and retained in memory that overwrites the oldest data when full.

[AV-125] The METS CBM+ data should identify the Coordinated Universal Time (UTC) when each data is recorded and stored.

[AV-126] The METS CBM+ data storage capacity should be greater than or equal to data generated from 25 continuous flight-hours.

[AV-127] The METS CBM+ should display an alert on the MFDs or EKBs when the data storage capacity exceeds 80 percent.

[AV-128] The METS should have a single access location for retrieving CBM+ data from the airplane.

[AV-129] The METS CBM+ should permit the Government to independently recover the data directly from the airplane, have the ability to de-partition, decrypt, and decompress extracted raw data, and decode the raw data to a Comma Separated Values (CSV) format.

[AV-130] The METS CBM+ should record the parameters at the resolutions listed in Table 3-5.

Table 3-5 CBM+ Data Elements

Parameter	Minimum Rate	Resolution
Pitch attitude	5 Hz	0.1 deg
Roll attitude	5 Hz	0.1 deg
Yaw angle	5 Hz	0.1 deg
Pitch rate	5 Hz	0.1 deg/sec
Roll rate	5 Hz	0.1 deg/sec
Yaw rate	5 Hz	0.1 deg/sec
Nz (G)	5 Hz	0.1G
Nx (G)	5 Hz	0.1G
Ny (G)	5 Hz	0.1G
Angle of attack	5 Hz	0.1 deg
Magnetic heading	5 Hz	0.1 deg
Ground track	1 Hz	0.1 deg
Barometric altitude	1 Hz	5ft
Radar altitude	1 Hz	1 FT
Indicated airspeed	1 Hz	0.5 kt
Ground speed	1 Hz	0.5 kt
True airspeed	1 Hz	0.5 kt
Outside air temperature	1 Hz	1 deg
Vertical speed	1 Hz	5 FT/min
Control wheel pitch position	5 Hz	0.5 deg
Control wheel roll position	5 Hz	0.5 deg
Rudder pedal position	5 Hz	0.5 deg
Power lever position	5 Hz	0.5 deg

Parameter	Minimum Rate	Resolution
All trim positions, as applicable	1 Hz	0.5 deg
All failure/warning/caution lights	1 Hz	--
Battery switch position	1 Hz	--
Engine speed	1 Hz	RPM or 0.50%
Gearbox oil temperature	1 Hz	1 deg C
Gearbox oil pressure	1 Hz	1 PSI
Engine oil temperature	1 Hz	1 deg C
Engine oil pressure	1 Hz	1 PSI
Torque	1 Hz	0.50%
Hydraulic pressure	1 Hz	1 PSI
Fuel quantity	1 Hz	8 pounds
Fuel pressure	1 Hz	1 PSI
Fuel shutoff valve position	1 Hz	--
Hydraulic switch On/Off position	1 Hz	--
Engine vibration (X, Y, Z)	Per design	Sampled over frequency applicable to engine
Gearbox vibration (X, Y, Z)	Per design	Sampled over frequency applicable to gearbox
Fuel pump(s) switch position	1 Hz	--
Starter switch position	1 Hz	--
Ignition/exciter switch positions	1 Hz	--
Engine gas temperature	1 Hz	1 deg C
Date	1 Hz	1 day
UTC	1 Hz	1 sec
Aircraft serial number	1 per flight	Numerical values
Latitude	1 Hz	0.1 deg
Longitude	1 Hz	0.1 deg
Volts battery	1 Hz	0.5V
Volts primary buss	1 Hz	0.5V
Volts generator (primary and secondary)	1 Hz	0.5V
Configuration	1 per flight	Hardware or software configuration version
Failure messages	1 Hz	Fault detection and isolation results
Engine performance parameters	Per design	Sampled over frequency applicable to engine
Landing gear position	1 Hz	Up, down, locked
Flap position	5 Hz	0.1 deg
Start attempts	Per occurrence	Count
Landings	Per occurrence	Count
Engine operating hours	1 Hz	1 min
Power On Time	1 Hz	1 min
Fluid servicing levels	1 Hz	Ounces

3.2.3.1 Maintenance Ground Station (MGS)

[AV-131] The METS MGS should process and store aircraft CBM+ data.

[AV-132] The METS MGS should display the CBM+ data in the English language.

[AV-133] The METS MGS should distinguish CBM+ data between multiple flights on a single storage media.

[AV-134] The METS MGS should display the history sequence for each flight.

[AV-135] The METS MGS should alert personnel to failed conditions or impending failures.

[AV-136] The METS MGS should categorize CBM+ data for maintenance operations: (1) failure detection and isolation; (2) servicing/maintenance indications; and (3) overstress conditions.

[AV-137] The METS MGS should categorize CBM+ data for flight operations: (1) warning; (2) caution; (3) advisory; and (4) system discrete indications, i.e., engine start and shutdown, weight-off-wheels, etc.

[AV-138] The METS MGS should trend engine performance and failure indications.

[AV-139] The METS MGS should trend fluid servicing levels.

[AV-140] The METS MGS should generate trend reports.

[AV-141] The METS MGS should predict the failure probability.

[AV-142] The METS MGS should provide an alert when performance degrades on oxygen and environmental control systems.

[AV-143] The METS MGS should playback the subsystem performance and quickly advance to degraded or failure annunciations.

[AV-144] The METS MGS should generate and export reports in Microsoft Office and CSV formats.

[AV-145] The METS MGS should separate engineering data into separate reports not normally viewable by maintainers or pilots.

[AV-146] The METS MGS should associate failure indications with troubleshooting and repair procedures.

[AV-147] The METS MGS should utilize a modular open system architecture to update predictive algorithms, mature failure thresholds, and troubleshooting procedures.

[AV-148] The METS MGS should implement a diagnostics file filter to eliminate false alarms.

[AV-149] The METS MGS should support component fatigue damage assessment projections.

[AV-150] The METS MGS should transmit CBM+ data to a cloud storage system daily.

3.2.3.2 METS CBM+ Cloud

[AV-151] The METS CBM+ Cloud should receive, store, and process CBM+ data.

[AV-152] The METS CBM+ Cloud should generate the same reports as the MGS.

[AV-153] The METS CBM+ Cloud should generate user selected reports.

[AV-154] The METS CBM+ Cloud should utilize a modular open system architecture to update predictive algorithms, mature failure thresholds, and troubleshooting procedures from analyzing the data across the entire fleet of airplanes.

4 Verification

Section 4 specifies the verification of requirements delineated in Section 3 of this PBS. Verification will be accomplished during Government Acceptance Test (GAT) prior to aircraft DD250.

