INCH-POUND

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PERFORMANCE SPECIFICATION
IMPROVED POSITION AND AZIMUTH DETERMINING SYSTEM (IPADS)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1. Scope. This specification covers an inertial surveying system that is air and ground vehicle mounted.

2. APPLICABLE DOCUMENTS

2.1. General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in section 3 and 4 of this specification, whether or not they are listed.

2.2. Government documents.

2.2.1. Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ENGINEER RESEARCH AND DEVELOPMENT CENTER, CORPS OF ENGINEERS, U.S. ARMY TOPOGRAPHIC ENGINEERING CENTER, ATTN CEERD-TS-T, 7701 TELEGRAPH ROAD, ALEXANDRIA, VA 22315-3864 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6675

Distribution Statement A. Approved for public release; distribution is unlimited.

SPECIFICATIONS

FEDERAL

A-A-52567	Survey Instrument Automated, Integrated (AISI)
A-A-52573	Theodolites, Surveying, Direction: Third Order
A-A-52574	Theodolites, Surveying, Direction: Second Order

STANDARDS

FEDERAL

FED-STD-595	Colors Used In Government Procurement

DEPARTMENT OF DEFENSE

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems And Equipment
MIL-STD-464	Electromagnetic Environmental Effects
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1275	Characteristics of 28 Volt DC Electrical Systems in Military Vehicles
MIL-STD-1472	Human Engineering
MIL-STD-1474	Noise Limits

HANDBOOKS

DEPARTMENT OF DEFENSE

MIL-HDBK-781	Reliability Test Methods, Plans and Environments for Engineering, Development, Qualification and Production
MIL-HDBK-783	Chemical and Biological (CB) Contamination Avoidance and Decontamination
MIL-HDBK-784	Design to Minimize Contamination and to Facilitate Decontamination of Military Vehicles and Other Equipment: Interiors and Exteriors

(Unless otherwise indicated, copies of the above specifications, standards and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094. They also may be downloaded from http://131.82.253.19/quicksearch/.)

2.2.2. Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications, form a part of this document, to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

SAAL-RP 4 Jan 2000	MEMORANDUM, SUBJECT: Development, Acquisition and Fielding of Weapon and Information Systems with Batteries

(This document may be accessed at: http://lrc7.monmouth.army.mil/QuickPlace/ipm/PageLibrary85256AE1004DB1FD.nsf/h_Toc/8A26328FBC6148FE85256BAB006763E7/?OpenDocument)

	Army Policy On Selection/Approval of Portable Power Sources, 11 May 2000

(This document may be accessed at: http://lrc7.monmouth.army.mil/QuickPlace/ipm/PageLibrary85256AE1004DB1FD.nsf/h_Toc/CB6E6E841468E14C85256BAB00672371/?OpenDocument)

FSS-SS-0011-ICD	Improved Position And Azimuth Determining System Interface Control Document for the Forward Observer System

(This document may be obtained from the Procuring Contracting Officer.)

NIMA TR8350.2 Third Edition Amendment 1	Department of Defense World Geodetic System 1984, Its Definition and Relationships with Local Geodetic Systems

(NIMA TR8350.2 may be downloaded from http://164.214.2.59/GandG/tr8350_2.html)

SEL Form 1183 Feb 2001	System Safety Design Verification Checklist

(SEL Form 1183 can be downloaded from http://www.monmouth.army.mil/cecom/safety/spub/form1183.dot)

42 U.S.C. 4321-4370d	National Environmental Policy Act
29 C.F.R 1920.145	Specifications for Accident Prevention Signs and Tags
40 C.F.R. 1500-1508	National Environmental Policy Act Regulations
Executive Order 12114	Environmental Effects Abroad of Major Federal Actions
FM 3-5	NBC Decontamination, July 2000, with Change 1, 31 January 2002

(FM 3-5 may be downloaded from http://155.217.58.58/cgi-bin/atdl.dll/fm/3-5/fm3-5.htm)

2.3. Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation.

Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C63.16-1993	American National Standard Guide for Electrostatic Discharge Test Methodologies and Criteria for Electronic Equipment

(Application for copies should be addressed to American National Standards Institute, 1819 L Street NW, Suite 600, Washington, DC 20036. http://webstore.ansi.org/ansidocstore/default.asp)

RELIABILITY ANALYSIS CENTER

PRISM Software Tool

(Information on PRISM can be obtained from http://www.rac.iitri.org/prism/)

GENERAL MOTORS CORPORATION

GM9540P	Accelerated Corrosion Test

(Application for copies should be addressed to Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112. http://global.ihs.com/)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.

SAE ARP 1199	Selection, Application, and Inspection of Electric Overcurrent Protective Devices (DoD Adopted).

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096. http://www.sae.org/servlets/productDetail?PROD_TYP=STD&PROD_CD=ARP1199B)

MILTOPE CORPORATION

Soldier's Portable On-System Repair Tool (SPORT) Data Sheet

(This document may be downloaded from http://www.miltope.com/pdf/sport.pdf)

2.4. Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1. Design verification. When specified in the contract, (see 6.2), a sample of the IPADS shall be subjected to design verification in accordance with 4.2.

3.2. First article. When specified in the contract (see 6.2), a sample of the IPADS shall be subjected to first article inspection in accordance with 4.3.

3.3. Performance characteristics.

3.3.1. External signals. IPADS shall not use external, electromagnetic signals in the determination of position and azimuth.

3.3.2. Geographic area of operation. IPADS shall operate as specified herein in any geographic area of the world except within 15º latitude of the poles.

3.3.3. Local operational area. IPADS shall perform as specified herein when operated within a circle of 75 Km radius, minimum, centered on the initialization point or subsequent update point.

3.3.4. Vehicle dynamics and attitudes. IPADS shall perform as specified herein when operated within the following envelopes for vehicle dynamics and attitudes:

a. Horizontal velocity, ground speed: 0 to 150 knots, in any direction.

b. Vertical velocity: 0 to 2400 feet per minute.

c. Acceleration: 0 to 3g in any direction.

d. Angular velocity: 0 to 140º per second around any axis.

e. Pitch (longitudinal vehicle axis): -85º to +85º from the horizontal.

f. Roll (transverse vehicle axis): -180º to +180º from the horizontal.

3.3.4.1. Base motion while stationary. IPADS shall perform as specified herein when the host vehicle, while nominally stationary, is subject to wind buffeting, normal crew movement, engine vibration, vibration from engine/generator sets, and other sources of motion usually found on the battlefield.

3.3.5. Initialization time.

3.3.5.1. Normal. Initialization time shall not exceed the values shown in Table 1. Initialization time begins at IPADS power turn-on and ends when the system is fully initialized and ready to start a survey.

3.3.5.2. "Hot start". If not moved since the last shutdown, IPADS shall be capable of being initialized, without requiring position data entry, within the "hot start" initialization time specified in Table 1. "Hot start" initialization time begins at IPADS power turn-on and ends when the system is fully initialized and ready to start a survey.

3.3.5.2.1. Excessive motion. IPADS shall automatically revert to normal initialization if it was moved and cannot meet the survey accuracies specified in Table 1 with "hot start" initialization.

3.3.6. Operating modes.

3.3.6.1. High order survey. IPADS shall have a high order survey mode.

3.3.6.2. Lower order survey. IPADS shall have a lower order survey mode.

3.3.6.3. Unadjusted survey. IPADS shall operate as specified herein when furnished no information other than the horizontal position and altitude coordinates of the starting point entered during initialization.

Table 1 - IPADS performance requirements.

Latitude of Operation		**0° - 65° N/S**		**65° -75° N/S**	
Survey Order		**High**	**Lower**	**High**	**Lower**
Initialization Time (minutes)		10.0	10.0	20.0	20.0
"Hot Start" Initialization Time (minutes)		5.0	5.0	10.0	10.0
Zero-velocity update interval (minutes)		5.0	10.0	5.0	10.0
Horizontal position (meters)	CEP	4.0	7.0	4.0	7.0
	99% radial errors	±10.4	±18.2	±10.4	±18.2
Altitude (meters-PE)	PE	2.0	3.0	2.0	3.0
	99% errors	±7.8	±11.7	±7.8	±11.7
Azimuth error (mils-PE)	PE	0.4	0.4	0.6	0.6
	99% errors	±1.6	±1.6	±2.3	±2.3

3.3.6.4. Adjusted survey. At the end of a survey leg, IPADS shall adjust the data to minimize error when provided with the known coordinates of the Survey Control Point (SCP) ending the survey leg.

3.3.7. Accuracy. The allowable errors specified below include errors associated with transfer of horizontal position, altitude, and azimuth to and from IPADS and apply to both unadjusted and adjusted traverse operation.

3.3.7.1. Horizontal position. Horizontal position circular error probable (CEP) shall not exceed the values specified in Table 1. 99 percent or more of individual horizontal position radial errors shall be within the ranges specified in Table 1.

3.3.7.2. Altitude. Altitude probable error (PE) shall not exceed the values specified in Table 1. 99 percent or more of individual altitude errors shall be within the ranges specified in Table 1.

3.3.7.3. Azimuth. Azimuth PE shall not exceed the values specified in Table 1. 99 percent or more of individual azimuth errors shall be within the ranges specified in Table 1. Azimuth accuracy requirements apply to orienting lines 100 meters in length and longer.

