

**U.S. DEPARTMENT OF HOMELAND SECURITY
U.S. CUSTOMS AND BORDER PROTECTION
OFFICE OF CBP AIR AND MARINE**



**PERFORMANCE SPECIFICATION
FOR THE
U.S. CUSTOMS AND BORDER PROTECTION
UNMANNED AIRCRAFT SYSTEM (UAS)
VERSION 2.4
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PREFACE

This Performance Specification has been amended for the purpose of satisfying the requirements only for the hardware delivered under contract #: HSBP101010C00026. There are capabilities and specifications contained herein that remain in this document; but appear lined out (~~Example Requirement~~). These requirements Do NOT apply to this document or to the hardware delivered under contract #HSBP1010C00026. Other capabilities and specifications contained herein refer to items of hardware not delivered under this contract, but are not lined out. These later capabilities and specifications will be definitized through Contract Change Proposals.

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1.0 SCOPE

1.1 Purpose

This specification establishes the performance requirements for the U.S. Customs and Border Protection (CBP) Office of Air and Marine (OAM) unmanned aircraft system (UAS). These requirements establish minimum and optimal standards of performance for the UAS in operating, non-operating and storage conditions. The purpose of the CBP OAM UAS is to provide airborne assets to gather intelligence, surveillance and reconnaissance (ISR) data in support of Department of Homeland Security (DHS) and CBP missions. UAS will be used to collect and pass information using a long duration airborne sensor platform that will provide CBP and other DHS agents in the air or on the ground/surface an extended and enhanced situational awareness. The payloads that support these missions will evolve and mature over time. The UAS shall be interoperable with a wide variety of mission payloads. It is anticipated that this requirement will be met through a versatile set of physical, electrical, and data interfaces. The data interfaces shall include internal interfaces within the CBP OAM UAS and external interfaces into the UASNOC and DHS 1 network that provides secondary distribution of the data to end users.

The contractor shall have total program responsibility for ensuring that the requirements defined herein are met and that the sensors and avionics perform according to this specification. The word “equipment”, as used in this document, includes all components or units necessary (as determined by the equipment manufacturer or installer) to properly perform its intended function. In this document, the terms “shall” and “must” are used to indicate requirements. An approved design would comply with every requirement, which can be assured by inspection, test, analysis or demonstration. The term “must” is used to identify items which are important but are either duplicated somewhere else in the document as a “shall”, or are specified in other documents. The term “should” is used to denote a recommendation but does not constitute a minimum requirement. Additionally, requirements that represent the threshold (i.e., minimum) capabilities are identified with a (T). It is the intent of the Government to acquire UASs, equipment and services that meet or exceed threshold requirements. The requirements that represent desired capabilities are identified as objectives (O). Where practical, the UASs and services should satisfy those requirements.

1.2 Overview

The CBP OAM UAS consists of a medium-altitude, long-endurance unmanned aircraft (UA); sensor and communication packages; a link segment; a Ground Control Station (GCS) and launch and recovery/mobility GCS (LRGCS/MGCS); and engineering, maintenance, technical and logistics support. Components of the CBP OAM UAS can be deployed to multiple locations and operated simultaneously. Control of the CBP OAM UAS will be from (GCSs) at the UAS National Operating Center (UASNOC), Operational Centers (OC), or at Forward Operating Locations (FOL). Beyond Line of Sight (BLOS) operations maybe operated locally, transferred to the UASNOC, or other designated operational centers (OC). Sensor data and imagery will be received by the GCS in control of the UAS, and for BLOS operations at the UASNOC. When the OC or FOL have access to DHS networks, LOS sensor data can be transmitted to the UASNOC and to designated local users.

CBP has determined by analysis of alternatives and multiple field demonstrations that a medium altitude, long endurance, unmanned aircraft provides significant and unique force enhancements to the intelligence gathering, situational awareness, and law enforcement tasks performed by CBP and other DHS organizations. Further tasks, such as communication relay and interception, although not yet evaluated in the field, are assessed to also be best performed by such a platform. Alternatives considered were sensors mounted in airships, aerostats, towers, and manned aircraft.

1.3 Operational Strategy

UASs will be launched, recovered and maintained at an unmanned aircraft system operations center (UASOC) or temporary forward operating location (FOL) (see Figure 1). In addition to these activities, these OCs or FOLs may run local area line-of sight (LOS) operations, training, or transfer control of the aircraft to a satellite command and control center for beyond-line-of-sight (BLOS) operations. The UASNOC, collocated with the Air and Marine Operations Center (AMOC) in Riverside, CA will be the primary BLOS OC. The UASNOC will have operational control of all BLOS operations. Priorities for the use of UASs will be established and managed by CBP Air and Marine through the UASNOC in conjunction with requests for support submitted by Border Patrol Sector Chiefs, other designated DHS representatives, or other approved organizations.

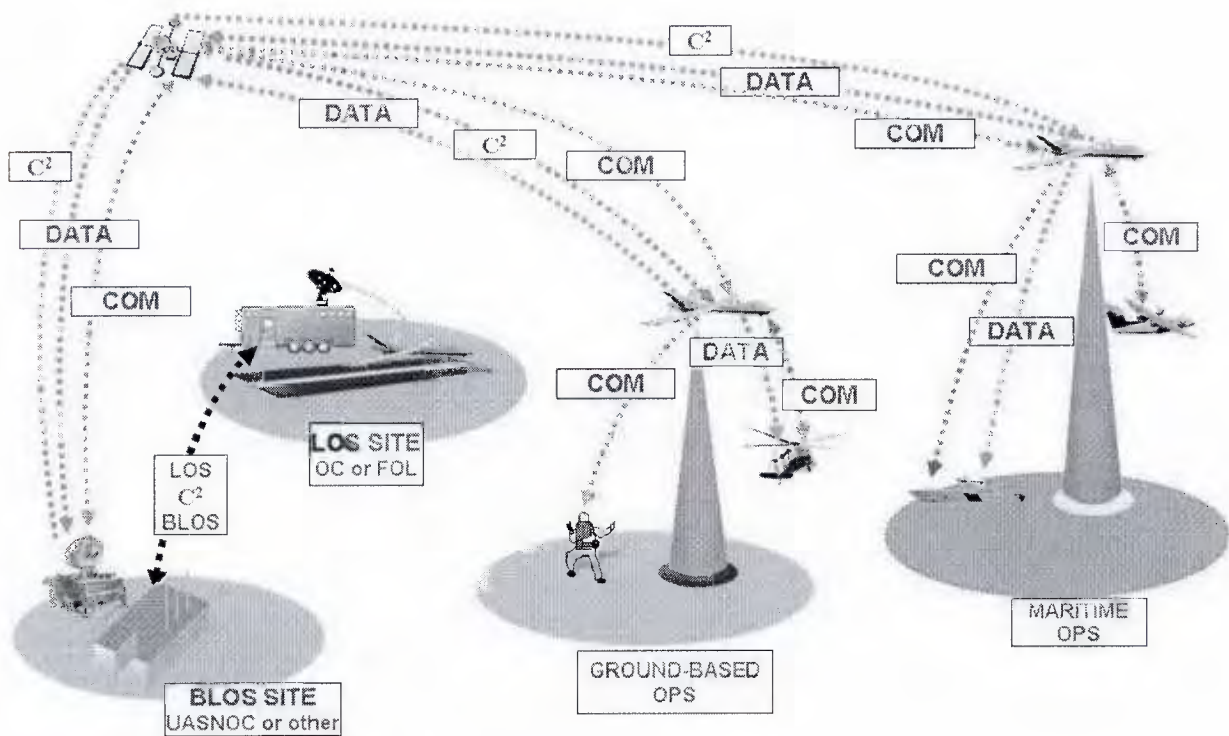


Figure 1: Operational Strategy

(b) (7)(E)