The following verification methods are used in this section:

- **Inspection (I)** - examination of documents, certificates of compliance, report, or hardware. No testing conducted.
- **Analysis (A)** - technical evaluation of data, analysis, or reports not based on testing to determine compliance with requirements.
- **Demonstration (D)** - the exercise of hardware, software, and/or operations to determine by observation, with no specific instrumentation or data collection that qualitatively specified functions can be performed. These requirements will be verified during GAT.
- **Simulation (S)** - the use of established technical or mathematical/computer models, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements are met.
- **Test (T)** - the exercise of hardware, software, and/or operations using procedures and instrumentation/measuring equipment to verify compliance with quantitatively specified requirements. Specific instrumentation or data collection is required and post-test analysis is performed.

Req ID	Text	Method	Document
AV-001	The METS **shall** have a current Federal Aviation Administration (FAA) Type Certification (TC) that authorizes operations under day and night visual flight rules in accordance with 14 Code of Federal Regulations (CFR) Part 23 and 14 CFR Part 91.	Inspection (I)	FAA TC or STC
AV-002	The METS **shall** have a current FAA TC or Supplemental Type Certificate (STC) that authorizes operations under instrument flight rules in accordance with 14 CFR Part 23 and 14 CFR Part 91.	Inspection (I)	FAA TC or STC
AV-003	The METS **shall** implement all requirements in this PBS in a single type/model/series aircraft configuration in accordance with NAVAIRINST 13100.16.	Inspection (I)	OEM documents
AV-004	The METS **shall** operate in temperatures ranging from -25ºF (-31.7ºC) to +110ºF (+43.3ºC) at sea level conditions and temperatures at operating altitudes of the airplane.	Inspection (I)	FAA TC Limitations
AV-005	The METS should execute the Appendix B missions on a runway length less than or equal to 5,000 feet in accordance with the takeoff and landing distance definitions in Appendix B.	Analysis (A)	OEM Performance Charts
AV-006	The METS **shall** execute Appendix B profiles in operational day environmental conditions at or below Mission Takeoff Gross Weight (MTGW) with the Environmental Control System on (ECS-ON).	Analysis (A)	OEM Performance Charts
AV-007	The METS cruise airspeed **shall** be greater than or equal to 195 Knots True Airspeed (KTAS) in accordance with the Appendix B profiles in operational day environmental conditions with ECS-ON.	Inspection (I)	OEM Manual Restrictions or GAT
AV-008	The METS **shall** have a service ceiling greater than or equal to 20,000 feet (FT) Mean Sea Level (MSL).	Inspection (I)	FAA TC Limitations
AV-009	The METS should operate for greater than or equal to 3.5 flight-hours endurance while executing Appendix B profiles.	Analysis (A)	OEM Performance Charts
AV-010	The METS should have a service life of 30 years utilizing a usage spectrum that is developed with the Appendix B profiles.	Analysis (A)	Fatigue life analysis based on the spectrum derived using appendix B mission profiles

Req ID	Text	Method	Document
AV-011	All requirements of this specification **shall** be satisfied with mission aircrew equipped with the following personal aircrew gear: • Flight suit, gloves, boots, and jacket • Communication headset	Demonstration (D)	GAT
AV-012	The METS **shall** be equipped with a communication headset with active noise reduction and microphone for operation at both pilot stations and the student jump seat.	Inspection (I)	GAT
AV-013	The METS **shall** be equipped with electrical charging provisions for the EKB.	Inspection (I)	GAT
AV-014	The METS **shall** provide a storage area suitable for flight information publications and EKB at each pilot station.	Inspection (I)	GAT
AV-015	The METS **shall** meet emergency egress requirements for pilots, student pilot, and passengers equipped with personal aircrew gear.	Demonstration (D)	GAT
AV-016	The METS **shall** provide side-by-side seating for two pilots.	Inspection (I)	GAT
AV-017	The METS **shall** be operable from either pilot seat.	Inspection (I)	GAT
AV-018	The METS should meet the anthropometric attributes shown in Table 3-1.	Demonstration (D)	GAT
AV-019	The METS **shall** be equipped with one jump seat for the student pilot.	Inspection (I)	GAT
AV-020	The METS jump seat **shall** be adjustable permitting the student pilot to view the cockpit instruments and displays and then stow the seat.	Inspection (I)	GAT
AV-021	The METS **shall** be equipped with seating for a minimum of two passengers.	Inspection (I)	GAT
AV-022	The METS seating systems **shall** provide crashworthy protection.	Inspection (I)	OEM Manuals
AV-023	The METS pilot and jump seats **shall** meet the requirements of TSO-C114 and SAE-AS8043.	Inspection (I)	OEM Manuals
AV-024	The METS **shall** provide storage for 200 pounds of baggage.	Inspection (I)	OEM Manual
AV-025	The METS physical controls and displays **shall** be within human performance limitations, while wearing a glove, with respect to actuation, dimensions, resistance, displacement, separation, orientation, color, and illumination.	Demonstration (D)	GAT
AV-026	The METS automated systems **shall** provide information to keep the aircrew continuously informed of each system's operating mode, intent, function, output, automation failures, and potentially unsafe modes being manually selected.	Demonstration (D)	GAT

Req ID	Text	Method	Document
AV-027	The METS **shall** be equipped with a lavatory.	Inspection (I)	GAT
AV-028	The METS **shall** be equipped with integrated sunshades for the passenger windows and removable sunshades for cockpit windows.	Inspection (I)	GAT
AV-029	The METS **shall** be equipped with a 6-person life raft in a stowed location.	Inspection (I)	GAT
AV-030	The METS **shall** be equipped with an autopilot with controls accessible from either pilot position.	Inspection (I)	OEM Manual
AV-031	The METS autopilot **shall** capture and hold attitude, altitude, airspeed, vertical speed, course, and heading.	Demonstration (D)	GAT
AV-032	The METS autopilot **shall** be integrated with the flight management system to control the approach modes.	Demonstration (D)	GAT
AV-033	All flying quality requirements **shall** apply to both pilot stations.	Inspection (I)	OEM Manual
AV-034	The METS **shall** incorporate independent, mechanically linked controls between the pilot stations for pitch, roll, and yaw axes of control.	Inspection (I)	OEM Manual
AV-035	The METS **shall** have stall warning system.	Inspection (I)	OEM Manual
AV-036	The METS should have stall warning buffet furnished through the inherent aerodynamic qualities of the airplane.	Inspection (I)	OEM Manual
AV-037	The METS **shall** be equipped with an ECS.	Inspection (I)	OEM Manual
AV-038	The METS ECS should maintain the cockpit and cabin temperature ranges identified in Figure 3-1.	Analysis (A)	OEM Documents
AV-039	The METS **shall** pressurize the cockpit and cabin to less than 10,000 FT MSL at 30,000 FT altitude.	Inspection (I)	OEM Manual
AV-040	The METS **shall** provide oxygen to the cockpit and cabin.	Inspection (I)	OEM Manual
AV-041	The METS **shall** be equipped with full-face, quick-donning oxygen masks for both pilot stations and the jump seat station.	Inspection (I)	GAT
AV-042	The METS oxygen masks **shall** permit internal and external communication on the radios and Intercommunication System (ICS).	Inspection (I)	OEM Manual
AV-043	The METS **shall** provide a reconfigurable cabin permitting seating or space for loading and securing cargo to attachment points.	Inspection (I)	OEM Manual
AV-044	The cargo attachment points should restrain cargo to the following static limit load factors: 3G Forward, 2G Aft, 2G Lateral, 2G Vertical-Up, each one applied independently at the center of gravity of the load.	Inspection (I)	OEM Manual
AV-045	The cargo attachment points should be compatible with a MIL-DTL-25959 tie down tensioner or a MIL-PRF-27260 tie down assembly.	Inspection (I)	OEM Manual