3.3.8. Operating time. IPADS shall perform as specified herein for 24 continuous hours including initialization time. This requirement does not preclude the operator from extending operating time indefinitely.

3.3.9. Zero-velocity stops. The average required stationary time for a zero-velocity stop shall not exceed 30 seconds. The maximum required stationary time for a zero-velocity stop shall not exceed 60 seconds.

3.3.9.1. Travel intervals. Travel intervals between required zero-velocity stops shall be no less than the values specified in Table 1.

3.3.10. Time to update or establish position and azimuth.

3.3.10.1. Position only. The time to update or establish horizontal position and altitude shall not exceed 2 minutes using the driver's interface (3.4.5.a.) The time to update horizontal position and altitude shall not exceed 10 minutes using the offset interface (3.4.5.c.) The duration includes the time to perform all crew actions required to establish, physically mark, and record the position.

3.3.10.2. Position and azimuth. The time to establish horizontal position, altitude and azimuth shall not exceed 15 minutes using the two-position method or offset interface (3.4.5.b, c, and d.) The duration includes the time to perform all crew actions required to establish, physically mark, and record the azimuth and the positions of both ends of the Orienting Line (OL).

3.3.11. Back-up power. IPADS shall include a rechargeable battery that will automatically sustain IPADS operation for not less than 15 minutes after loss of external power.

3.3.11.1. Battery charge. IPADS shall automatically charge the back-up battery when the host vehicle power system is outputting sufficient voltage to charge the vehicle battery. After IPADS is operated only on the back-up battery for a minimum of 15 minutes, and host vehicle power is available, the back-up battery shall be sufficiently recharged within 4 hours to support another 15 minutes of IPADS operation with only the back-up battery.

3.3.11.2. No charge. IPADS shall not charge the back-up battery when the host vehicle battery is being discharged.

3.3.11.3. Overcharge. IPADS shall not overcharge the back-up battery.

3.3.11.4. Battery replacement. When provided with host vehicle power, IPADS operation shall be maintained while batteries are being replaced.

3.3.12. Power loss. While stationary or moving, IPADS shall not be damaged by:

a. Loss of vehicle power and/or

b. Disconnection or exhaustion of back-up power.

3.3.13. Data retention. After normal shutdown or inadvertent loss of all power, IPADS shall retain all data needed for operation, all survey data, and user defined ellipsoid and datum parameters, while stationary or moving, and data required to perform a "hot start" while stationary. The default ellipsoid and datum shall be those last used prior to shutdown.

3.3.14. Survey data storage. IPADS shall retain survey data for a minimum of 360 SCPs for later recall (3.4.4.3.v), survey adjustment (3.3.6.4), and communication to an external host (3.4.4.3.z and 3.4.4.3.aa.) The minimum data set for each SCP shall contain: SCP identifier, horizontal position, altitude, mark identifier(s), azimuth(s), and any other data required for survey adjustment.

3.3.15. Information security. IPADS shall not:

a. Permit external devices to access or alter IPADS software or firmware, except for intentional reprogramming (see 3.6.7.7.)

b. Permit external devices to interfere with IPADS operation.

c. Permit external devices to access the host system through IPADS.

d. Contain malicious code, viruses, or trap doors.

3.3.16. Vehicle-to-vehicle transfer. An operating IPADS shall be transferable from one host vehicle to another, by a two-person crew, and be ready to continue the mission in the second vehicle within 10 minutes, without losing information or requiring reinitialization. Installation hardware and cables may be pre-installed in ground vehicles to meet this requirement. No prior preparation of aircraft shall be required to meet this requirement.

3.3.17. Visibility. IPADS controls and displays shall be visible under conditions ranging from full darkness to direct, bright sunlight.

3.3.17.1. Night vision. IPADS shall be operable by personnel wearing night vision goggles. Night vision of personnel in the vicinity of IPADS shall not be degraded, whether they are wearing night vision goggles or not.

3.3.17.2. Blackout. IPADS shall be operable under blackout conditions. When operated under blackout conditions, no part of IPADS shall be visible at distances 10 meters and greater from the center of the system.

3.4. Interface and Interoperability requirements.

3.4.1. Mechanical interface requirements. When installed in a host aircraft or ground vehicle, the IPADS shall operate without interference with or from normal operation of the host vehicle or vehicle accessories.

3.4.1.1. Installation. IPADS shall mount in all host vehicles, see 3.4.1.1.1 and 3.4.1.1.2, utilizing additional interface hardware (installation kit), if required. Interface hardware (installation kit(s)) shall be provided for host vehicle(s) specified in acquisition documents (see 6.2). Installation kits shall contain all hardware items and electrical cables necessary to install and operate IPADS in the specified host vehicle(s).

3.4.1.1.1. Ground vehicles. IPADS shall interface with the host ground vehicles listed below. No permanent modification to the host vehicle is permitted, with the exception of replacement hardware.

a. Utility Truck: Cargo/Troop carrier, 1-1/4 ton, 4 x 4, M998

b. Truck, Utility: Heavy Variant, 10,300 GVW, 4 x 4, M1123

c. Carrier, cargo, 1-1/2 Ton, M973 Small Unit Support Vehicle (SUSV).

3.4.1.1.2. Aircraft. IPADS shall interface with the host aircraft listed below. No modification to host aircraft is permitted.

a. Aircraft, Rotary Wing, Utility: UH-60.

3.4.1.1.3. Transport aircraft. IPADS installed in a ground host vehicle shall be transportable when sling hoisted by the aircraft listed below. When transported, IPADS may be non-operating or operating from its backup batteries and the ground vehicle batteries.

a. Aircraft, Rotary Wing, Cargo-Transport: CH-46, CH-47 and CH-53.

3.4.2. Power interface.

3.4.2.1. Ground vehicle power. IPADS shall function as specified herein when provided with power from a vehicle power system meeting the requirements of MIL-STD-1275 under fault free and single fault conditions.

3.4.2.1.1. Multiple fault conditions. IPADS shall not be damaged by multiple fault malfunction of the host vehicle power system as specified in MIL-STD-1275.

3.4.2.1.2. Power connection. IPADS shall obtain power from the host vehicle battery or other available terminals. IPADS also shall be capable of obtaining power from the host vehicle NATO receptacle, where available.

3.4.2.2. Aircraft power. IPADS shall function as specified herein when provided with 28 VDC or 115 VAC power meeting the requirements of MIL-STD-704, as tailored in Appendix B, and shall be in accordance with the utilization equipment requirements of MIL-STD-704, as tailored in Appendix B. IPADS shall function as specified herein when the aircraft power source is operating within MIL-STD-704 limits, as tailored in Appendix B, for normal, abnormal, starting and transfer conditions. A separate AC to DC converter may be used in aircraft that do not provide 28 VDC power.

3.4.2.3. Reverse polarity. IPADS shall not be damaged from reverse polarity connection of DC power.

3.4.2.4. Power consumption. IPADS shall consume no more than 150 watts from the host vehicle, including any power required to (re)charge IPADS batteries.

3.4.2.5. Power disconnect. IPADS shall provide a capability to draw no power from the host vehicle without disconnecting cables or removing fuses.

3.4.3. Digital interfaces.

3.4.3.1. Digital data interface. IPADS shall exchange digital data with an external host system over a serial data interface. Interface characteristics, data protocols, and messages shall be in accordance with FSS-SS-0011-ICD. IPADS shall include a digital interface cable that connects to the connectors identified in FSS-SS-0011-ICD.

3.4.3.1.1. Hot connect/disconnect. IPADS shall not be damaged or cause damage to the interfacing host system and IPADS operation shall not be interrupted when the serial data interface is connected and disconnected while IPADS is operating. No operator action shall be required to establish and maintain serial communications with the exception of mating the interface electrical connectors.

3.4.3.1.2. Time synchronization. IPADS shall synchronize date and time of day to that contained in a FSS-SS-0011-ICD Time Message from the host system to within two seconds.

3.4.3.2. Reprogramming interface(s). IPADS shall interface to a Soldier's Portable On-System Repair Tool (SPORT) (standard configuration) or equivalent to reprogram all Line Replaceable Units (LRUs), which utilize software or firmware. Reprogramming cables shall be provided for those reprogramming devices specified in acquisition documents (see 6.2).

3.4.4. Control and display interface. IPADS shall provide a control and display interface for the operator. From a single location, the operator shall be able to control the IPADS mode of operation; accomplish data entry, readout, and update; observe system status; display survey and other operational parameters; and initiate data transfer to an external host system.

3.4.4.1. Control and display location. The control and display interface shall be visible and accessible for hands-free operation (except for data entry and selection procedures) by both the vehicle driver and IPADS operator (not necessarily at the same time).

3.4.4.2. Display parameters. IPADS shall display:

a. Survey control point identifier.
b. UTM easting, northing and grid zone.
c. Latitude and longitude.
d. Altitude.
e. Mark identifier.
f. Azimuth.
g. Distance.
h. Angle.
i. Ellipsoid display name.
j. Semi-major axis, flattening or semi-minor axis indicator, and semi-minor axis or inverse flattening of user defined ellipsoids.
k. Datum display name.
l. X, Y, Z-shifts for user defined datums.
m. Current date and time of day.
n. Date and time of day a SCP or Mark was established.
o. Unadjusted or adjusted survey indicator for stored SCP data.
p. IPADS software version(s).
q. All other parameters required to operate IPADS.