station, Sensor Operators (either locally or at the UASNOC) will control the aircraft's imaging sensor(s). CBP agents on the ground, or other designated users, may provide direction to the sensor operator. The sensor(s) will broadcast its images/video to those CBP agents in its line of sight who are equipped with a Remote Video Terminal (RVT). Imagery will be sent to the UASNOC for further dissemination over the DHS1 network. Border patrol agents or other users providing input to the sensor operator may change as the aircraft approaches subsequent areas.

Requests to change the aircraft's mission shall be made through the OC for LOS operations or the UASNOC for BLOS operations to the controlling GCS, Command Duty Officer (CDO) who will be responsible for flight safety. Airspace separation and altitude de-confliction will be managed by the AMOC to ensure safe separation among manned helicopters, the UAS, and manned aircraft operating near each other.

2.0 APPLICABLE DOCUMENTS

Since this specification does not require strict adherence to federal aviation administration (FAA) regulations or military specifications governing hardware, testing, technical data, handbooks or other practices associated with standard equipment design, the following documents shall be used as general guides in the performance of the requirements set forth herein. The applicable issue of these documents, unless otherwise specified, shall be that version which is in effect on the date of this performance specification. 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 unless a specific exemption has been obtained. Particular attention shall be devoted to items affecting personnel safety, structural integrity and safety-of-flight. At no time, shall safety, quality or performance of equipment be compromised or sacrificed.

2.1 Federal

AC 20-136	Protection of Aircraft Electrical/Electronic Systems against the Indirect Effects of Lightning
AC 25-10	Guidance for Installation of Miscellaneous, Non-required Electrical Equipment
AC 43.13-1B/2A	Acceptable Methods, Techniques and Practices for Aircraft Inspections, Repair and Alterations
AFS-400 UAS Policy 05-01	Unmanned Aircraft Systems Operations in the U.S. National Airspace System-Interim Operational Approval Guidance
ANSI/EIA-310-D	EIA Standard for Racks, Panels and Associated Equipment
EIA/TIA-232	Data Interface
FAA-STD-020B	Transient Protection, Grounding, Bonding and Shielding Requirements for Electrical Equipment
FAA-STD-021	Configuration Management (Contractor Requirements)

FAR Part 33*	Certification Procedures for Products and Parts
FAR Part 34	Fuel Venting and Exhaust Emission Requirements for Turbine Engine Powered Airplanes
FAR Part 39	Airworthiness Directives
FAR Part 43	Maintenance, Preventative Maintenance, Rebuilding and Alteration
FED-STD-595	Colors
TSO-C31d	High Frequency (HF) Radio Communications Transmitting Equipment
TSO-C32d	High Frequency (HF) Radio Communications Receiving Equipment
TSO-C37d	VHF Radio Communications Transmitting Equipment
TSO-C38d	VHF Radio Communications Receiving Equipment
TSO-C52b	Flight Director Equipment
14 CFR SEC 91.215, 91.411, 91.413	Pitot static system, altitude reporting equipment and ATC Transponder use, certification and testing

2.2 Military Specifications

MIL-E-7016F	Electric Load and Power Source Capacity
MIL-W-25140B	Weight and Balance Control Data

2.3 Military Standards and Handbooks

ASTM F 2411-04	Standard Specification for Design and Performance of an Airborne Sense-and-Avoid System
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-464	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-882D	DOD, Standard Practice for System Safety (Feb 2000)
MIL-STD-1686C	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (excluding electrically initiated explosive devices)
MIL-STD-7179	Finishes, Coatings and Sealants for the Protection of Aerospace Weapons Systems
MIL-STD-810 E/F/G	Environmental Engineering Considerations and Laboratory Tests

* FAR in this specification refers to Federal Aviation Regulation

NATO STANAG 4586	Standard Interfaces of the Unmanned Control System (UCS) for NATO UAV Interoperability
MIL-HDBK-310	Global Climatic Data For Developing Military Products
MIL-HDBK-516	Airworthiness Certification Criteria

2.4 Non-governmental Documents*

RTCA/DO-160B	Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments Radar operating manual
RTCA/DO-178A	Software Considerations in Airborne Systems and Equipment Certification Electro-optical/infrared (EO/IR) sensor operating manual AN/ARC-210 Multi-band, Multi-mode line-of-sight (LOS) and SATCOM/DAMA Radio Manual Global Wulfsberg Association of Public Safety Communications (APCO) P-25 Compliant RT 5000/C-5000 multi-band manual

3.0 REQUIREMENTS

3.1 General Requirements

3.1.1 Government Furnished Equipment

The contractor is responsible for the safeguarding and security of government furnished equipment (GFE), assemblies and installations and shall ensure the availability of all contractor-furnished equipment (CFE).

3.1.2 Upgrades

To readily acquire state-of-the-art technology upgrades and improvements to the commercial products and services, CBP OAM may solicit or the contractor may independently propose changes, upgrades, or enhancements to the aircraft, equipment, components, or other requirements to reduce costs, improve performance, save energy or improve safety. At a minimum, the contractor shall submit the following information with each proposal:

- a. A description of the differences between the existing contract requirements and the proposed changes and the comparative advantages and disadvantages of each
- b. Itemized requirements of the contract that must be changed if the proposal is adopted and the proposed revision to the contract for each such change

* Nongovernmental documents may be used as reference material where there is no existing engineering data, military specification or FAA regulation that is applicable to the specific task.

- c. An estimate of the changes in performance and cost that will result from adoption of the proposal
- d. An evaluation of the effects the proposed change would have on collateral costs to the Government such as GFE, related items, and operations and maintenance costs
- e. The time when the change order adopting the proposal must be issued so as to obtain the maximum benefits of the changes during the remainder of the contract and the impact on the contract completion time or delivery schedule

3.1.3 Workmanship

The contractor shall ensure that parts fabricated and installed in the UAS shall conform to manufacturing standards consistent with the aircraft manufacturing industry. The following general manufacturing qualities shall apply to assembled parts and sub-assemblies:

- a. free from blemishes, defects, burrs and sharp edges
- b. dimensions shall be within tolerances established in engineering drawings
- c. radii of fillets within tolerances established in engineering drawings
- d. marking of parts and sub-assemblies to allow proper identification and tracking of model and serial numbers installed on each UA, link segment and GCS
- e. alignment of parts, and tightness of sub-assemblies, screws and bolts shall be IAW contractor specifications

The contractor shall ensure that all parts listed in the engineering drawing or wiring diagrams correspond to the respective diagram legend and installed part. The contractor should place the part number in a location that it remains readable when installed. Terminal strips shall be readily identified and marked on permanent parts of the equipment. A number painted or marked on the chassis or rack adjacent to the plug or connector shall identify internal and external plugs and connectors. Screws, bolts and non-welded connections that fasten flight critical components shall be equipped with lock washers, lock nuts or other non-loosening devices or compounds.