Req ID	Text	Method	Document
AV-046	The METS **shall** have two engines with non-centerline thrust.	Inspection (I)	OEM Manual
AV-047	The METS **shall** execute the Appendix B profiles with a simulated single engine failure during climb-out, cruise, holding, approach, and landing phases of flight.	Analysis (A)	OEM Performance Charts
AV-048	The METS **shall** be equipped with fire extinguishing system in each engine compartment.	Inspection (I)	OEM Manual
AV-049	The METS **shall** be authorized to use all primary fuels specified in Table 3-2.	Inspection (I)	OEM Manual
AV-050	The METS **shall** accept external electrical power.	Inspection (I)	OEM Manual
AV-051	The METS external power receptacle **shall** be in accordance with SAE AS35061A or SAE AS7974/3A, for direct current or alternating current powered aircraft, respectively.	Inspection (I)	OEM Manual
AV-052	The METS electrical wiring **shall** permit inspection and repair per the original equipment manufacturer's manuals.	Inspection (I)	OEM standard wiring practices document
AV-053	The METS **shall** be certified for flight into known icing conditions.	Inspection (I)	FAA TC, STC, or TSO
AV-054	The METS **shall** provide clear visibility for both pilots during taxi, takeoff, approach, and landing conditions during moderate to heavy rain.	Inspection (I)	OEM Manual
AV-055	The METS **shall** be equipped with retractable landing gear in a tricycle configuration.	Inspection (I)	OEM Manual
AV-056	The METS landing gear **shall** permit taxiing over the E-28 shore-based emergency arresting gear cable.	Inspection (I)	OEM Manual
AV-057	The METS avionics **shall** be approved under the aircraft's TC or an STC.	Inspection (I)	FAA TC, STC, or TSO
AV-058	The METS avionics equipment controls **shall** be accessible from either pilot position.	Demonstration (D)	GAT
AV-059	The METS cockpit **shall** provide an integrated crew vehicle interface through independent, digital cockpit Multi-Function Displays (MFD).	Demonstration (D)	GAT
AV-060	The METS **shall** be equipped with an MFD at each pilot station and a third MFD positioned between them.	Inspection (I)	GAT
AV-061	The METS MFDs **shall** display primary flight information at each pilot station.	Demonstration (D)	GAT
AV-062	The METS avionics equipment output **shall** be within the field of view for both pilots.	Inspection (I)	GAT

Req ID	Text	Method	Document
AV-063	The control and indications of METS avionics equipment **shall** be integrated in the MFDs.	Inspection (I)	GAT
AV-064	The METS **shall** be equipped with an emergency standby attitude indicator within the field of view of both pilots.	Inspection (I)	GAT
AV-065	The METS **shall** be equipped with one Very High Frequency (VHF) radio and one combined VHF and Ultra High Frequency (UHF) commercial radio.	Inspection (I)	GAT
AV-066	The METS **shall** permit each pilot to transmit and receive over the radios.	Demonstration (D)	GAT
AV-067	The METS **shall** be equipped with a dedicated antenna for each independent radio.	Inspection (I)	FAA TC, STC, or TSO
AV-068	The METS VHF radios **shall** be equipped with 8.33 kHz and 25 kHz selectable channel spacing with VHF guard frequency capability.	Demonstration (D)	GAT
AV-069	The METS UHF radios **shall** be equipped with 50 kHz or less channel spacing with UHF guard capability.	Demonstration (D)	GAT
AV-070	The METS **shall** be equipped with an ICS receive and transmit capability for each pilot and jump seat station.	Demonstration (D)	GAT
AV-071	The METS **shall** be equipped with a VOR/DME.	Inspection (I)	FAA TC, STC, or TSO
AV-072	The METS **shall** support VOR/DME approaches.	Demonstration (D)	GAT
AV-073	The METS **shall** support ILS approaches in accordance with FAA standards for category I weather minima.	Demonstration (D)	GAT
AV-074	The METS **shall** be equipped with an integrated GPS wide area augmentation systemreceiver.	Inspection (I)	FAA TC, STC, or TSO
AV-075	The METS **shall** support GPS approaches to localizer performance with vertical guidance minima.	Demonstration (D)	GAT
AV-076	The METS **shall** support Performance Based Navigation functionality to include Enroute (RNP 2.0), Terminal (RNP 1.0), and RNAV(GPS) Approach (RNP 0.3).	Demonstration (D)	GAT
AV-077	The METS systemshould include all ARINC 424 leg types required for RNP RNAV departure and arrival procedures.	Demonstration (D)	GAT
AV-078	The METS **shall** be equipped with ADS-B Out capability.	Inspection (I)	FAA TC, STC, or TSO
AV-079	The METS should be equipped with ADS-B In capability.	Inspection (I)	FAA TC, STC, or TSO
AV-080	The METS should display ADS-B In flight information services-broadcast weather and aeronautical information to the pilots.	Demonstration (D)	GAT