3.4.4.2.1. Display field characteristics. Characteristics of display fields shall be as specified in Appendix A.

3.4.4.2.2. Survey data page. Survey control point identifier, horizontal position, altitude, mark identifier, azimuth, distance from last SCP (if displaying survey in progress), length of OL (if displaying saved survey data), ellipsoid name, and datum name shall be displayed on a single page.

3.4.4.2.3. Display field selection. At any time, IPADS shall allow the operator to select display of:

a. Geodetic or UTM horizontal coordinates.

b. UTM coordinates with respect to the normal or adjacent zone, when horizontal position is within 40 Km of a UTM zone boundary.

c. Grid or geodetic (true) azimuth.

d. Azimuth in mils; degrees, minutes and seconds; or decimal degrees.

e. User ellipsoid inverse flattening or semi-minor axis.

3.4.4.2.4. Horizontal position display. Horizontal position shall be displayed with respect to the selected horizontal datum.

3.4.4.2.5. UTM zone.

a. UTM coordinates shall be displayed with respect to standard, 6° wide longitude zones throughout the UTM coverage area.

b. Within 40 Km of a UTM zone boundary, IPADS shall accept initialization or update UTM coordinates with respect to the normal UTM zone, for that location, or the adjacent (extended) UTM zone. IPADS shall display UTM coordinates with respect to the input zone until the operator changes the zone (3.4.4.2.3.b.) or a normal or extended zone boundary is crossed.

c. The first time a UTM zone boundary is crossed from west to east during a mission, IPADS shall prompt the operator to select whether display of UTM coordinates shall remain with respect to the previous zone or shall be with respect to the new zone. For subsequent crossings of the same zone boundary, IPADS shall display UTM coordinates with respect to the previously selected zone for the current side of the boundary.

d. The first time IPADS crosses into an extended zone from east to west during a mission, IPADS shall prompt the operator to select whether display of UTM coordinates shall remain with respect to the current (normal) zone or shall be with respect to the adjacent (extended) zone. For subsequent crossings of the same extended zone boundary, IPADS shall display UTM coordinates with respect to the previously selected zone for the current side of the boundary.

e. When further than 40 Km from a UTM zone boundary, IPADS shall display UTM coordinates with respect to the normal UTM zone for that location.

3.4.4.2.6. Altitude display. Altitude shall be displayed with respect to the local vertical datum. Altitude shall not be transformed between datums.

3.4.4.3. Operator control functions and data entry. IPADS shall allow the operator to:

a. Turn IPADS on and off.

b. Read out survey data from the previous mission, if not previously cleared by the operator.

c. Perform “hot start” initialization (see 3.3.5.2.)

d. Select high or lower order operating mode.

e. Select and use survey control point data provided by the host system for position initialization and update.

f. Select the vehicle reference or offset reference for position and azimuth transfer.

g. Establish the relative location of the vehicle reference for different host vehicles.

h. Enter distance for offset position and azimuth transfer.

i. Enter angle for offset azimuth transfer.

j. Enter date and time.

k. Enter survey control point identifiers. If the operator does not enter a survey control point identifier, IPADS shall populate the field with an unambiguous identifier.

l. At any time, select ellipsoid and horizontal datum from preprogrammed table of all datums listed in NIMA TR8350.2 without requiring reinitialization or a position update.

m. At any time, select ellipsoid from preprogrammed table of all ellipsoids listed in NIMA TR8350.2 and enter shift parameters for two user-defined horizontal datums without requiring reinitialization or a position update.

n. At any time, enter ellipsoid and shift parameters for two user-defined horizontal datums without requiring reinitialization or a position update.

o. At any time, initialize and update horizontal position coordinates, independent of and in conjunction with altitude.

p. At any time, initialize and update altitude, independent of and in conjunction with horizontal position.

q. Enter mark identifiers. If the operator does not enter a mark identifier, IPADS shall populate the field with an unambiguous identifier.

r. Associate up to two marks with a survey control point

s. Establish the azimuth of an orienting line.

t. Save survey control point data.

u. Display current position and heading.

v. Display data for any saved survey control point.

w. Delete data for any saved survey control point.

x. Delete data for all saved survey control points.

y. Adjust all survey control points on a survey leg for closure.

z. Send data for any saved survey control point to the host system.

aa. Send data for all saved survey control points to the host system.

bb. Adjust control and display lighting intensity.

cc. Turn the audible alarm on and off.

3.4.4.4. Status indications. IPADS shall indicate to the operator:

a. Operational status (BIT) of all LRUs.

b. Status of vehicle power and backup power.

c. Operational status (connected/disconnected) of serial data link with host system.

d. Requirements to stop the vehicle or remain stationary, both audibly and visually.

e. Travel time until a stop is required.

f. Time remaining to complete alignment.

g. When a UTM zone boundary or extended zone boundary has been crossed, both audibly and visually.

h. When data entry or other operator action is needed.

i. When a data entry is outside the allowable limits.

j. When a dynamic or attitude limit (see 3.3.4) has been exceeded and IPADS accuracy has been degraded.

k. Failure of normal or "hot start" initialization.

l. High or lower order operating mode.

3.4.5. Position and azimuth transfer interfaces. IPADS shall provide interfaces to:

a. Transfer the position of a SCP on the ground to IPADS, from the host ground vehicle driver position.

b. To transfer IPADS determined position and azimuth (two-position method) from the vehicle to points on the ground.

c. Transfer position coordinates in and out of IPADS, from and to a location offset from the host vehicle, using a survey instrument to autoreflect and determine distance to the IPADS. (The survey instrument is not an IPADS component.) The minimum range of transfer distances shall be from 1 to 16 meters. Transfer requirements shall be met when the survey instrument is a mil-reading theodolite, conforming to A-A-52573 or A-A-52574, or a mil-reading Automated Integrated Survey Instrument (AISI), conforming to the basic requirements of A-A-52567. Transfer requirements shall be met when the host vehicle is on slopes and side slopes within the range of ±15°, for ground vehicles, and ±10°, for helicopters. Transfer shall be possible under any visibility conditions greater than 150 meters.

d. Transfer azimuth from IPADS to an orienting line offset from the host vehicle, using a survey instrument to autoreflect, turn the angle between IPADS and the EOL, and determine distance to the IPADS. The minimum range of transfer distances shall be from 1 to 16 meters. Transfer requirements shall be met when the survey instrument is a mil-reading theodolite, conforming to A-A-52573 or A-A-52574, or a mil-reading, AISI, conforming to the basic requirements of A-A-52567. Transfer requirements shall be met when the host vehicle is on slopes and side slopes within the range of ±15°, for ground vehicles, and ±10°, for helicopters. Transfer shall be possible under any visibility conditions greater than 150 meters.

3.5. Environmental requirements.

3.5.1. Operating conditions. The IPADS operating ambient temperature range shall be -50° F (-46° C), with negligible solar energy, to +125° F (+52° C), with solar radiation to 360 BTU per square foot, per hour.

3.5.2. Storage conditions. The IPADS storage ambient temperature range shall be -50°F (-46° C) to +160° F (71° C) in and out of transit cases.

3.5.3. Atmospheric pressure (altitude).

3.5.3.1. Operational. IPADS shall operate at altitudes from 500 feet below to 15,000 feet above sea level.

3.5.3.2. Storage/transport. IPADS, in its transit cases, shall not be damaged when transported or stored at altitudes from 500 feet below to 15,000 feet above sea level.

3.5.3.3. Rapid decompression. IPADS, in its transit cases, shall survive rapid decompression from an initial aircraft cabin altitude of 8,000 feet to a final cabin altitude of 40,000 feet.

3.5.4. Dust. IPADS shall not be damaged and shall perform as specified herein during and after a 12 hour exposure with dust concentrations of 0.3 ± 0.2 grams per cubic foot and air velocity from 300 ft/min (1.5 m/s) to 1750 ft/min (8.9 m/s).

3.5.5. Sand. IPADS shall not be damaged and shall perform as specified herein during and after a 90-minute exposure to each exposed surface with sand concentrations of 1.32×10^{-4} lb/ft^3 (2.19×10^{-3} kg/m^3) and air velocity from 3540 ft/min (18 m/s) to 5700 ft/min (29 m/s).

3.5.6. Rain. IPADS shall operate and not be damaged during and after exposure to rain at a rate not less than 4 in/hr (10 cm/hr) with a wind velocity greater than 40 mph (18 m/s). Compartments containing electronics and other sensitive components shall not contain any water after exposure to rain.

3.5.7. Humidity. IPADS shall not be damaged by operation, transportation, or storage when exposed to ambient relative humidity within the range of 1 to 100 percent (condensing).

3.5.8. Fungus. IPADS shall not be damaged and shall operate after exposure for 28 days to a viable spore suspension containing at least the following fungi: Aspergillus Niger, Aspergillus Flavus, Aspergillus Versicolor, Penicillium Funiculosum, and Chaetomium Globosum.