3.2 Design and Configuration

The UAS design should (O) be of a modular nature that will facilitate reconfigurations to include or remove subsystem components.

The UAS should (O) provide autonomous operation with automatic features that allow for manual intervention on critical functions such as rapid re-tasking of the sensors and flight rerouting. The Government anticipates the UAS will maximize the use of existing commercial and government systems and/or components.

The UAS command and control functions are incorporated and integrated into the ground control station (GCS) and the UA. These command and control systems shall (T) provide the data link and the ground control functionality for command and control of the aircraft and payload(s). The initial classes of UAS and their North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) 4586 level of connectivity are as follows:

Table 1: NATO STANAG 4586 Levels of Control

LEVEL	TYPE OF CONTROL
Level 1	Indirect receipt of secondary imagery and/or data
Level 2	Direct receipt of payload data by a UCS
Level 3	Level 2 interoperability plus control of the UAS payload by a UCS
Level 4	Level 3 interoperability plus UAS flight control by a UCS
Level 5	Level 4 interoperability plus the ability of the UCS to launch and recover the UAS

Table 2: UAS Element and level of Control

UAS Element	Level of Control
GCS	5
Launch & Recovery GCS	5
SCT	3
RVT	2

3.2.1 System Component Descriptions

The CBP Air and Marine UAS consists of the following major elements.

3.2.1.1 Unmanned Aircraft (UA)

The UA is the airborne element of the UAS and carries the payloads and embedded airborne communication suite with relay capability. The UA is capable of LOS, wide band LOS and BLOS SATCOM operations. A system may include multiple UAs.

3.2.1.2 Payloads

The payloads are modular elements that are designed to accomplish specific missions. Payloads will be operated on the aircraft element depending upon specific mission needs of the CBP Air and Marine UAS sortie. The system shall (T) be able to simultaneously carry an EO/IR sensor package, an airborne communications suite, and one of the following: synthetic aperture radars (SAR) with a ground moving target indicator mode (GMTI), or signals interception receivers.

3.2.1.3 Ground Control Station (GCS)

The UAS Ground Control Station (GCS) contains the hardware and software for the following tasks: mission planning, aircraft and payload command and control, receiving data, recording and dissemination of data, and the equipment necessary for required communications. There are five types of GCS configurations: a deployable GCS, a fixed GCS (FGCS), a Launch & Recovery GCS (LRGCS), a Mobility Ground Control Station (MGCS) and a portable GCS (PGCS). Except for the PGCS, the GCS configurations shall provide aircraft control redundancy by incorporating flight controls at both side-by-side operator stations.

3.2.1.3.1 Deployable GCS

The deployable GCS is a self-contained GCS unit that can be used for extended operations in an enclosed transportable shelter. The shelter shall (T) be C-130H and C-130J transportable. The GCS shall (T) have side-by side work stations for the pilot and sensor operator that have flight controls at each station. Video monitors shall display sufficient information to the pilot and sensor operator to allow the crew to safely fly the aircraft, operate the sensors, monitor aircraft performance, monitor data from the payloads, monitor command and control status, and manage integrated mapping and flight planning software. Controls for the intercom interface and radio controls, and other essential mission equipment shall be within reach of the pilot and sensor operators. The deployable GCS shall include a line-of-sight (LOS) antenna and the necessary link equipment to command and control the aircraft as well as receive and send data.

3.2.1.3.2 Fixed GCS

A fixed GCS (FGCS) will have many of the same functionalities as the deployable GCS, but is designed to be installed in permanent facilities. Due to the centralized nature of having multiple GCS's located in a FGCS system; it will have a different configuration and crew structure than the deployable GCS. The pilot and sensor operator work stations for each aircraft shall remain in a distinct "cockpit" design, but other crew member stations (CDO, SAR analyst, and technicians) may be combined for multiple aircraft. These "pods" may be grouped into four aircraft systems. The final design of these fixed GCS systems shall be approved by CBP Air and Marine.

3.2.1.3.3 Launch & Recovery GCS (LRGCS)

The LRGCS is designed for command and control of an unmanned aircraft at a forward operating location (FOL). The LRGCS is designed in an enclosed container that is smaller than the deployable GCS to enhance mobility. The LRGCS equipment shall (T) be designed to be installed into an S-280 shelter or other small shelter. The LRGCS equipment installed into the shelter shall be mounted to protect against vibration and shock. The LRGCS shall (T) include provisions for the installation of the following mission equipment: data and voice link;; the control, reception and recording capability of video; and a LOS antenna.

3.2.1.3.4 Mobility GCS (MGCS)

The MGCS is designed for command and control of an unmanned aircraft at a forward operating location (FOL). The MGCS is designed in an enclosed container that is smaller than the deployable GCS to enhance mobility. The MGCS equipment shall (T) be designed to be installed into an S-280 sized shelter or equivalent. The MGCS equipment installed into the shelter shall be mounted to protect against vibration and shock. The side-by-side workstations and the center equipment rack shall (T) be of the same design and equipment as the deployable GCS. The MGCS shall (T) include provisions for the installation of the following mission equipment: a primary BLOS C², data and voice link; a second BLOS voice link and downlink telemetry data; the control, reception and recording capability of video and/or synthetic aperture radar data; and a standard LOS antenna.

3.2.1.3.5 Portable GCS

Portable GCS's shall be self contained, backup launch and recovery systems that are delivered in their own protective shipping containers. The system should be of a single work station design and be easily assembled and disassembled for rapid deployment. The system will include a single Portable GDT (PGDT) for LOS UA operations.

3.2.1.4 Link Segment



3.2.1.5 Remote Video Terminals (RVT)

The RVT provides the CBP agents or other designated users in the field, in the air, or in a maritime environment, with direct access in real time to EO/IR sensor video imagery and data independent of the GCS. The system may include multiple RVTs.

3.2.2 Functional Configuration

~~The baseline functions and equipment configurations of UAS elements shall (T) be modular and can be interchanged and intermixed to meet specific missions.~~

3.2.3 Baseline Configuration

The UA should (O) be deployed in one configuration. In this configuration functions and equipment configurations of UA components shall (T) be modular and can be interchanged and intermixed to meet specific missions.

3.2.4 External Interfaces

The UAS shall (T) export data to existing DHS system interfaces and should (O) implement an open systems architecture. The UAS should (O) possess standard communication interfaces, including standard peripheral ports, and provide an industry standard to:

- a. Local area networks
- b. Support the interface to an external database for storage, retrieval, analysis, exploitation and distribution of sensor data, metadata, and mission audio.

3.2.5 Internal Interfaces

The UAS shall (T) be defined through a set of Interface Control Documents (ICDs). These interfaces shall use commercial and non-commercial interface standards. The ICDs represent the functional and physical interfaces between system elements and sub-elements. These ICDs define the functional, hardware, and software boundaries between major functional sub-elements. The ICDs are expected to evolve during detailed design of the UAS with the purpose of facilitating the replacement of obsolete parts, upgrading components, and incorporation of additional system elements.