Req ID	Text	Method	Document
AV-081	The METS **shall** be equipped with a mid-air collision avoidance capability which provides cues and warning to the aircrew of conflicting air traffic.	Demonstration (D)	GAT
AV-082	The METS should allow the user to mute aural alerts.	Demonstration (D)	GAT
AV-083	The METS **shall** be equipped with a radar beacon transponder with Mode 3/A, Mode C, and Mode S capability.	Inspection (I)	FAA TC, STC, or TSO
AV-084	The METS **shall** be equipped with a crash survivable cockpit voice and flight data recorder system.	Inspection (I)	FAA TC, STC, or TSO
AV-085	The METS crash survivable cockpit voice and flight data recorder system**shall** store greater than or equal to 25 flight hours of data.	Inspection (I)	FAA TC, STC, or TSO
AV-086	The METS **shall** be equipped with a 406 MHz ELT integrated with GPS geolocation data that automatically activates during a crash.	Inspection (I)	FAA TC, STC, or TSO
AV-087	The METS **shall** be equipped with a radar altimeter that displays from zero to a minimum of 2000 feet above ground level with an adjustable low altitude alert to the pilots.	Demonstration (D)	GAT
AV-088	The METS **shall** be equipped with a color weather radar and displayed on the MFDs.	Demonstration (D)	GAT
AV-089	The METS **shall** be equipped with a TACAN.	Inspection (I)	FAA TC, STC, or TSO
AV-090	The METS **shall** support TACAN approaches.	Demonstration (D)	GAT
AV-091	The METS **shall** have TACAN air-to-air ranging capability.	Demonstration (D)	GAT
AV-092	The METS **shall** be equipped with an AOA indexer on the glare shield above the instrument panel for each pilot that displays the symbology and color coding for the aircraft conditions in Table 3-3.	Demonstration (D)	GAT
AV-093	The METS **shall** be equipped with an AOA indicator for each pilot with a circular scale that displays the AOA value, the AOA on-speed mark at the three o'clock position, and the AOA impending stall mark above the on-speed mark.	Demonstration (D)	GAT
AV-094	The METS AOA indicator should be integrated into the avionics systemand displayed on the MFDs to each pilot.	Demonstration (D)	GAT
AV-095	The METS AOA indexer should be recorded on the crash survivable memory unit.	Inspection (I)	FAA TC, STC, or TSO
AV-096	The METS **shall** be equipped with a TAWS that alerts a potentially hazardous terrain situation to each pilot.	Demonstration (D)	GAT
AV-097	The METS **shall** be equipped with an integrated FMS.	Inspection (I)	FAA TC, STC, or TSO

Req ID	Text	Method	Document
AV-098	The METS FMS **shall** retain the navigation data settings after loss or interruption of electrical power without manually saving to a removable data storage medium.	Demonstration (D)	GAT
AV-099	The METS FMS **shall** determine steering commands necessary to maintain the defined path for all supported flight plan legs in an active flight plan.	Demonstration (D)	GAT
AV-100	The METS FMS **shall** determine steering commands necessary to fly coupled ILS and GPS approaches.	Demonstration (D)	GAT
AV-101	The METS FMS **shall** provide steering commands to the autopilot and be displayed to both pilots.	Demonstration (D)	GAT
AV-102	The METS FMS **shall** accept and use navigation data from the authorized aeronautical database that is compliant with FAA AC 20-153B.	Demonstration (D)	GAT
AV-103	The METS should display on the MFDs Department of Defense (DOD) flight information program instrument approach plates or supplement commercial package that includes military approach plates.	Demonstration (D)	GAT
AV-104	The METS **shall** display on the MFDs information from the digital obstacle file.	Demonstration (D)	GAT
AV-105	The METS aeronautical navigation database **shall** be read-only.	Demonstration (D)	GAT
AV-106	The METS should display the effective date of the aeronautical navigation database.	Inspection (I)	OEM Manual
AV-107	The METS should display the expiration date of the aeronautical navigation database.	Inspection (I)	OEM Manual
AV-108	The METS FMS **shall** create and store flight plans.	Demonstration (D)	GAT
AV-109	Each METS flight plan database **shall** hold a minimum of 200 waypoints.	Demonstration (D)	GAT
AV-110	The METS **shall** store user defined reference points, waypoints, and mark points that are independent of the flight plans in addition to those contained in the aeronautical database.	Demonstration (D)	GAT
AV-111	The METS **shall** be equipped with a DMM system to store, select, and display map data and graphics on the MFDs.	Demonstration (D)	GAT
AV-112	The METS DMM **shall** present an independent digital map display at each pilot station.	Demonstration (D)	GAT
AV-113	The METS DMM **shall** provide the ability to selectively overlay on any map display, the active flight plan, obstacle database, any navigation aid, any airfield, any fix, and any reference point or waypoint contained in the aeronautical database.	Demonstration (D)	GAT
AV-114	The METS FMS **shall** provide each pilot the ability to declutter the MFD.	Demonstration (D)	GAT
AV-115	The METS **shall** be equipped with exterior and interior lighting.	Inspection (I)	OEM Manual
AV-116	The METS **shall** have a high visibility paint scheme and marking in accordance with MIL-STD-2161C.	Inspection (I)	Blueprint

Req ID	Text	Method	Document
AV-117	The METS **shall** be equipped with corrosion protection design features.	Inspection (I)	OEM process specification and identification of the materials used for corrosion protection
AV-118	The METS should achieve the readiness performance in Table 3-4.	Inspection (I)	OEM Documents
AV-119	The METS should record maintenance and flight data in Naval Aviation Logistics Command Management Information System - Optimized Organizational Maintenance Activity.	Inspection (I)	Government Documents
AV-120	The METS should be equipped with CBM+ to perform an operational check of aircraft health before flight and monitor systemhealth during flight.	Inspection (I)	OEM Manual
AV-121	The METS should have a probability of fault detection of greater than or equal to 90 percent.	Inspection (I)	OEM Manual
AV-122	The METS should have a probability of fault isolation of greater than or equal to 85 percent.	Inspection (I)	OEM Manual
AV-123	The METS should present current status, fault detection and isolation results, fault data, and degraded functions on the MFDs or EKBs.	Inspection (I)	OEM Manual
AV-124	The METS CBM+ data should be recorded and retained in memory that overwrites the oldest data when full.	Inspection (I)	OEM Manual
AV-125	The METS CBM+ data should identify the Coordinated Universal Time (UTC) when each data is recorded and stored.	Inspection (I)	OEM Manual
AV-126	The METS CBM+ data storage capacity should be greater than or equal to data generated from 25 continuous flight-hours.	Inspection (I)	OEM Manual
AV-127	The METS CBM+ should display an alert on the MFDs or EKBs when the data storage capacity exceeds 80 percent.	Inspection (I)	OEM Manual
AV-128	The METS should have a single access location for retrieving CBM+ data from the airplane.	Inspection (I)	OEM Manual
AV-129	The METS CBM+ should permit the Government to independently recover the data directly from the airplane, have the ability to de-partition, decrypt, and decompress extracted raw data, and decode the raw data to a Comma Separated Values (CSV) format.	Inspection (I)	OEM Manual
AV-130	The METS CBM+ should record the parameters at the resolutions listed in Table 3-5.	Inspection (I)	OEM Manual
AV-131	The METS MGS should process and store aircraft CBM+ data.	Inspection (I)	OEM Manual
AV-132	The METS MGS should display the CBM+ data in the English language.	Inspection (I)	OEM Manual