3.5.9. Salt fog. IPADS shall not be damaged and shall operate during and after 2 weeks of continual exposure to salt fog.

3.5.10. Vibration.

3.5.10.1. Ground vehicle vibration. An operating IPADS shall perform as specified herein and shall not be damaged when exposed to the random vibration profiles in Table 2 for 40 minutes in each axis.

3.5.10.2. Helicopter vibration. An operating IPADS shall not be damaged when exposed to the vibration profiles in Figure 1 and Table 3 for 60 minutes in each of three mutually perpendicular axes. The sinusoid components in Figure 1 vary by helicopter type and are listed in Table 3.

3.5.10.3. Loose cargo. IPADS LRUs, in their transit cases, shall not be damaged when transported as loose cargo. Transit cases shall show no evidence of damaged seals, impaired structural integrity, malfunctioning latches, damaged carrying devices, and damaged pressure

relief valves. Any dents or warpage sustained shall not impair normal opening and closing of the case.

3.5.11. Shock.

3.5.11.1. Operational shock. An operating IPADS shall perform as specified herein and not be damaged when subjected to shocks with peak acceleration of 40 g's, effective transient duration (T_E) of 15 - 23 ms., and cross over frequency of 45 Hz.

3.5.11.2. Non-operating shock. A non-operating IPADS shall not be damaged when subjected to shocks with peak acceleration of 40 g's, effective transient duration (T_E) of 15 - 23 ms., and cross over frequency of 45 Hz.

Table 2 - Composite Wheeled Vehicle Random Vibration Profiles

Vertical Axis		**Transverse Axis**		**Longitudinal Axis**	
Frequency (Hz)	**PSD (g^2/Hz)**	**Frequency (Hz)**	**PSD (g^2/Hz)**	**Frequency (Hz)**	**PSD (g^2/Hz)**
5	0.2308	5	0.1373	5	0.0605
8	0.7041	9	0.09	6	0.0577
12	0.0527	12	0.0902	8	0.0455
16	0.03	14	0.0427	12	0.0351
20	0.0235	16	0.0496	15	0.0241
22	0.0109	18	0.0229	16	0.035
24	0.0109	119	0.0008	19	0.0092
26	0.0154	146	0.0013	25	0.0159
69	0.0018	166	0.0009	37	0.0041
79	0.0048	201	0.0009	41	0.006
87	0.0028	273	0.0053	49	0.0017
123	0.0063	289	0.0021	105	0.0006
161	0.0043	371	0.0104	125	0.0004
209	0.0057	382	0.0019	143	0.0013
224	0.015	402	0.0077	187	0.0013
247	0.0031	422	0.0027	219	0.0028
278	0.0139	500	0.0016	221	0.0068
293	0.0037	**1.6 g RMS**		247	0.0325
357	0.0028			249	0.0098
375	0.0052			270	0.0026
500	0.0011			293	0.0094
2.18 g RMS				336	0.012
				353	0.0247
				379	0.0085
				431	0.0224
				433	0.0092
				500	0.0014
				1.96 g RMS	

Table 3 - Helicopter Vibration Profile

Random Vibration Component			UH-60 Sinusoid Components		
	Frequency (Hz)	PSD (g2/Hz)		Frequency (Hz)	Acceleration (G's peak)
w_0	10	0.0010	f_1	4.3	0.109
w_1	100	0.010	f_2	17.2	1.72
w_1	300	0.010	f_3	34.4	2.5
w_0	500	0.0010	f_4	51.6	1.5

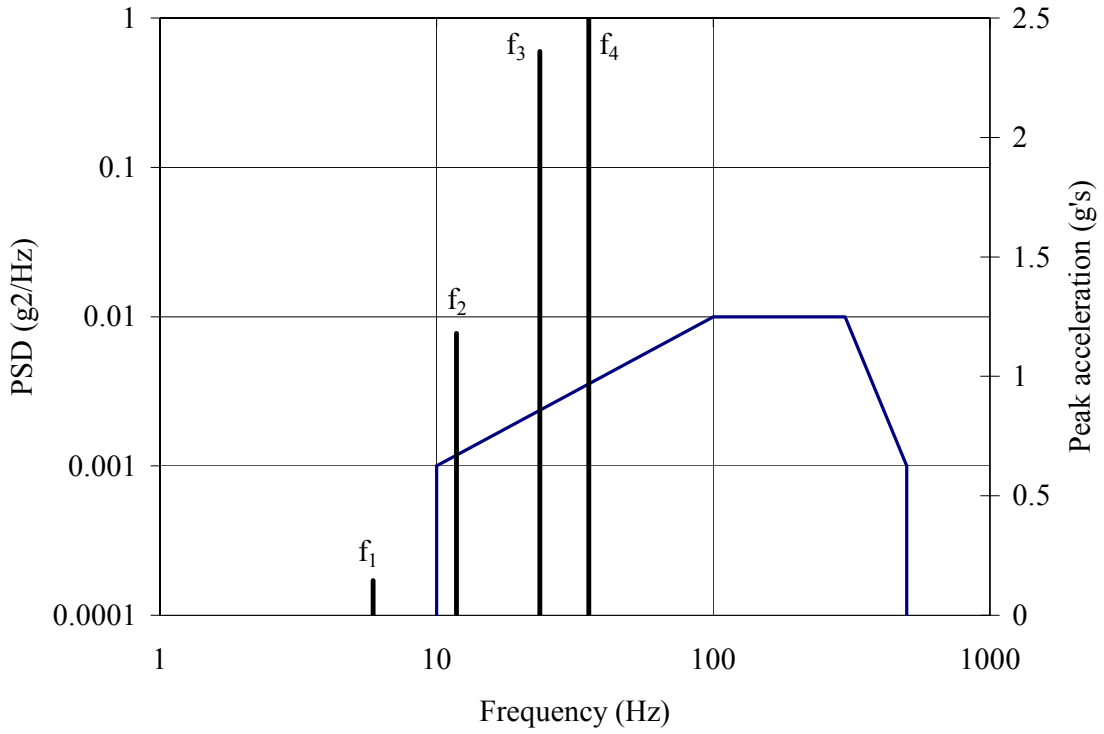

Figure 1 - Helicopter Random Plus Sinusoid Vibration Profile

3.5.11.3. Crash hazard.

3.5.11.3.1. Ground vehicle crash hazard shock. All IPADS components shall remain secured and shall not become hazards to personnel and other equipment in the host vehicle when subjected to shocks with peak acceleration of 75 g's, effective transient duration (T_E) of 8 - 13 ms., and cross over frequency of 80 Hz.

3.5.11.3.2. UH-60 crash hazard. When installed in a UH-60 helicopter, all IPADS components shall remain secured and shall not become hazards to personnel, the aircraft and other equipment in the aircraft when subjected to the load factors in Table 4.

Table 4 - UH-60 Crash Hazard Load Factors

Load Factors	Acting Separately	Simultaneous (a)	Simultaneous (b)	Simultaneous (c)
NX	+-20	+-20	+-10	+-10
NZ	20down/10up	10down/-5up	20down/-10up	10down/-5up
NY	+-18	+-9	+-9	+-18

X is parallel to the aircraft longitudinal axis, Y parallel to the aircraft cross axis, and Z parallel to the aircraft vertical axis.

3.5.11.4. Transit drop. IPADS, in its transit case, and IPADS LRUs, in their transit cases, shall not be damaged and shall perform as specified herein after being dropped from the height(s) specified in Table 5. Transit cases shall show no evidence of damaged seals, impaired structural integrity, malfunctioning latches, damaged carrying devices, and damaged pressure relief valves. Any dents or warpage sustained shall not impair normal opening and closing of the case.

Table 5 - Drop Height

Weight lbs (kg)	Largest Dimension, in (cm)	Height of Drop, in (cm)
Under 100 (45.4)	Under 36 (91)	48 (122)
	36 (91) & over	30 (76)
100 – 200 (45.4 - 90.8)	Under 36 (91)	30 (76)
	36 (91) & over	24 (61)
200 – 1000 (90.8 - 454)	No limit	24 (61)

3.5.12. Airdrop. When installed in a host ground vehicle (M998 HMWWV), which has been rigged for airdrop, IPADS shall not be damaged after multiple airdrops from cargo aircraft (see 6.6.)

3.5.13. Leakage. The transit cases shall not leak more than 4 cubic centimeters per 28,000 cubic centimeters when submerged in water to a depth of 6 inches above the highest point.

3.5.14. Electromagnetic interference.

3.5.14.1. Intra-system electromagnetic compatibility (EMC). When installed in host ground vehicles and aircraft, IPADS shall meet requirements 5.2 and 5.2.3 of MIL-STD-464. Intra-system electromagnetic compatibility includes compatibility with communications equipment and other electronic equipment in the host vehicles.

3.5.14.2. Electromagnetic pulse (EMP). Operating and non-operating, IPADS shall not be damaged by the radiated transient electromagnetic field specified in MIL-STD-461 requirement RS105. IPADS is not required to remain operating through an EMP event.

3.5.14.3. Subsystems and equipment electromagnetic interference (EMI). IPADS subsystems and equipment shall meet the following requirements.