3.2.6 Performance Characteristics

This section defines the performance characteristics of the UAS. Specific system component performance characteristics are defined herein. The typical installed payloads include the communications suite, EO/IR camera and synthetic aperture radar (SAR).

3.2.6.1 Mission Capability Requirements

(b) (7)(A), (b) (7)(E)

3.2.6.2 System Computations

(b) (7)(A), (b) (7)(E)

3.2.6.3 Target Location Accuracy

(b) (7)(A), (b) (7)(E)

3.2.6.4 Mission Planning

3.2.6.4.1 Pre-Flight Programming

The UAS shall (T) be capable of programming the aircraft and payload elements with mission planning data, including operational and lost link mission planning, prior to launch.

3.2.6.4.2 In-Flight Programming

The UAS shall (T) be capable of re-planning / update the aircraft operational and lost link mission from the controlling GCS while the air vehicle is in flight.

3.2.6.5 System Control

3.2.6.5.1 Launch and Recovery

The UAS shall (T) be launched and recovered by the pilot manually flying the aircraft through these phases of flight from the GCS. As the technology advances, the UAS should be able to launch and recover using onboard sensors and navigation equipment (O) without the pilot manually flying the aircraft. This pilot shall (T) be able to override any Automatic Launch and Recovery capability and revert to manual control for launch and recovery. The UAS pilot shall (T) be able to command the aircraft to abort the automatic takeoff or landing sequence with execution of a pre-programmed, single action flight command.

3.2.6.5.2 Command and Control Hand-off

The UAS shall (T) be able to hand-off Level 4 or Level 5 control of an aircraft / payload from one UAS GCS to another UAS GCS.

3.2.6.6 Embedded Operational Training Functions

The Deployable GCS, the Fixed Facility GCS and the Mobility GCS shall (T) possess an embedded training and simulator capability to provide operational training via the GCS. The aircrew training functions should (O) have add-on interactive training, with self-paced instruction, duplicating UAS flight performance characteristics, capabilities, and limitations.

3.2.7 System Compatibility

3.2.7.1 Regulatory Requirements

3.2.7.1.1 FAA Conformance

The UAS shall (T) meet Federal Aircraft Administration (FAA) sections: 91.215, 91.411, 91.413. The UAS should (O) meet applicable FAA requirements for Day VFR, Night VFR and IFR for flight in the national airspace system (NAS).

3.2.7.1.2 FCC/IRAC Conformance

The UAS should (O) meet applicable Federal Communications Commission (FCC) and Interdepartmental Radio Advisory Committee (IRAC) requirements for transmitting commands, telemetry, and data.

3.2.7.1.3 Environmental Protection Agency (EPA) Conformance

The UAS shall (T) comply with National Environmental Protection Act (NEPA).

3.2.7.2 UAS Preparation Time

For the purposes of this section the UAS equipment includes one GCS, one LOS Link Segment and one GSE package (aircraft fly in) to support one aircraft.

3.2.7.2.1 Set-Up Times

A UAS excluding the UA shall (T) be capable of being off-loaded from its transport vehicles and achieving full mission capable (FMC) status within 1 work day not to exceed 40 man-hours.

A UA shall (T) be capable of being off-loaded from its transport vehicles and achieving full mission capable (FMC) status within 3 working days.

3.2.7.2.2 Fueling

The UAS shall (T) be compatible with gravity fueling systems and pressure (O) fueling systems.

3.2.7.2.3 Preparation for Transportation Times

The UAS excluding the UA shall (T) be capable of being disassembled, made ready for transport, and reloaded aboard its ground transport vehicles within 1 working day not to exceed 40 man-hours.

The UA shall (T) be capable of being disassembled, made ready for transport, and loaded aboard its ground transport vehicles within 2 working days.

3.2.7.2.4 Launch and Recovery Time

(b) (7)(A), (b) (7)(E)

3.2.7.2.5 Environmental Impact

The UAS should (O) minimize any adverse impact on the environment.

3.2.7.2.6 Electrical Power

Primary Power - Primary electrical power for the UAS shall (T) be compatible with current domestic (U.S.) electrical systems and with standard commercially available mobile electrical generations systems.