Req ID	Text	Method	Document
AV-133	The METS MGS should distinguish CBM+ data between multiple flights on a single storage media.	Inspection (I)	OEM Manual
AV-134	The METS MGS should display the history sequence for each flight.	Inspection (I)	OEM Manual
AV-135	The METS MGS should alert personnel to failed conditions or impending failures.	Inspection (I)	OEM Manual
AV-136	The METS MGS should categorize CBM+ data for maintenance operations: (1) failure detection and isolation; (2) servicing/maintenance indications; and (3) overstress conditions.	Inspection (I)	OEM Manual
AV-137	The METS MGS should categorize CBM+ data for flight operations: (1) warning; (2) caution; (3) advisory; and (4) system discrete indications, i.e., engine start and shutdown, weight-off-wheels, etc.	Inspection (I)	OEM Manual
AV-138	The METS MGS should trend engine performance and failure indications.	Inspection (I)	OEM Manual
AV-139	The METS MGS should trend fluid servicing levels.	Inspection (I)	OEM Manual
AV-140	The METS MGS should generate trend reports.	Inspection (I)	OEM Manual
AV-141	The METS MGS should predict the failure probability.	Inspection (I)	OEM Manual
AV-142	The METS MGS should provide an alert when performance degrades on oxygen and environmental control systems.	Inspection (I)	OEM Manual
AV-143	The METS MGS should playback the subsystem performance and quickly advance to degraded or failure annunciations.	Inspection (I)	OEM Manual
AV-144	The METS MGS should generate and export reports in Microsoft Office and CSV formats.	Inspection (I)	OEM Manual
AV-145	The METS MGS should separate engineering data into separate reports not normally viewable by maintainers or pilots.	Inspection (I)	OEM Manual
AV-146	The METS MGS should associate failure indications with troubleshooting and repair procedures.	Inspection (I)	OEM Manual
AV-147	The METS MGS should utilize a modular open system architecture to update predictive algorithms, mature failure thresholds, and troubleshooting procedures.	Inspection (I)	OEM Manual
AV-148	The METS MGS should implement a diagnostics file filter to eliminate false alarms.	Inspection (I)	OEM Manual
AV-149	The METS MGS should support component fatigue damage assessment projections.	Inspection (I)	OEM Manual
AV-150	The METS MGS should transmit CBM+ data to a cloud storage system daily.	Inspection (I)	OEM Manual
AV-151	The METS CBM+ Cloud should receive, store, and process CBM+ data.	Inspection (I)	OEM Manual

Req ID	Text	Method	Document
AV-152	The METS CBM+ Cloud should generate the same reports as the MGS.	Inspection (I)	OEM Manual
AV-153	The METS CBM+ Cloud should generate user selected reports.	Inspection (I)	OEM Manual
AV-154	The METS CBM+ Cloud should utilize a modular open system architecture to update predictive algorithms, mature failure thresholds, and troubleshooting procedures from analyzing the data across the entire fleet of airplanes.	Inspection (I)	OEM Manual
AV-155	The METS **shall** be equipped with an AOA system that contains a sensor, two indexers, and two indicators.	Inspection (I)	OEM Manual

Appendix A: Definitions, Abbreviations, And Acronyms

Glossary

The glossary is a collection of the definitions used to help bound and clarify the requirements. The words and terms defined here appear in context in the main body and appendices of this specification.

Airspeed

--Calibrated Airspeed (CAS) is basic airspeed corrected for pitot-static error and (or) attitude of the aircraft

--Indicated Airspeed (IAS) is the uncorrected reading taken from the face of the indicator.

--True Airspeed (TAS) is equivalent airspeed that has been corrected for air density.

AOA Indexer System

--An AOA indexer system offers a visual indication of the amount of lift the wing is generating at a given airspeed or angle of bank. The AOA is the angle at which the frame reference line of an aircraft's wing meets the relative wind. The AOA system delivers critical information visually to indicate the actual safety margin above an aerodynamic stall. The METS aircraft will utilize the AOA indexer system to train student pilots to perform field carrier landing approaches without touchdown. The AOA on-speed (optimum) will be based on the OEM approach speed.

--Aircraft condition on-speed (optimum) is illuminated $\pm$0.42 degrees around its on-speed AOA.

--Aircraft condition slow is illuminated greater than the slightly slow AOA range.

--Aircraft condition slightly slow is illuminated from on-speed range to +0.42 degrees above on-speed AOA range.

--Slightly fast is illuminated from on-speed range to -0.42 degrees below the on-speed AOA range.

--Fast is illuminated greater than the slightly fast AOA range.

Capture

-- Capture is defined as automatically transitioning to a flight parameter at a selected reference value that is to be held.

Caution

-- A cautionary condition is defined as a condition in which some hazard exists if flight or aircraft/system operation is unduly prolonged. It requires the aircrew's attention and response.

CBM+

-- CBM+ is the application and integration of appropriate processes, technologies, and knowledge-based capabilities to achieve the target availability, reliability, and operation and support costs of DoD systems and components across their life cycle.

Electrical System

-- The electrical system includes all components required for generation, storage, conversion, regulation, distribution, and control of electrical power. It also includes bonding and electrical system protection.

Endurance

--Time to fly a zero wind, Appendix B profiles from takeoff to destination at MTGW arriving over destination with reserve fuel.

Environmental Conditions

-- Operational day is temperature 95ºF (35ºC) at sea level pressure altitude.

-- Standard Day is temperature 59ºF (15ºC) at 0 feet pressure altitude.

Failure

-- An event in which a system, subsystem, or component does not perform as specified.

Fuel

-- Fuel is considered in the following categories:

Endurance Fuel

--Fuel required to fly a zero wind Appendix B profiles from takeoff to destination at MTGW in operational day conditions.

Reserve Fuel

--10% of initial mission fuel, or 20 minutes at max endurance airspeed, or original equipment manufacturer flight manual reserves, whichever is greater.

Mission Fuel

--Fuel required to complete Appendix B profiles.

Internal Fuel

-- Fuel that is contained in permanently installed tanks enclosed by and secured to the normal structure and panels.

Usable Fuel

-- Internal fuel less unusable fuel.