3.5.14.3.1. Conducted emissions, power leads, 30 Hz to 10 kHz. IPADS power lead conducted emissions shall not exceed the limits of MIL-STD-461 requirement CE101 (Army aircraft) from 30 Hz to 10 kHz.

3.5.14.3.2. Conducted emissions, power leads, 10 kHz to 10 MHz. IPADS power lead conducted emissions shall not exceed the limits of MIL-STD-461 requirement CE102 from 10 kHz to 10 MHz.

3.5.14.3.3. Conducted susceptibility, power leads, 30 Hz to 150 kHz. IPADS power lead conducted susceptibility shall not exceed the limits of MIL-STD-461 requirement CS101 from 30 Hz to 150 kHz.

3.5.14.3.4. Conducted susceptibility, bulk cable injection, 10 kHz to 200 MHz. IPADS bulk cable injection conducted susceptibility shall not exceed the limits of MIL-STD-461 requirement CS114 from 10 kHz to 200 MHz.

3.5.14.3.5. Conducted susceptibility, bulk cable injection, impulse excitation. IPADS bulk cable injection conducted susceptibility to impulse excitation shall not exceed the limits of MIL-STD-461 requirement CS115.

3.5.14.3.6. Conducted susceptibility, damped sinusoidal transients, cables and power leads, 10 kHz to 100 MHz**.** IPADS cable and power lead conducted susceptibility to damped sinusoidal transients shall not exceed the limits of MIL-STD-461 requirement CS116 from 10 kHz to 100 MHz.

3.5.14.3.7. Radiated emissions, magnetic field, 30 Hz to 100 kHz**.** IPADS magnetic field radiated emissions shall not exceed the limits of MIL-STD-461 requirement RE101 from 30 Hz to 100 kHz.

3.5.14.3.8. Radiated emissions, electric field, 10 kHz to 18 GHz**.** IPADS electric field radiated emissions shall not exceed the limits of MIL-STD-461 requirement RE102 from 10 kHz to 18 GHz, with no reduction in the upper limit.

3.5.14.3.9. Radiated susceptibility, magnetic field, 30 Hz to 100 kHz**.** IPADS magnetic field radiated susceptibility shall not exceed the limits of MIL-STD-461 requirement RS101 from 30 Hz to 100 kHz.

3.5.14.3.10. Radiated susceptibility, electric field, 2 MHz to 18 GHz**.** IPADS electric field radiated susceptibility shall not exceed the limits of MIL-STD-461 requirement RS103 from 2 MHz to 18 GHz.

3.5.14.3.11. Electrostatic charge control. IPADS shall control and dissipate the build-up of electrostatic charges in accordance with requirement 5.7 of MIL-STD-464. When installed in a ground vehicle sling hoisted from a helicopter, IPADS shall meet requirement 5.7.1 of MIL-STD-464.

3.5.14.4. Electrical bonding. IPADS shall meet requirements 5.10, 5.10.1, 5.10.3 (Army aircraft) and 5.10.4 of MIL-STD-464.

3.5.15. Nuclear, Biological & Chemical (NBC) Survivability. IPADS and transit cases shall survive NBC contamination and decontamination. NBC contaminants remaining on, desorbed from, or re-aerosolized from exposed surfaces after decontamination using standard field decontaminates, equipment and procedures, shall result in no more than a negligible risk to unprotected personnel working one meter from the IPADS. MIL-HDBK-784 provides guidance. An overview of potential threat agents, available decontamination and contamination avoidance countermeasures, and design and material selection guidelines which will enable design of systems which can operate effectively in a CB-agent-contaminated environment is given in MIL-HDBK-783. FM 3-5 describes decontamination operations.

3.6. Support and ownership requirements.

3.6.1. Design, materials and manufacturing processes. Unless otherwise specified, the design, materials, and manufacturing processes selected are the prerogative of the contractor provided they fully meet the operating, interface, ownership and support, and environmental requirements specified herein.

3.6.1.1. Battery selection. All battery(ies) shall be available from Army inventory and shall have been approved for IPADS use in accordance with the policy stated in MEMORANDUM SAAL-RP, SUBJECT: Development, Acquisition and Fielding of Weapon and Information Systems with Batteries, 4 Jan 2000, and Army Policy On Selection/Approval of Portable Power Sources, 11 May 2000.

3.6.1.2. Color. The color of IPADS and transit case external surfaces shall be Lusterless Forest Green No. 34083 in accordance with FED-STD-595.

3.6.1.3. Connector caps. Connector caps shall be provided for all connectors that are not mated during all normal IPADS operations. Connector caps shall be tethered to IPADS near the applicable connector.

3.6.2. Interchangeability. All parts having the same part number shall be functionally and dimensionally interchangeable.

3.6.3. Nameplates and Product Marking. An identification plate shall be permanently attached to each IPADS LRU. Identification plates shall be marked in accordance with MIL-STD-130 with the following information:

a. Nomenclature.
b. Design activity CAGE or NCAGE and PIN.
c. Manufacturer's identification, if different from the design activity CAGE or NCAGE.
d. Acquisition instrument identification number.
e. Serial number.
f. U.S.
g. NSN.

3.6.4. Transit cases.

3.6.4.1. IPADS transit case. A transit case shall be provided with each IPADS end item.

3.6.4.1.1. Size. Transit case dimensions shall not exceed 38.7 inches (98.3 Cm) in height, 39.5 inches (100.3 Cm) in width, and 37.3 inches (94.7 Cm) in depth.

3.6.4.1.2. Weight. The transit case weight shall not exceed 205 lb. (93.2 kg.) If the loaded transit case weight exceeds the criteria for lifting and carrying by six soldiers, the transit case shall have provisions for handling by forklift.

3.6.4.2. LRU transit cases. Transit cases shall be provided for each type of LRU as specified in the contract or delivery order (see 6.2.)

3.6.4.3. Pressure relief valve. Transit cases shall have an automatic pressure relief valve.

3.6.4.4. Handles. Transit cases shall be fitted with a handle for each soldier (maximum of six) needed to lift and carry the loaded transit case (see 3.6.10). Each transit case shall have at least one handle. Handles shall be located such that the load is balanced and equally distributed between the carrying soldiers.

3.6.5. Accessory storage. Storage shall be provided on the IPADS for all tools, accessories, cables, supplies, and contractor supplied manuals.

3.6.5.1. Tool kit. All tools necessary to perform routine maintenance and to install the IPADS in the host vehicles shall be supplied. The tools shall be readily accessible and constrained to prevent damage to manuals, accessories, cables, supplies, equipment, and other tools. Tools shall be common hand tools available from Army inventory.

3.6.6. Reliability. The IPADS Mean-Time-Between-Failure (MTBF) shall be 2,400 hours or greater (6.7). Failures attributable to hardware and software shall be included in the computation of MTBF.

3.6.7. Maintenance.

3.6.7.1. Maintenance level. IPADS shall not require scheduled maintenance above the Unit (first echelon) maintenance level.

3.6.7.2. Fault isolation. The IPADS shall possess Built-in Test or Built-in Test Equipment (BIT/BITE) to fault isolate 95 percent of all system abort failures to the single Line Replaceable Unit (LRU) at the organizational level.

3.6.7.2.1. False removal rate. False removal rate shall not exceed 5 percent.

3.6.7.2.2. False alarm rate. False alarm rate for system abort failure BIT/BITE notification shall not exceed 5 percent.

3.6.7.2.3. Fault display. IPADS shall be capable of determining and displaying faults or errors and indicating corrective actions.

3.6.7.3. Replacement time. Any LRU requiring replacement at the unit level shall have a mean time for removing and replacing of 30 minutes or less and require no more than 10 minutes for calibration or adjustment.

3.6.7.4. Maintenance items. Components requiring maintenance or having a limited life (e.g. batteries) shall be maintainable and replaceable without exposing electronics and other sensitive components to the external environment.

3.6.7.5. Special support equipment. IPADS shall not require any special equipment at the user, unit, DS, and GS levels.

3.6.7.6. Calibration and adjustment. Any calibration or adjustment required periodically or after a repair action shall be performed automatically, at the unit level.

3.6.7.7. Reprogramming. All IPADS LRUs, which utilize software or firmware, shall be reprogramable using a Soldier's Portable On-System Repair Tool (SPORT) (standard configuration) or equivalent IBM-compatible Personal Computer.

3.6.8. Environment, Safety, and Occupational Health (ESOH). IPADS shall not present health hazards to personnel and shall comply with applicable sections of 42 U.S.C. 4321-4370d, 40 C.F.R. 1500-1508, and E.O. 12114.

3.6.9. Safety. IPADS and its transit cases, installation in host vehicles, and operation shall have no hazards with a risk level greater than "Low" as specified in Table 6.

Table 6 - Risk Level Matrix

Hazard Severity (see Table 12)	**Accident Probability of Occurrence** (see Table 11)				
	Frequent	**Likely**	**Occasional**	**Seldom**	**Unlikely**
Catastrophic	High	High	High	High	Medium
Critical	High	High	High	Medium	Low
Marginal	High	Medium	Medium	Low	Low
Negligible	Medium	Low	Low	Low	Low

3.6.9.1. Weight and balance. The host vehicle weight and balance limits shall not be exceeded when IPADS is installed and the vehicle is carrying a crew, the crew's personal equipment and rations, and full range of fuel.