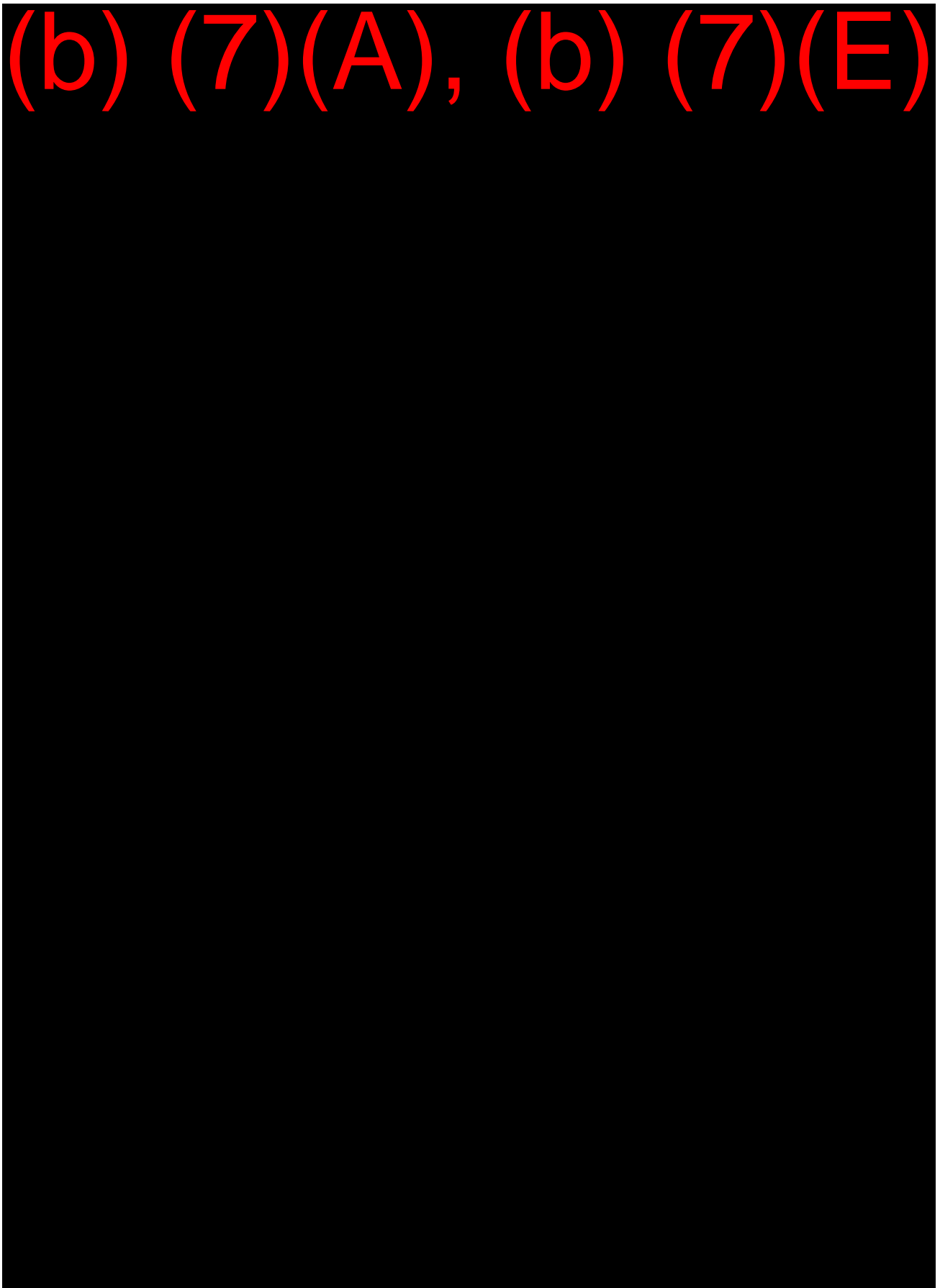
3.2.7.2.7 Human Engineering

The UAS shall not (T) cause adverse effects on the operators or maintainers.

3.2.7.3 Environmental Conditions

Unless otherwise specified in the remainder of this document the UAS including UA, GCS, LOS and BLOS link segments, and GSE shall meet the environmental conditions specified in this section.

(b) (7)(A), (b) (7)(E)



(b) (7)(A), (b) (7)(E)

3.2.7.3.13 — Acceleration

The UAS equipment shall (T) withstand positive and negative accelerations induced during vehicular transport, as part of a mobile assemblage over all types of roads and off-road terrain. The UAS equipment should (O) withstand acceleration induced during rail, air and sea transport.

3.2.7.4 System Reliability, Availability, Maintainability (RAM)

3.2.7.4.1 Reliability

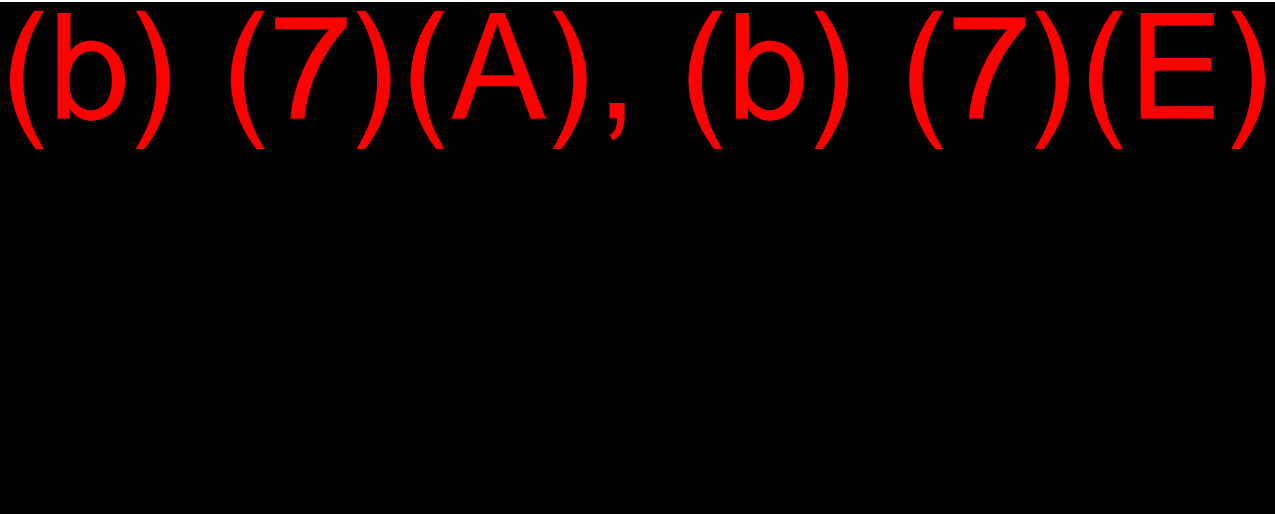
(b) (7)(A), (b) (7)(E)

3.2.7.4.2 Availability

(b) (7)(A), (b) (7)(E)

Mean Maintenance Time (MMT): MMT is based on all preventative and corrective maintenance actions.

3.2.7.4.3 Maintainability



- c. Independence of Failures. Failure, damage, or removal of one item shall not (T) cause failure or damage in any other item and not cause a critical failure if there is a properly functioning item which is redundant to the failed item.

3.2.7.4.4 System Diagnostics

- a. As part of the system diagnostics, the system shall (T) be capable of being commanded from the GCS to move each flight control surface (ailerons, flaps, tails, and cowl flap servo-actuator), and verify proper position versus command and slew rate.
- b. The system diagnostics shall (T) also be capable of monitoring, displaying, and recording health status and warnings, to include variables such as temperature, voltage, and current for selected systems. The health status shall (T) include BIT, and provide Flight Critical warnings and Red limit warnings to alert the operator of a failed or degraded condition.
- c. The system diagnostics shall (T) also be capable of operating from the GCS to the payload equipment and verify proper operation and status.

~~3.2.7.4.5 System Operations Support~~

~~The UAS shall (T) initially be operated and maintained under a contractor logistics support (CLS) contract.~~

3.2.7.5 Transportability

The UAS shall (T) be capable of being configured for (or de-configured from) sea, ground, or air transport. The UAS shall not (T) exceed industry standard size and weight restrictions for a designated transport medium.

3.2.7.5.1 Ground Transportability

The UAS shall (T) be ground transportable using standard commercial vehicles which do not exceed the ordinary and customary restrictions imposed by the Federal Department of Transportation.

3.2.7.5.2 Rail Transportability

The UAS shall (T) be capable of rail transport and be capable of meeting the Gabarit International de-Chargement (GIC) rail clearance diagram requirements. The UAS should (O) be capable of withstanding rail impacts without damage at speeds of up to (b) (7)(E)

3.2.7.5.3 Air Transportability

Each component of the UAS shall (T) be transportable within the cube dimensions and weight constraints of a U.S. Coast Guard (USCG) C-130 H and C-130 J aircraft.

3.2.7.5.4 Marine Transportability

The UAS shall (T) be capable of transport by commercial marine transport vessels. The UAS shall not (T) sustain damage from physical or environmental hazards incurred by marine transport in sea states 4 or below (as defined by the Pierson - Moskowitz Sea Spectrum scale) while being transported by International Organization for Standardization (ISO) dry freight cargo containers.

3.3 Material Definition

3.3.1 Materials

~~The materials used in the UAS shall be suitable for operation in marine environments, and for extended periods of storage. Materials should (O) resist degradation when exposed to the service life environments. This includes utilization of corrosion resistant protective finishes and corrosive resistive materials.~~

3.3.1.1 — Hazardous, Toxic and Ozone Depleting Chemicals Prevention

~~The use of toxic chemicals, hazardous substances, or ozone-depleting chemicals (ODC) shall (T) be avoided. When unavoidable, the hazardous substances, toxic chemicals, or ODCs shall (T) be safety compliant, and regulation compliant in accordance with local, state, and federal regulations. DHS's objective is to prevent hazardous and toxic materials and ozone depleting materials at the source.~~

3.3.1.2 — Recycled, Recovered, or Environmentally Preferable Materials

~~Recycled, recovered, or environmentally preferable materials should (O) be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.~~

3.3.2 Computer Hardware and Software

The UAS should (O) contain non-proprietary software including open specifications for interfaces, services, and formats.