Unusable Fuel

-- Total fuel that is unavailable to the engine under normal level flight and landing conditions.

Primary Fuel

-- A fuel that the aircraft is authorized to use for continuous unrestricted operations.

F-24 Fuel

-- NATO F-24 fuel is defined as Jet A (ASTM D1655) with mandatory addition of fuel system icing inhibitor, corrosion inhibitor/lubricity improver, and static dissipater at concentrations prescribed in accordance with MIL-DTL-83133.

Hazardous Condition

-- A hazardous condition is defined as a condition in which some danger exists if flight or aircraft/system operation is unduly prolonged. It requires the aircrew's immediate attention and action.

Independent

-- Design feature that provides a primary and a secondary means for sustaining system operations in the event of equipment, circuit, or system outages. The secondary implementation is not required to be an exact hardware or software duplication, but it does provide the same functionality and capabilities.

Pressure Altitude (PA)

-- Pressure altitude is the altitude reading with the altimeter set to 29.92 inches Hg.

Redundant

-- Design feature that provides a primary and a secondary means for sustaining system operations in the event of equipment, circuit, or system outages. The secondary implementation is required to be an exact hardware or software duplication and provides the same functionality and capabilities.

Service Ceiling

-- Service ceiling is defined as the altitude at which the maximum steady-state rate-of-climb potential is 100 FT per minute for a specified configuration, weight, speed, and thrust (power) setting.

Warning

-- Warning is defined as an indication of the existence of hazardous conditions that require immediate corrective action. A warning is displayed in red, accompanied by an audio message and both are attention getting.

Weight:

Basic Weight

-- The basic weight is the weight of the airplane with the following assumptions:

-- Basic Weight includes all systems that are required to allow the airplane to meet all the requirements of this specification, installed and ready for operational use, regardless of how, or even if, they are described in this specification.

-- Basic weight includes any systems installed and ready for operational use.

-- Basic weight includes all fluid systems, except for fuel, filled to capacity; e.g., hydraulic oil, coolant.

-- Basic weight includes unusable fuel.

-- Basic weight does not include operating equipment, crew, passengers, baggage, or any other payload item.

Mission Equipment Weight

-- Mission equipment weight is mission specific and includes optional mission equipment that is not required for flight and navigation in all operating configurations.

Mission Payload

-- Mission payload is set to 750 pounds representing two pilots and one student pilot with equipment.

Mission Takeoff Gross Weight

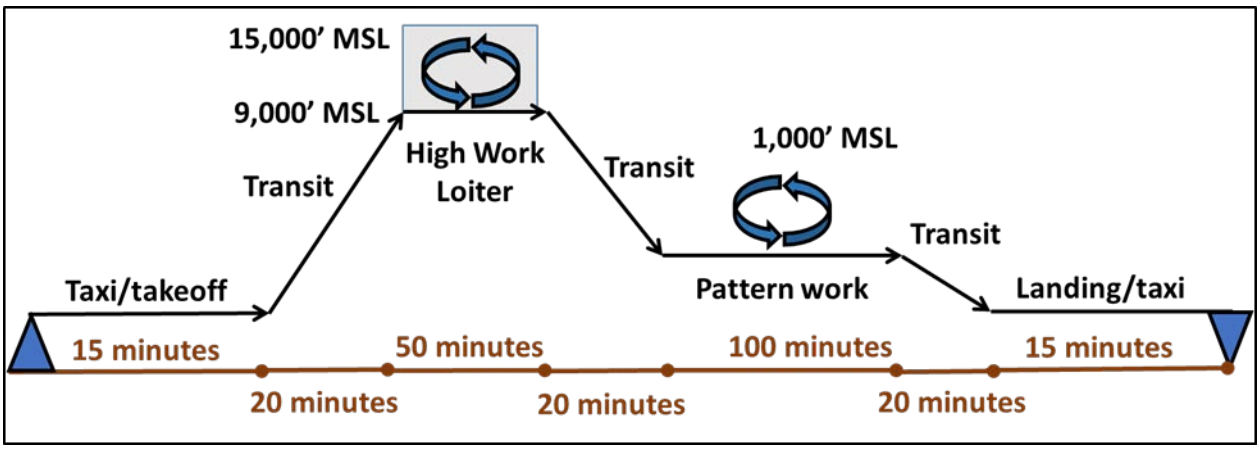
-- The MTGW is the sum of airplane basic weight, mission equipment weight, mission fuel, reserve fuel, and mission payload.

Acronym	Definitions
ADS-B	Automatic Dependent Surveillance – Broadcast
APMSE	Assistant Program Manager Systems Engineering
ASTM	American Society for Testing and Materials
CBM+	Condition Based Maintenance Plus
CFR	Code of Federal Regulations
CNATRA	Chief of Naval Air Training
CSV	Comma Separated Values
DMM	Digital Moving Map
DoD	Department of Defense
ECS	Environmental Control System
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration
FMS	Flight Management System
FT	Feet
GAT	Government Acceptance Test
GPS	Global Positioning System
Hz	Hertz
ICS	Intercommunication System
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INS	Inertial Navigation System
ISA	International Standard Atmosphere
JSSG	Joint Service Specification Guide
kHz	Kilo Hertz
KTAS	Knots True Airspeed
METS	Multi-Engine Training System
MFD	Multi-Function Display
MSL	Mean Sea Level
MHz	Mega Hertz
MIL	Military
MIL-DTL	Military Detail Specification
MTGW	Mission Takeoff Gross Weight
NATO	North Atlantic Treaty Organization
NAVAIRINST	Naval Air Systems Command Instruction

Acronym	Definitions
OAT	Outside Air Temperature
PA	Pressure Altitude
PBS	Performance Based Specification
PEMA	Portable Electronic Maintenance Aid
PEO(T)	Program Executive Office for Tactical Aircraft Programs
PSI	Pounds per Square Inch
R&M	Reliability and Maintainability
RCCA	Root Cause and Corrective Action
RNP RNAV	Required Navigation Performance Area Navigation
SAE	Society of Automobile Engineers
SEH	Sitting Eye Height
STC	Supplemental Type Certificate
TACAN	Tactical Air Navigation
TC	Type Certification
TSO	Technical Standard Order
TTR	Thumb Tip Reach
UHF	Ultra High Frequency
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency

Appendix B: Mission Profiles

Mission Profile A: Visual Flight Rules/Contact Flight Training



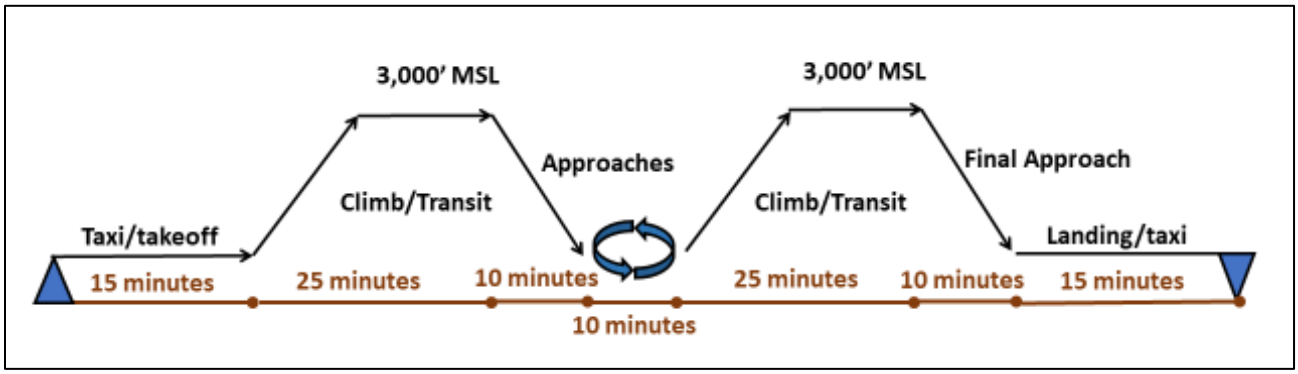
Mission profile A description: Transit and climb to VFR high work area followed by descent and transit to outlying field for extended landing pattern then transit home. The total mission time is 210 minutes (3.5 hrs.) except the 30 minutes of taxi/takeoff/landing time are not included.

Profile Summary:

1) Takeoff Fuel: Start engine(s), warm-up, taxi, and takeoff. Fuel allowance equal to 10 minutes idle fuel burn at sea level, static condition plus five (5) minutes at max engine takeoff thrust (power) at sea level, static condition. Takeoff thrust (power) is defined as the maximum thrust certified for takeoff operation, for a specified speed and altitude. Operation at this rating is usually limited to a limit time per takeoff interval, unless otherwise specified in the engine specification. This time is not included in the mission total flight time (endurance).
2) Accelerate to Climb Airspeed: Accelerate from end of takeoff airspeed to climb airspeed.
3) Transit to High Work Area: Transit 20 minutes to the high work area. Transit includes performing the most efficient climb and cruise combination to arrive at the high work area in 20 minutes and at the high work area altitude between 9,000 and 15,000 FT MSL.
4) High Work Area Loiter: Loiter for 50 minutes (25 minutes in a clean configuration at maximum endurance and 25 minutes in a landing configuration at approach indicated airspeed) at the high work area altitude between 9,000 and 15,000 FT MSL. These two configurations approximate the fuel burn for practice approaches to stalls in a landing configuration, simulated ditch at altitude, and other maneuvers.
5) Transit to Pattern Work Area: Transit 20 minutes to the pattern work area. Transit includes performing the most efficient cruise and descent combination to arrival at the pattern work area in 20 minutes at an altitude of 1,000 FT MSL.
6) Pattern Work: Loiter at the pattern work area for a minimum of 100 minutes at an altitude of 1,000 FT MSL. Loiter for 80 minutes in the landing configuration at the approach airspeed, loiter 20 minutes in a clean configuration at maximum endurance. These two configurations approximate the fuel required for low approaches, touch-and-goes, and simulated single engine landings.
7) Transit to a landing airfield: Transit for 20 minutes at 1,000 FT at the best cruise airspeed.

8) Landing and taxi: Landing and taxi will be a fuel allowance equal to a 10 minutes loiter at sea level in the landing configuration at the approach airspeed and 5 minutes idle fuel burn at sea level.
9) Reserve Fuel: Land with a fuel reserve of 10% of initial mission fuel, or 20 minutes at max endurance airspeed at sea level, or original equipment manufacturer flight manual reserves, whichever is greater.

Mission Profile B: Instrument Flight Rules/Radio Instrument Flight Training



Mission profile B description: Transit to airfield for descent on instrument approach to option of low approach or touch and go at approach airfield, followed by climb and transit to another airfield to repeat for a total of eight approaches ending with a full stop landing after the eighth approach. The final approach should include a minimum of eight (8) approaches. The total mission time is 210 minutes (3.5 hrs.) except the 30 minutes of taxi/takeoff/landing time are not included.

Profile Summary:

1) Takeoff Fuel: Start engine(s), warm-up, taxi, and takeoff. Fuel allowance equal to 10 minutes idle fuel burn at sea level, static condition plus 5 minutes at max engine takeoff thrust (power) at sea level, static condition. Takeoff thrust (power) is defined as the maximum thrust certified for takeoff operation, for a specified speed and altitude. Operation at this rating is usually limited to a limit time per takeoff interval, unless otherwise specified in the engine specification. This time is not included in the mission total flight time (endurance).
2) Accelerate to Climb Airspeed: Accelerate from end of takeoff airspeed to climb airspeed.
3) Transit 25 minutes to the approach airfield, performing the most efficient climb and cruise combination to arrival at the approach airfield in 25 minutes and at an altitude of 3,000 FT MSL.
4) Perform seven (7) of the following:
   a. Initial instrument approach will be a fuel allowance equal to a 10 minutes loiter at 2,000 FT MSL in the clean configuration at best cruise airspeed.
   b. Low approach/touch and go will be a fuel allowance equal to a 5 minute loiter at sea level in the approach configuration (flaps and gear down) at the approach airspeed.
   c. Missed approach will be a fuel allowance equal to: accelerate from low approach/ touch and go airspeed to climb airspeed and climb to 2,000 FT MSL within 5 minutes.
5) Transit 25 minutes to the approach airfield. Transit includes performing the most efficient climb and cruise combination to arrive at the approach airfield in 15 minutes and at an altitude of 3,000 FT MSL.
6) Final approach will be a fuel allowance equal to a 10 minutes loiter at 2,000 FT MSL in the approach configuration (flaps and gear down) approach airspeed.
7) Landing and taxi: Landing and taxi will be a fuel allowance equal to a 10 minutes loiter at sea level in the landing configuration at the approach airspeed and 5 minutes idle fuel burn at sea level.

8) Reserve Fuel: Land with a fuel reserve of 10% of initial mission fuel, or 20 minutes at max endurance airspeed at sea level, or original equipment manufacturer flight manual reserves, whichever is greater.