3.6.9.2. Electrical connections. A mistake-proof means to prevent the inadvertent reversing or mismating of electrical connections shall be provided.

3.6.9.3. Electrical overload protection. IPADS and the host vehicle shall be protected from damage resulting from electrical overloads induced by normal or abnormal (fault) IPADS operation and conditions. SAE ARP 1199 provides design guidance.

3.6.9.4. Ground fault protection. When IPADS is connected to 115 VAC power, personnel shall be protected from shock hazards resulting from ground faults. Leakage currents in excess of six milliamperes are considered shock hazards.

3.6.9.5. Battery safety. Battery(ies) shall be firmly secured. Adequate room shall be provided for battery installation, maintenance, testing and removal without disassembly of the equipment. The housing shall prevent pressure build-up from heat, gases, rupture, or chemicals released during battery operation and charging, within the enclosure and shall also prevent such materials from entering the electronic compartment. The design shall preclude build-up of explosive gas concentrations under normal operating and fault conditions.

3.6.9.5.1. Battery installation markings. Connections, polarity, normal voltage, minimum acceptable voltage for equipment operation, and the type of batteries required shall be marked in a prominent place on or near the battery unit.

3.6.9.5.2. Caution labels. The IPADS shall be labeled externally as follows:

CAUTION
REMOVE BATTERIES BEFORE
SHIPMENT
OR
INACTIVE STORAGE OF 30 DAYS OR MORE

If the weight of a component or loaded transit case exceeds 42 pounds, a caution placard or label shall be attached to the component or transit case permanently. Wording shall be as follows:

CAUTION
XX POUNDS
X PERSONS LIFT OR CARRY

Color coding of caution placards or labels shall be in compliance with 29 C.F.R. 1910.145. The caution wordings may be stenciled on the applicable component(s).

3.6.10. Human factors engineering. IPADS shall be operable, maintainable, and supportable in daylight and darkness by 5th percentile female through 95th percentile male soldiers dressed appropriately for the anticipated environments of operation (battle dress uniform, cold/wet weather gear, arctic clothing, and MOPP IV protective equipment).

3.6.10.1. Soldier Performance. IPADS shall be capable of being operated in performance of a mission with less than 5 percent error (to include errors of omission and commission) in performance of mission critical tasks and with not more than 1 percent error for data entry and display reading tasks. The IPADS shall be capable of being installed on and removed from the host vehicle by no more than two people. The weight of any single IPADS component shall not exceed 84 pounds. Installation of the IPADS on a host vehicle shall not impede access for routine maintenance on the host vehicle or ingress and egress for personnel.

3.6.10.2. Human Factors Design. The IPADS shall comply with the human engineering design criteria, principles, and practices of MIL-STD-1472. Special design emphasis shall be given to MIL-STD-1472, paragraphs 4 (General Requirements), 5.1 (Control/Display Integration), 5.2 (Visual Displays), 5.3 (Audio Displays), 5.4 (Controls), 5.5 (Labeling), 5.9 (Design for Maintainer), 5.10 (Design of Equipment for Remote Handling), 5.11 (Small Systems and Equipment), 5.13 (Hazards and Safety), and 5.14 (Human-computer interface) as applicable.

3.6.11. Noise limits. When installed in a stationary ground vehicle, with engine off, an operating IPADS shall not exceed the steady state noise limits of MIL-STD-1474, Requirement 1, Category F, for all normal operator and driver locations.

3.6.12. Government furnished property. Government furnished property shall be as specified in acquisition documents (see 6.2).

3.6.13. Workmanship. Workmanship in the fabrication and assembly of the IPADS shall comply with best commercial practices. The parts shall be clean and free of burrs, sharp edges,

unblended radii, surface defects, cracks, chips, dirt, grease, oil (except where specifically required), rust, foreign matter or any evidence of poor workmanship that could render the system unsuitable for its intended purpose or that would affect life, serviceability or appearance.

4. VERIFICATION

Table 7 - Requirement/verification cross-reference matrix

METHOD OF VERIFICATION N/A - NOT APPLICABLE 1 - ANALYSIS 2 - DEMONSTRATION 3 - EXAMINATION 4 - TEST						CLASSES OF VERIFICATION A - DESIGN VERIFICATION B - FIRST ARTICLE C - ACCEPTANCE			
SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS			SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	VERIFICATION
3.1		X	X	X	X	X			4.2
3.2		X	X	X	X		X		4.3
3.3	X								
3.3.1		X				X			4.6.1.1
3.3.2		X				X			4.6.1.2
3.3.3			X			X	X	X	4.6.1.5
3.3.4		X				X			4.6.1.3
3.3.4.1			X			X	X	X	4.6.1.5
3.3.5	X								
3.3.5.1			X			X	X		4.6.1.5
					X			X	4.6.1.4
3.3.5.2			X			X	X		4.6.1.5
3.3.5.2.1			X			X			4.6.1.7
3.3.6	X								
3.3.6.1			X			X	X	X	4.6.1.5
3.3.6.2			X			X	X		4.6.1.5
3.3.6.3			X			X	X	X	4.6.1.5
3.3.6.4			X			X	X	X	4.6.1.5
3.3.7	X								
3.3.7.1			X			X	X		4.6.1.5
					X			X	4.6.1.4
3.3.7.2			X			X	X		4.6.1.5
					X			X	4.6.1.4
3.3.7.3			X			X	X		4.6.1.5
					X			X	4.6.1.4
3.3.8			X			X			4.6.1.8
3.3.9			X			X	X	X	4.6.1.5
3.3.9.1			X			X	X	X	4.6.1.5
3.3.10	X								
3.3.10.1			X			X	X	X	4.6.1.5
3.3.10.2			X			X	X	X	4.6.1.5
3.3.11					X	X	X		4.6.3.4, 4.6.3.6
3.3.11.1					X	X	X		4.6.3.4, 4.6.3.6
3.3.11.2			X			X			4.6.1.9
3.3.11.3		X				X			4.6.1.10
3.3.11.4			X			X			4.6.1.11
3.3.12			X			X			4.6.1.12, 4.6.1.13
3.3.13			X			X			4.6.1.12, 4.6.1.13

Table 7 - Requirement/verification cross-reference matrix

METHOD OF VERIFICATION N/A - NOT APPLICABLE 1 - ANALYSIS 2 - DEMONSTRATION 3 - EXAMINATION 4 - TEST						CLASSES OF VERIFICATION A - DESIGN VERIFICATION B - FIRST ARTICLE C - ACCEPTANCE			
SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS			SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	VERIFICATION
3.3.14			X			X			4.6.1.14
3.3.15				X		X			4.6.1.15
3.3.16			X			X			4.6.1.16
3.3.17				X		X			4.6.1.17
3.3.17.1			X			X			4.6.1.18
3.3.17.2			X			X			4.6.1.19
3.4	X								
3.4.1				X		X			4.6.2.1
3.4.1.1				X		X			4.6.2.1
3.4.1.1.1				X		X			4.6.2.1
3.4.1.1.2				X		X			4.6.2.1
3.4.1.1.3				X		X			4.6.2.1
3.4.2	X								
3.4.2.1					X	X			4.6.2.2
3.4.2.1.1		X				X			4.6.2.3
3.4.2.1.2			X			X			4.6.2.4
3.4.2.2					X	X			4.6.2.5
3.4.2.3			X			X			4.6.2.6
3.4.2.4					X	X			4.6.2.7
3.4.2.5					X	X			4.6.2.8
3.4.3	X								
3.4.3.1			X			X	X	X	4.6.2.9
3.4.3.1.1			X			X			4.6.2.10
3.4.3.1.2			X			X			4.6.2.11
3.4.3.2			X			X			4.6.2.12
3.4.4			X			X			4.6.2.13
3.4.4.1				X		X			4.6.2.14
3.4.4.2			X			X			4.6.2.15
3.4.4.2.1			X			X			4.6.2.16
3.4.4.2.2			X			X			4.6.2.17
3.4.4.2.3			X			X			4.6.2.18
3.4.4.2.4			X			X			4.6.2.19
3.4.4.2.5			X			X			4.6.2.20, 4.6.2.21
3.4.4.2.6			X			X			4.6.2.22
3.4.4.3			X			X			4.6.2.23
3.4.4.4			X			X			4.6.2.24
3.4.5			X			X	X		4.6.1.6
						X	X	X	4.6.1.5
3.5	X								
3.5.1					X	X	X		4.6.3.4, 4.6.3.6
3.5.2					X	X	X		4.6.3.3, 4.6.3.5
3.5.3	X								
3.5.3.1					X	X			4.6.3.7