3.3.2.1 — Data Storage and Main Memory Reserve Capacity

~~The UAS shall (T) possess 50% or more reserve capacity for program instruction memory for each system processor, and 50% or more reserve capacity for data storage devices, evaluated under normal operating conditions.~~

3.3.2.2 — Processing Speed/Throughput Reserve Capacity

~~The UAS shall (T) provide 50% or more reserve capacity in throughput for each system processor, evaluated under worst case loading conditions. Techniques, such as bank switching, used to address memory requirements should (O) not degrade the computer system performance during operational missions.~~

3.3.2.3 — Input / Output (I/O) Channel Requirements

~~The I/O channel throughput for each system processor shall (T) have 50% or more reserve capacity, with serial channels possessing a 50% or more reserve data transfer rate capacity, evaluated under worst case loading conditions.~~

3.3.2.4 Processor and Firmware Enhancements

Processors shall (T) be upwardly-scaleable to yield faster execution, reduce life cycle costs, and mitigate obsolescence. The processors may be replaced by, or augmented by, another processor having an identical instruction set or instruction superset and memory architecture (word length and addressing scheme). Firmware should (O) be compatible with existing and planned hardware configurations and allow for system enhancements.

3.3.2.5 Computer Software

The UAS software shall (T) be modular and scaleable and be classified as either operational software or support software. Operational software includes programs executed to fulfill the CBP mission and BIT software. BIT software includes programs for readiness test, fault detection, performance monitoring, maintenance data retrieval, and special test capabilities integral to the system. Support software includes capabilities required for the production, verification, and maintenance of all software and for the test and maintenance of system equipment.

3.3.2.6 Firmware

Contractor developed / controlled computer programs that are stored in Read-Only-Memory (ROM), Programmable ROM (PROM), or other similar memory should (O) be considered firmware. Included are computer programs and data loaded into memory that cannot be dynamically modified by the computer during processing.

3.3.2.7 Programming Languages

The UAS software shall (T) be Higher Order Languages (HOL) which follows ANSI, IEEE, or equivalent standards. The use of assembly language or low level code is restricted to processing-time-constrained and memory-constrained functions.

3.3.2.8 Commenting Standards

Standards shall (T) be established and utilized for embedding comments in source code. The comment standards for banners, headers, and special comments shall be as described in contractor-approved standards or an equivalent methodology.

3.3.2.9 Error and Diagnostic Messages

The UAS software shall (T) possess on-line error and diagnostic messages. The messages should (O) include a textual description of the condition, time of occurrence, required operator actions, and data processor and software execution status when applicable. Error and diagnostic messages are uniquely identifiable and shall be recorded or trapped. Errors detected in the processing of a command or function should (O) result in an alert to the operator and the erroneous command or function ignored. Alerts shall (T) be displayed to the operator upon error detection.

3.3.2.10 Character Set Standards

Character sets shall conform to commercial standards (T).

3.3.2.11 Software Security

The UAS software shall (T) possess the capability to be protected from unauthorized, intentional or unintentional, modification.

3.3.2.12 Fault Tolerance

The UAS software shall (T) prevent single point failures from disabling the entire system.

3.3.2.13 Computer Program Regeneration

The UAS software shall (T) be capable of being regenerated via the source code as stored in the central repository. Patches to UAS software are not considered source code.

3.3.3 Electromagnetic Environmental Effects (E3)

The individual communication and electronic equipment/subsystems utilized on the UAS shall (T) be inter- and intra-system/platform electro-magnetically compatible to ensure that system and platform operational performance requirements are met. The performance of the UAS should (O) minimize degradation when exposed to its operational electromagnetic environment (natural or man-made).

3.3.3.1 Electromagnetic Compatibility (EMC)

All new or modified UAS systems replaceable assemblies (SRAs) or modified portions of interface subsystems shall not (T) interfere with, or be interfered by the operation of any other aircraft equipment or ground control station subsystem. ~~The electromagnetic compatibility (EMC) of the UAS shall allow full use of its SIGINT payload.~~

3.3.3.2 Electromagnetic Vulnerability (EMV)

The UAS ~~shall (T)~~ should (O) be electro-magnetically compatible with the external electromagnetic environment (EME) as referenced in MIL-STD-461E RS103 Section 5.19 Radiated Susceptibility for a 200 V/m field strength.

3.3.3.3 Electromagnetic Interference (EMI)

The generation of an electromagnetic environment by new or modified LRUs and the susceptibility of new or modified LRUs to an electromagnetic environment ~~shall (T)~~ should (O) be controlled within the limits of MIL-STD 461E for UA or FCC Part 15B. The following emissions and susceptibility requirements may apply: CE102, CE106, CS101, CS114, CS115, CS116, RE102, RE103, and RS103. Bonding resistance between cable shields and LRUs shall be IAW MIL-STD-464A. Bonding resistance between the GCS and Earth ground shall be less than 2 ohms.

3.3.3.4 Electromagnetic Radiation Hazards (HERP, HERF)

The UAS shall (T) protect personnel, ordnance and fuel from the hazardous effects of electromagnetic and electrostatic energy. Hazards of Electromagnetic Radiation to Personnel (HERP) and Hazards of Electromagnetic Radiation to Fuel (HERF) concerns shall be addressed. The electromagnetic radiation hazard criteria of MIL-STD 464A are applicable.

3.3.3.5 Electrostatic Discharge (ESD)

The UAS shall (T) control and dissipate the build-up of electrostatic charges caused by precipitation static (p-static), fluid flow, air flow, and other charge generating mechanisms to aircraft fuel ignition to protect personnel from shock hazards, and to prevent performance degradation or damage to electronics.

3.3.4 Safety

3.3.4.1 System Safety

The UAS shall (T) function / operate in a safe manner in accordance with MIL-STD-882 or its equivalent.

3.3.4.2 Safety Provisions

The UAS shall (T) ensure against degradation or negation of safety features during operations, maintenance, storage, and shipping. The UAS should (O) have fail-safe features with adequate redundancy, and be capable of being rendered safe during emergency or abnormal situations.

The UAS should (O) minimize the probability and severity of injury to personnel during all activities including set-up, operation, maintenance, and tear-down throughout the life cycle of the equipment. The system shall be designed (T) to reduce the probability of electrical shock or thermal shock type injuries, and the operator's stations designed to minimize inadvertent operator encounters with edges, shelves, and other station protuberances.

If laser illuminator operations are expected, laser safety goggles shall be available on site so if the laser illuminator would not shut off, and the payload could not be retracted, at least it can land while still radiating and not injure anyone on the ground at the GCS site.

3.4 Logistics

The UAS should (O) emphasize maintainability, commonality, reliability, and accessibility of components to reduce maintenance, supply, support equipment, and manpower requirements.

3.4.1 Ground Support Equipment

The UAS should (O) use Ground Support Equipment (GSE) that is common to DHS/CBP aviation. Contractor provided UAS GSE shall (T) be capable of operating in the environments specified herein.