All METS mission profiles are defined under the ground rules and conditions of this appendix and the METS mission flight profiles and conditions contained herein.

a. All engines operating unless specified differently. When calculations are performed with a simulated engine inoperative, the drag of the devices used to trim the air vehicle, as well as the worst-case engine out simulated drag, must be included. The determination of which simulated inoperative engine is most critical includes both controllability and loss-of-lift considerations.
b. Un-refueled performance (no aerial refueling as receiver).
c. All performance is calculated based on specified air vehicle configuration as defined in this PBS.
d. All altitudes are above MSL and all airspeeds are in KTAS or knots calibrated airspeed as stated.
e. ECS-ON
f. +20°C International Standard Atmosphere (ISA) day

This paragraph and its sub-paragraphs establish the definitions and ground rules that determine the performance of a fixed-wing air vehicle. It is intended to provide conditions and limitations inherent in the definitions and ground rules which must be followed when any characteristic of performance included herein is calculated.

Definitions

This section defines the performance terms of fixed-wing air vehicles and qualifications for their use. For the purpose of this appendix, the following applies:

a. Any air vehicle limitations/criteria that are more restrictive should take precedence over the performance/flying qualities criteria specified herein. Realistic constraints such as control system dynamics, control law scheduling, mode changes, control surface rates, engine response to throttle transients, etc., are to be applied. No operational techniques should be utilized that are not included nor intended to be included as recommended procedure in the applicable flight manual.
b. In the calculation of mission performance, under certain mission conditions, any fuel load required for proper sub-system performance [ECS-ON, cooling, etc.], which is above the landing reserve fuel load is considered unusable fuel for the mission.
c. Definitions assume the use of a point mass, flat non-rotating earth, constant gravity, standard day, and zero wind (unless winds are otherwise specified). An exception is that guidance, navigation and control analysis using precision GPS assumes the use of a WGS-84 ellipsoid for the navigation output. When conditions other than these are used, ensure the differences introduced by changes are taken into account.
d. When calculations are performed with an engine inoperative, the drag of the devices used to trim the air vehicle, as well as the worst-case engine out drag, must be included. The determination of which inoperative engine is most critical includes both controllability and loss-of-lift considerations.

e. Configuration refers to the center of gravity location, gear and flap position, external configuration of the vehicle, and normal mission segment engine bleeds.
f. Steady-state refers to the instantaneous condition of equilibrium in which all forces and moments are balanced and the change in all velocities and rotational rates is zero.
g. All mission and maneuver performance is calculated for an International Civil Aviation Organization standard day, no wind, zero humidity with anti-ice off unless specified differently.
h. Data is for a single aircraft only.
i. Unless otherwise specified, distance covered in combat, maneuvering, loiter, or patrol is not to be included in the mission radius, and radius missions are to be conducted without in-flight refueling as a receiver.
j. When the energy state at the start of a new mission segment is greater than at the end of the previous mission segment, fuel to increase the energy state must be included. When the change in energy is negative (a decrease in the energy state), the change is assumed to be instantaneous with no change in time, distance, or fuel, except when specified as an enroute descent.
k. Fuel grade used for calculated aircraft performance is Jet A fuel at density of 6.8 lbs./gal.
l. All performance is calculated with a minimum engine performance level as defined by the minimum performance threshold of acceptance for new and overhauled engines.
m. Corrections to thrust and fuel flow for all propulsion bleeds, horsepower extraction and secondary systems utilizing fuel and/or power required for each phase of flight are to be included.
n. Unless otherwise indicated, all altitudes are referenced as pressure altitude. Sea level may be stated to indicate 0 FT MSL.
o. MIL-STD-3013 and JSSG-2001 may be used as guidelines.

Takeoff Distance

Takeoff distance shall be defined by the critical field length for a dry runway at a sea level field elevation on a 35°C OAT day with a 750 lbs. mission weight and fuel load to execute the appendix B mission profiles. Critical field length is defined as the sum of the distance required to accelerate to critical engine failure speed with all engines operating, plus the distance to accelerate to liftoff speed and clear a 50 FT obstacle with the critical engine inoperative or to decelerate to a stop from critical engine failure speed in the same distance for a specified altitude, weight, configuration, and thrust (power) setting.

a. At engine failure, the air vehicle continues to accelerate for three (3) seconds with the operating engine(s) at the thrust (power) setting being used for takeoff, while the inoperative engine is at a drag level that represents the most critical engine failure condition. This period is to account for recognition of the engine failure and initiation of a response.
b. At the end of the three (3) second period, brakes are instantly applied (while all brake and tire limits are observed), and action initiated to reduce thrust (power) on the operating engine(s) to idle and to deploy deceleration devices. Sufficient time will be allowed for full deployment of deceleration devices and decay of thrust (power) to idle before including their effects on deceleration. If time response data is available to model their effects more accurately, it will be used, subject to the approval of the procuring activity.

c. Action to initiate reverse thrust, if available, will be taken once the engine(s) has reached idle thrust (power). Sufficient time will be allowed for increase to full reverse thrust before including its effects on deceleration. If time response data is available to model its effect more accurately, it will be used, subject to the approval of the procuring activity. If reverse thrust is used, it will be limited to the amount which can be trimmed-out by the rudder, asymmetric braking, nose wheel steering, etc.

Landing Distance

Landing distance shall be defined for dry runway at a sea level field elevation on a 35°C OAT day with a 750 lbs. mission weight and a reserve fuel load as defined in the mission profiles and for a flaps up configuration without the use of reverse thrust. Landing distance is defined as the sum of the landing air run distance and ground roll distance. Landing air run distance is defined, for land-based air vehicles, as the horizontal distance from the 50-ft obstacle height to touchdown. The air vehicle is in the landing configuration, at the specified thrust (power) setting, weight, and altitude. Ground roll distance is defined as the distance to decelerate from touchdown speed to a full stop. Ground roll is divided into two segments—transition and braking. The transition segment is the ground roll that immediately follows touchdown, which allows for the change from the touchdown attitude to the taxi attitude. During transition, the air vehicle is brought from the landing configuration to the braking configuration (brakes on, throttles at idle position). Landing distance is calculated for a specified weight, altitude, and configuration. Ground roll distance is computed for zero wind on a dry, hard-surfaced runway (runway condition reading = 23) with no slope.

Cruise Airspeed

The cruise airspeed is calculated at 6,000 FT MSL for +20°C international standard day at maximum continuous power with ECS-ON, a 750 lbs. mission weight, and a 60% fuel load to execute the Appendix B mission profiles.

Service Ceiling

The service ceiling is calculated at international standard day at maximum continuous power with ECS-ON, a 750 lbs. mission weight, and a 60% fuel load to execute the Appendix B mission profiles.