Table 7 - Requirement/verification cross-reference matrix

METHOD OF VERIFICATION N/A - NOT APPLICABLE 1 - ANALYSIS 2 - DEMONSTRATION 3 - EXAMINATION 4 - TEST						CLASSES OF VERIFICATION A - DESIGN VERIFICATION B - FIRST ARTICLE C - ACCEPTANCE			
SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS			SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	VERIFICATION
3.5.3.2					X	X			4.6.3.8
3.5.3.3					X	X			4.6.3.9
3.5.4					X	X			4.6.3.10
3.5.5					X	X			4.6.3.11
3.5.6					X	X	X		4.6.3.12
3.5.7					X	X	X		4.6.3.13
3.5.8					X	X			4.6.3.14
3.5.9					X	X			4.6.3.15
3.5.10	X								
3.5.10.1					X	X			4.6.3.16
3.5.10.2					X	X			4.6.3.17
3.5.10.3					X	X			4.6.3.18
3.5.11	X								
3.5.11.1					X	X	X		4.6.3.19
3.5.11.2					X	X			4.6.3.20
3.5.11.3	X								
3.5.11.3.1					X	X			4.6.3.21
3.5.11.3.2		X				X			4.6.3.22
3.5.11.4					X	X			4.6.3.23
3.5.12			X			X			4.6.3.24
3.5.13					X	X	X		4.6.3.25
3.5.14	X								
3.5.14.1		X	X			X			4.6.3.26
3.5.14.2					X	X			4.6.3.27
3.5.14.3	X								
3.5.14.3.1					X	X			4.6.3.28
3.5.14.3.2					X	X			4.6.3.29
3.5.14.3.3					X	X			4.6.3.30
3.5.14.3.4					X	X			4.6.3.31
3.5.14.3.5					X	X			4.6.3.32
3.5.14.3.6					X	X			4.6.3.33
3.5.14.3.7					X	X			4.6.3.34
3.5.14.3.8					X	X			4.6.3.35
3.5.14.3.9					X	X			4.6.3.36
3.5.14.3.10					X	X			4.6.3.37
3.5.14.3.11					X	X			4.6.3.38
3.5.14.4		X			X	X			4.6.3.39
3.5.15		X		X	X	X			4.6.3.40
3.6	X								
3.6.1	X								
3.6.1.1				X		X			4.6.4.1
3.6.1.2				X		X			4.6.4.2
3.6.1.3				X		X	X	X	4.6.4.3

Table 7 - Requirement/verification cross-reference matrix

METHOD OF VERIFICATION N/A - NOT APPLICABLE 1 - ANALYSIS 2 - DEMONSTRATION 3 - EXAMINATION 4 - TEST						CLASSES OF VERIFICATION A - DESIGN VERIFICATION B - FIRST ARTICLE C - ACCEPTANCE			
SECTION 3	VERIFICATION METHOD					VERIFICATION CLASS			SECTION 4
REQUIREMENT	N/A	1	2	3	4	A	B	C	VERIFICATION
3.6.2			X			X			4.6.4.4
3.6.3				X		X	X	X	4.6.4.5
3.6.4				X		X	X		4.6.4.6
3.6.4.1.1				X		X	X		4.6.4.7
3.6.4.1.2				X		X	X		4.6.4.8
3.6.4.3				X		X	X		4.6.4.9
3.6.4.4				X		X	X		
3.6.5				X		X	X		4.6.4.10
3.6.5.1				X		X	X		4.6.4.12
3.6.6		X				X			4.6.4.13
			X				X		4.6.4.14
3.6.7	X								
3.6.7.1			X			X			4.6.4.15
3.6.7.2		X				X			4.6.4.16
3.6.7.2.1		X				X			4.6.4.17
3.6.7.2.2		X				X			4.6.4.18
3.6.7.2.3			X			X			4.6.4.19
3.6.7.3			X			X			4.6.4.20
3.6.7.4				X		X			4.6.4.21
3.6.7.5				X		X			4.6.4.22
3.6.7.6			X			X			4.6.4.23
3.6.7.7			X			X			4.6.2.12
3.6.8		X				X			4.6.4.24
3.6.9				X		X			4.6.4.25
3.6.9.1		X				X			4.6.4.26
3.6.9.2			X			X			4.6.4.27
3.6.9.3		X		X		X			4.6.4.28
3.6.9.4		X		X		X			4.6.4.29
3.6.9.5		X	X			X			4.6.4.30
3.6.9.5.1				X		X	X	X	4.6.4.31
3.6.9.5.2				X		X	X	X	4.6.4.32
3.6.10				X		X			4.6.4.33
3.6.10.1			X			X			4.6.4.34
3.6.10.2			X			X			4.6.4.35
3.6.11			X			X			4.6.4.36
3.6.12	X								
3.6.13				X		X	X	X	4.6.4.37

4.1. Classifications of verifications. The inspection requirements specified herein are classified as follows:

a. Design verification (see 4.2)

b. First article inspection (see 4.3)

c. Conformance inspection (see 4.4)

4.1.1. Verification conditions. Unless otherwise specified, all inspections shall be performed in accordance with the conditions specified in 4.5.1 and 4.6.1.5.2.

4.2. Design verification. When specified in the contract, a sample of the IPADS shall be subjected to design verification in accordance with Table 7.

4.2.1. Design verification quantity. Design verification shall be performed on three IPADS. If LRU transit cases are being verified at the same time, design verification shall be performed on four IPADS.

4.2.2. Verification to be performed. The design verification shall be performed in accordance with Table 7.

4.2.3. Design verification rejection. If any item of the sample fails to comply with the design verification requirements, the sample shall be rejected.

4.3. First article inspection. When specified in the contract, a sample of the IPADS shall be subjected to first article verification in accordance with Table 7.

4.3.1. First article quantity. First article verification shall be performed on a minimum of three IPADS. If LRU transit cases are being verified at the same time, first article verification shall be performed on a minimum of four IPADS.

4.3.2. Inspections to be performed. As determined by the Government, the first article assemblies, components and test specimens may be subjected to any or all of the examinations and tests specified in this specification and be inspected for compliance with any or all requirements of the specification and the applicable drawings.

4.3.3. First article rejection. If any assembly, component or test specimen fails to comply with any of the applicable requirements, the first article sample shall be rejected. The Government reserves the right to terminate inspection upon any failure of an assembly, component or test specimen to comply with any of the requirements.

4.4. Acceptance verification. Acceptance verification shall be performed on all IPADS production equipment in accordance with Table 7.

4.4.1. Acceptance rejection. Nonconformance to any specified requirement, the failure of any test or the presence of one or more defects shall be cause for rejection.

4.5. Verification methods. Methods utilized to accomplish verification include:

a. Analysis. An element of verification that utilizes established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements were met.

b. Demonstration. An element of verification, which generally denotes the actual operation, adjustment, or re-configuration of items to provide evidence that the designed functions were accomplished under specific scenarios. The items may be instrumented and quantitative limits of performance monitored.

c. Examination. An element of verification and inspection consisting of investigation, without the use of special laboratory appliances or procedures, of items to determine

conformance to those specified requirements which can be determined by such investigations. Examination is generally nondestructive and typically includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; mechanical and electrical gauging and measurement; and other forms of investigation.

d. Test. An element of verification and inspection that generally denotes the determination, by technical means, of the properties or elements of items, including functional operation, and involves the application of established scientific principles and procedures.

4.5.1. Test conditions. Unless otherwise specified, all tests shall be performed under shelter at the climatic conditions existing at the place of test. IPADS shall be operated as specified herein without maintenance, other than the scheduled maintenance as established by the maintenance schedule prepared and submitted by the contractor prior to testing. Failure attributable to Government-loaned equipment will not constitute failure of any test specified herein.

4.6. Verification methods.

4.6.1. Performance characteristics verification.

4.6.1.1. External signals analysis. The IPADS design shall be analyzed for use of external, electromagnetic signals in the determination of position and azimuth. Use of external, electromagnetic signals in the determination of position and azimuth constitutes failure.

4.6.1.2. Geographic area of operation analysis. A system analysis shall be performed of IPADS horizontal position accuracy, altitude accuracy, azimuth accuracy, and initialization time as a function of latitude. The analysis shall consider all error sources having significant contribution to the overall system error, including devices and external survey equipment used to transfer position and azimuth. The analysis shall be validated using the results of performance testing at the latitude(s) of the test site(s). The performance test results shall be extrapolated to the performance expected at 65° and 75° latitude, north and south. Failure to meet the accuracies and initialization times specified in Table 1 constitutes failure.

4.6.1.3. Vehicle dynamics and attitudes analysis. IPADS performance shall be analyzed as functions of the vehicle dynamics and attitudes specified in 3.3.4. Failure to meet the accuracies and initialization times specified in Table 1 at the worst-case combinations of vehicle dynamics and attitudes constitutes failure.

4.6.1.4. Acceptance performance verification. The capability of each IPADS to meet the accuracies and normal initialization times specified in Table 1 over the geographic area of operation and full range of environmental conditions shall be verified. This verification may include analysis of appropriate production (test) data. Failure to meet the requirements of the approved Acceptance Procedure constitutes failure.

4.6.1.5. Performance demonstrations. IPADS performance shall be demonstrated in accordance with Table 8 using the course(s) (4.6.1.5.1), conditions (4.6.1.5.2), demonstration data (4.6.1.5.3), and data analysis (4.6.1.5.4) specified below.