3.5 Characteristics of System Elements

3.5.1 Aircraft

3.5.1.1 Design Life

The aircraft shall (T) have a design life of 15,000 flight hours and 10 years.

3.5.1.2 Aircraft Performance

Characteristics of the aircraft are contained below and based on International Standard Atmosphere (ISA) standard day conditions with aircraft weight complement of payloads and the amount of fuel needed to accomplish the specific mission.

3.5.1.2.1 Endurance

(b) (7)(A), (b) (7)(E)

3.5.1.2.2 Takeoff Performance

(b) (7)(A), (b) (7)(E)

3.5.1.2.3 Operating Altitude

(b) (7)(A), (b) (7)(E)

- a. The aircraft shall (T) be capable of reaching this operating altitude during the transit phase of flight, i.e., before reaching the patrol area.
- b. The aircraft should (O) be capable of operating in level flight at the altitude allowing maximum line of sight reception by the communication suite and signals interception payload specifications.

3.5.1.2.4 Service Ceiling

(b) (7)(A), (b) (7)(E)

3.5.1.3 Noise Signature

KPP 5: The aircraft shall (T) be inaudible to the unaided human ear on the ground directly below it at its normal operating altitude. The aircraft should (O) not be detectable as a UAS at night to the unaided human eye on the ground directly below it at its operating altitude.

3.5.1.4 Other System Elements

3.5.1.4.1 Electrical system

The electrical system shall (T) provide sufficient electrical power to operate all aircraft subsystem functions plus all sensor subsystems simultaneously with a 20 percent reserve after losses. In the event of primary aircraft power being lost in-flight, aircraft power shall (T) automatically transition without interruption to a second, independent, onboard power source, capable of supporting full functionality of all aircraft systems except the payload sensors for a minimum of 30 minutes. The UA should (O) have a backup generator capable of supporting full functionality of all aircraft systems except the payload sensors for the duration of the flight.

3.5.1.4.2 Communication system

The communication system shall (T) provide a voice communication capability to enable beyond-line-of-sight (BLOS) communication between aircraft operators, air traffic controllers and other mission assets.

3.5.1.4.3 Sense-and-avoid system

The sense-and-avoid system should (O) provide a sensor, separate and independent of the specified electro-optical payload subsystem, capable of detecting non-cooperative airborne traffic that conforms to ASTM 2411.

3.5.1.4.4 Lost link and mission abort procedures

The lost link and mission abort procedures shall (T) be stored in the aircraft mission management computer that can be updated during the flight.

3.5.1.4.5 Airspeed

(b) (7)(A), (b) (7)(E)

3.5.1.4.6 Weight

- a. A mission ready aircraft shall (T) be capable of being emplaced by no more than four (T) two (O) people to support and perform the movement of the aircraft from its mover/storage site to the launch/recovery site and then back to the mover/storage site. The aircraft weight should (O) have a positive margin between mission weight and gross vehicle weight.
- b. Weight Variations: Weight changes to components and subsystems should (O) not adversely affect required flying qualities and performance.

3.5.1.4.7 Aircraft Position Accuracy

(b) (7)(A), (b) (7)(E)

3.5.1.4.8 Handling Qualities

The Flight Control System shall (T) limit maximum allowable roll and pitch angles, automatically provide coordinated flight in cruise phases of flight, and provide stall protection in order to prevent departure from controlled flight scenarios.

(b) (7)(A), (b) (7)(E)

- c. Flight Outside the Flight Envelope: The UAS shall (T) possess sufficient control power and response rate to safely return to the Aircraft operating flight envelope through the automatic flight control system.
- d. Transfer of Flight Control Modes: Engagement, disengagement or changes to the aircraft flight control mode shall (T) be achievable and not result in dangerous stability or control characteristics.

3.5.1.4.9 Aircraft Environmental Conditions

(b) (7)(A), (b) (7)(E)

~~e. Vibration: The aircraft shall (T) not suffer physical or functional damage and meet CBP mission objectives when subjected to vibration present throughout the aircraft operating environment.~~

3.5.1.4.10 Aircraft Modes of Operation

The UA shall (T) be capable of flying pre-programmed mission profiles independent of navigational assistance from the GCS, and be capable of being controlled via the Air Vehicle Operator's Console with manual flight control functions. With loss of the data link, the UAS shall (T) attempt to reestablish data link while continuing on the pre-programmed flight path and mission profile. When data link is not re-established within a predetermined time period, the aircraft shall (T) be capable of fully autonomous flight to a pre-designated point and perform an autonomous emergency recovery. The aircraft mission phase main modes of operation are:

- a. Pre-launch. In this mode, all aircraft pre-launch activities are accomplished. The aircraft will accomplish pre-launch activities using the data link or ground cable connected between the GCS and the aircraft.
- b. Launch. In this mode, manual or automatic aircraft launch is accomplished.
- c. Flight. In this mode, flight activities are accomplished.
- d. Recovery. In this mode, aircraft recovery is accomplished.

3.5.1.4.11 In-Flight Operations

The aircraft shall (T) have the following in-flight capabilities:

- a. Autonomous navigation and flight between multiple, selected waypoints.
- b. Automatic loiter and track on command.
- c. Automatic execution of lost-link procedures (in the event of a failure of the C² link) to fly a pre-planned flight-path to a geographic location to accomplish one or more of the following actions: re-establish the link between the aircraft and the GCS; establish a different link between the aircraft and the GCS; loiter for a period of time to allow for troubleshooting of the failed link.

- d. Automatic return to a pre-planned recovery area when a lost data link connection is not reacquired within a predetermined period of time. Automatic refers to a series of pre-programmed steps that allow the mission planners to set waypoints, altitudes, speeds, execution time (the period of time after lost link), holding, climbing, descending, and landing instructions.
- e. Autonomous execution of emergency procedures due to electrical generator failure or other critical aircraft subsystem failure.

3.5.1.5 Aircraft Functional Requirements

The aircraft shall contain the necessary equipment so that the pilot in the GCS can maintain control of the aircraft and the aircraft's subsystems; transmit and receive data to / from the GCS; provide communication capability between ground / airborne radios within LOS of the aircraft to the GCS; and perform the mission associated with the installed payloads.

3.5.1.5.1 Air Vehicle Data Link

The UA shall (T) have the equipment necessary to maintain a positive link between the aircraft and the GCS to accomplish the following tasks: receive C² inputs from the GCS; receive and transmit voice communications; transmit aircraft status information; and transmit sensor data to the GCS. The aircraft shall have the ability to maintain a link between the GCS and the aircraft during LOS and BLOS operations.

3.5.1.5.2 Airborne Voice Communications Suite

The UA shall have the on board radio equipment to enable voice communications to transmit to and from the GCS for communications with Air Traffic Control (ATC), other aircraft, and other tactical components. The initial aircraft radio complement shall include the following radios: one non-secure VHF / UHF transceiver, ~~one secure VHF / UHF transceiver,~~ and two tactical AM / FM multi-band tactical programmable transceivers. Additional performance specifications of the airborne communication suite are contained in Section 3.5.6.1.

3.5.1.5.3 Identification Friend or Foe (IFF)

The UA shall be equipped with an IFF Mode IIIC and IV identification transponder, which is capable of automatic or manual in-flight programming (T). The transponder should have Mode S and a Precision Locator Information (PLI) transponder capability (O). It should (O) also conform with FAA regulations for altitude encoding transponders as specified in 14 CFR Sections 91.215 and 91.413.

3.5.1.5.4 Locator Beacon

The UA shall (T) be equipped with a locator beacon whose frequency is compatible with existing USCG and FAA-capable search and rescue systems.

3.5.1.5.5 Satellite Tracker

The aircraft shall be equipped with a GFE satellite tracker that is capable of providing time, position, speed, and altitude data at selectable reporting intervals.

3.5.1.5.6 Navigation Lights

The aircraft shall (T) have a navigation, position, and anti-collision (strobe) lighting system which is compliant with Federal Aviation Administration regulations regarding flight in the national aerospace and be capable of being activated or deactivated from the GCS and (O) takeoff and landing system. The UAS should (O) contain anti-collision lighting having an operator-selectable capability for Night Vision Device (NVD) or for visible light range.

3.5.1.5.7 Navigation Modes

The UA shall (T) have redundant GPS and INS navigation system certified for IFR operations in the National Airspace.

The failure of a single GPS and INS navigation system shall not result in a loss of navigation solution or flight safety.

3.5.1.5.8 Sense and Avoid System

Sense-and-avoid is the onboard, self-contained ability to detect traffic that may present a conflict, evaluate flight paths, determine traffic right-of-way, and maneuver well clear (or as required) in accordance with (IAW) FAA regulatory guidance. Sense-and-avoid systems should (O) provide a minimum traffic detection capability as described in ASTM-2411.

3.5.1.5.9 Laser Altimeter System kit.

The Laser altimeter system kit shall (T) provide accurate vertical speed and height above touchdown to the pilot's heads up display. Laser altimeter system shall have multiple sensors (T) with software correction for errant sensor returns. GCS software should (O) provide angle of attack guidance to the pilot that maintains the aircraft with safe landing attitudes for all UA landing weights.

3.5.1.5.10 Centerline Hardpoint Kit

Centerline hardpoint kit shall include installation structure and fittings capable of supporting at least 750 pounds throughout the UA recommended flight envelope when installed to the UA fuselage. The centerline fittings to the fuselage structure shall (T) be attached at a location that maintains the UA in the recommended enter of gravity envelope at the maximum rated load (750 pounds) for all UA fuel weights. The kit shall (T) modify the structure of the UA sufficiently to provide routing access and security for the data and power cabling from accessible areas near the centerline hardpoints to areas where they will be integrated within existing UA avionics and wiring. The kit shall (T) include parts and assemblies necessary to re-route the existing UA fuel vent system to a location that is sufficiently clear of the area where sensors may be contaminated from vented fuel.

3.5.1.5.11 Payload Provisions

The UA shall (T) incorporate a payload capability that provides the following functions or provisions:

- a. Support operation of two or more sensors simultaneously in straight and level flight conditions.
- b. Provide a total payload weight capacity of at least (b) (7)(A), (b) (7)(E)
- c. Provide a total internal payload volume of at least five cubic feet.
- d. Provide an interface to support operation of 1 or more payloads.
- e. Provide aircraft position, attitude, and other flight information to the payloads.
- f. The aircraft shall (T) have a meteorological sensor with the capability to calculate and report winds aloft, measure temperature ($\pm 1^{\circ}$ C), and barometric pressure (± 0.1 inches (3.37 millibars) of mercury).

3.5.1.5.12 Aircraft Servicing

The UA shall (T) incorporate the following functions or provisions.

- a. Possess an embedded gravity (T) pressure (O) fuel and de-fuel capability.
- b. Withstand and remain operational after a fresh water wash of the airframe and engine
- c. Possess lift and hoisting (hard) point capable of supporting a mission ready aircraft
- d. Use reasonably available commercial fuel such as Jet-A, JP-5, JP-8 (T) or diesel (O)
- e. Possess a designated single point grounding site
- f. Ground Operation Provisions. All aircraft components should (O) be capable of being operated to accomplish system maintenance, training, and / or system preparation by either an external auxiliary power unit or internal aircraft power for at least 30 minutes under worse case thermal and environmental conditions without external cooling.

3.5.2 Payloads

3.5.2.1 Types of Payloads

KPP 6: The aircraft shall (T) be capable of simultaneously operating the communication suite, the EO/IR with laser illuminator and one or more of the following payloads, without degrading payload or aircraft performance, during flight: Synthetic Aperture Radar (SAR) with Ground Moving Target Indicator (GMTI).

3.5.2.2 Flight Operation

The payloads shall (T) operate within the flight envelope and under the same climatic, altitude, and operating conditions as the UAS.

3.5.2.3 Payload Tracking and Pointing

3.5.2.3.1 Automatic Tracking

Applicable payloads shall (T) be capable of automatically tracking an adult human-sized, single moving object and keep a stationary object in the center of that sensor's Field of View (FOV). Tracking accuracy should (O) be sufficient to allow target designation at the specified ranges.

3.5.2.3.2 Geographic Pointing

Applicable payloads shall (T) be able to automatically point at a specified geographic location within the payload's field of regard (FOR). In conjunction with the air vehicle's automatic loiter capability, the payload should (O) be able to maintain constant surveillance and track on a designated geographic point.

3.5.2.3.3 Fixed Pointing

Applicable payloads shall (T) be able to continuously point at a fixed azimuth and depression.

3.5.2.3.4 Target Marking

(b) (7)(A), (b) (7)(E)

3.5.2.4 Payload Control

The payloads shall (T) be capable of being controlled manually by an operator in the GCS, or an SCT, or automatically controlled via the mission plan. Payload command and controls shall (T) be accomplished from a workstation independent of the aircraft command and control workstation.

3.5.2.5 Data Display

EO/IR and radar payloads shall (T) supply the coordinates for payload center FOV to the UAS for display in the GCS, SCT, and RVT. The date and time of the EO/IR recording shall (T) be "stamped" on the raw video data. Agency information of the EO/IR recording shall (T) be "stamped" on the raw video data. Agency information of the EO/IR recording shall (T) be selectable on/off.

3.5.2.6 Payload Cooling System

If applicable, the payload detector cooling system shall (T) be a closed-loop, self-contained system, and not require charging prior to flight.

3.5.2.7 Sensor Metadata

Applicable sensors shall (T) be capable of providing sensor specific metadata for imagery embedding. Typical sensor metadata elements include: FOV, focal length, azimuth angle, depression angle, sensor type, time stamp, sensor settings, and sensor motion information (roll, pitch, and yaw).

3.5.2.8 Payload Interfaces

The contractor should provide non-proprietary payload interface specifications for integrating specified payloads into the UAS. Installation / loading of payload elements into the UAS shall not (O) require modification of aircraft, GCS, or RVT core operating software.

3.5.3 EO/IR Sensor

(b) (7)(A), (b) (7)(E)

3.5.3.1 EO/IR Sensor Performance Specifications

(b) (7)(A), (b) (7)(E)