Table 8 - IPADS Performance Demonstration Requirements

Verification Classification	Vehicle Type	Initialization Type	Survey Order	Number of Missions
Design Verification	Ground	Normal	High	6
			Lower	6
		"Hot Start"	High	2
			Lower	2
	Aircraft	Normal	High	2
			Lower	2
First Article Inspection	Ground	Normal	High	3
			Lower	3
		"Hot Start"	High	1
			Lower	1

4.6.1.5.1. Performance demonstration course(s). IPADS performance shall be demonstrated by operating IPADS in its host vehicle(s) over a Government approved course(s) with the following characteristics:

a. The test course shall have at least 12 known SCPs and OLs, including starting point, approximately equally spaced. Test data shall be taken at each survey point.

b. Reference coordinates and azimuths for all SCPs shall have 3rd order or higher accuracy.

c. For ground vehicles, approximately 40 percent of the SCPs and OLs shall be offset from the location of the occupying host vehicle. The remaining SCPs and OLs shall permit direct occupation by the host vehicle (two-position transfer method).

d. For aircraft, all SCPs and OLs shall be offset from the location of the occupying host vehicle.

e. The radial distance between the initialization point and farthest SCP shall be approximately 75 km.

f. The distance traveled per survey test shall be approximately 200 km.

4.6.1.5.2. Performance demonstration conditions. Unless otherwise specified, the following conditions apply to performance demonstrations:

a. Unless environmental conditions are outside the limits of this specification or preclude safe operation of the host vehicle, performance demonstrations shall be conducted under the environmental conditions existing at the demonstration site at the time of demonstration.

b. IPADS shall be subjected to base motions (3.3.4.1) created by the environmental conditions and host vehicle at the time of demonstration.

c. Unless necessitated by safety or traffic conditions, the vehicle shall not stop during travel between SCPs unless requested by IPADS.

d. For non-requested stops, travel shall be resumed as soon as it is safe to do so.

e. For requested stops, travel shall be resumed as soon as IPADS indicates travel is permitted.

f. For ground vehicles, the host vehicle engine shall be turned off for 1 minute at 75-minute intervals during each performance demonstration mission.

g. IPADS shall be shut down at least 1 hour between performance demonstration missions.

h. Except for "hot start" missions, the host vehicle shall be moved between missions while IPADS is off.

i. Survey adjustment shall be performed at the end of each performance demonstration mission.

4.6.1.5.3. Performance demonstration data. The following parameters shall be recorded for each performance demonstration mission:

a. Initialization time.

b. Travel time between stops.

c. Duration of each stop.

d. Unadjusted and adjusted IPADS determined horizontal position of each SCP.

e. Unadjusted and adjusted IPADS determined altitude of each SCP.

f. Unadjusted and adjusted IPADS determined azimuth of each OL.

g. Time to establish each position.

h. Time to establish each azimuth.

i. Failures.

j. Mission duration.

k. Number and types (data entry, display readout, or other) of operator tasks performed.

l. Number and types of operator errors.

4.6.1.5.4. Performance demonstration data analysis. The following parameters shall be analyzed for conformance to requirements. Unless otherwise specified, no data shall be excluded from the analysis.

a. Initialization time for each mission. Any initialization time in excess of that specified in Table 1 constitutes failure.

b. Average travel time between requested stops for each mission. Average travel time less than that specified in Table 1 constitutes failure.

c. Average duration of requested stops for each mission. Average stop time greater than that specified in 3.3.9 constitutes failure.

d. Duration of requested stops. Any stop time greater than the maximum specified in 3.3.9 constitutes failure.

e. Unadjusted survey horizontal position CEP for each mission. The initialization point shall be excluded from the CEP determination. Any mission CEP in excess of that specified in Table 1 constitutes failure.

f. Adjusted survey horizontal position CEP for each mission. The initialization and closure points shall be excluded from the CEP determination. Any mission CEP in excess of that specified in Table 1 constitutes failure.

g. Radial errors. More than one percent of the radial errors for the performance demonstration exceeding the 99 percent criterion of Table 1 constitutes failure.

h. Unadjusted survey altitude PE for each mission. The initialization point shall be excluded from the altitude PE determination. Any mission altitude PE in excess of that specified in Table 1 constitutes failure.

i. Adjusted survey altitude PE for each mission. The initialization and closure points shall be excluded from the altitude PE determination. Any mission altitude PE in excess of that specified in Table 1 constitutes failure.

j. Altitude errors. More than one percent of the altitude errors for the performance demonstration exceeding the 99 percent criterion of Table 1 constitutes failure.

k. Unadjusted survey azimuth PE for each mission. The initialization point shall be excluded from the azimuth PE determination. Any mission azimuth PE in excess of that specified in Table 1 constitutes failure.

l. Adjusted survey azimuth PE for each mission. The initialization and closure points shall be excluded from the azimuth PE determination. Any mission azimuth PE in excess of that specified in Table 1 constitutes failure.

m. Azimuth errors. More than one percent of the azimuth errors for the performance demonstration exceeding the 99 percent criterion of Table 1 constitutes failure.

n. Time to establish each position. Any time to establish the position of a SCP in excess of that specified in 3.3.10.1 (ground vehicle driver's interface) or 3.3.10.2 (offset transfer method) constitutes failure.

o. Time to establish each azimuth. Any time to establish the azimuth of an OL in excess of that specified in 3.3.10.2 constitutes failure.

p. Percentage of operator errors. Errors in excess of those specified in 3.6.10.1 constitutes failure.

4.6.1.6. Position and azimuth transfer demonstration. The ability to transfer position and azimuth to remote locations with the host ground vehicle parked on slopes and side slopes within the range of ±15° shall be demonstrated. The ability to transfer position and azimuth to remote locations with the host helicopter on slopes and side slopes within the range of ±10° shall be demonstrated. Failure to achieve the accuracies specified in Table 1 or the transfer ranges in 3.4.5 constitutes failure.

4.6.1.7. "Hot start" excessive motion demonstration. At the end of a mission, IPADS shall be normally shutdown with the host vehicle parked on nominally level pavement. With IPADS off, the host vehicle shall be driven approximately 10 meters in a nominally straight direction. IPADS shall be turned on and initialized in such a manner that would result in "hot start" initialization if IPADS hadn't been moved. The operator shall complete initialization, following any instructions provided by IPADS. After initialization is complete, the operator shall conduct a survey. Failure to meet the requirements of 3.3.5.2.1 or failure to achieve the accuracies specified in Table 1 constitutes failure.

4.6.1.8. Operating time demonstration. IPADS shall be operated in the high order survey mode over the performance demonstration course for 24 continuous hours without position update except for the initial position at the start of the mission and at mission completion. Failure to maintain operation for 24 hours or failure to achieve the accuracies specified in Table 1 constitutes failure.

4.6.1.9. No charge demonstration. When IPADS is operating from host vehicle power and the engine is off, current into the back-up battery shall be monitored. Observation of charging current into the battery constitutes failure.

4.6.1.10. Overcharge analysis. The IPADS back-up battery charging circuitry shall be analyzed for its ability to overcharge the back-up battery throughout the ambient and induced temperature range. An ability to overcharge the back-up battery constitutes failure.

4.6.1.11. Battery replacement demonstration. While IPADS is operating from host vehicle power, the back-up battery(ies) shall be replaced. Inability to replace the battery(ies) or failure to sustain IPADS operation constitutes failure.

4.6.1.12. Stationary power loss demonstration. While stationary, at the end of a normal mission, host vehicle power and back-up power shall be disconnected. Upon restoration of power, survey data and ellipsoid and datum parameters from the previous mission shall be recalled and a “hot start” attempted. Damage to IPADS, missing or erroneous recalled data or failure to achieve “hot start” initialization constitutes failure.

4.6.1.13. Moving power loss demonstration. While moving, at the end of a normal mission, host vehicle power and back-up power shall be disconnected. Upon stopping and restoration of power, survey data and ellipsoid and datum parameters from the previous mission shall be recalled and a normal initialization attempted. Damage to IPADS, missing or erroneous recalled data or failure to achieve initialization constitutes failure.

4.6.1.14. Survey data storage demonstration. Complete survey data sets for 50 SCPs shall be stored. Each data set shall be recalled and compared to the data originally stored. Inability to recall all stored data sets, or incomplete or erroneous data constitutes failure.

4.6.1.15. Information security examination. The IPADS design and software/firmware shall be examined for vulnerabilities to information security. Software/firmware containing malicious code, viruses, or trap doors, or the capability for an external device to: access or alter IPADS software or firmware, except for intentional reprogramming; interfere with IPADS operation; or access the host system through IPADS constitutes failure.

4.6.1.16. Vehicle-to-vehicle transfer demonstration. A two-person, or fewer, crew shall transfer an operating IPADS from one host vehicle to another. Failure to be ready to continue the mission in the second vehicle within 10 minutes, or loss of information, or a need to reinitialize constitutes failure.

4.6.1.17. Visibility examination. IPADS controls and displays shall be examined under lighting conditions ranging from full darkness to direct, bright sunlight. Inability to accurately operate IPADS, enter data, and read out data constitutes failure.

4.6.1.18. Night vision demonstration. IPADS, in full darkness, shall be operated by personnel wearing night vision goggles and observed by personnel with both unaided vision and

wearing night vision goggles. Inability to accurately operate IPADS, enter data, and read out data, or degradation of observers' night vision constitutes failure.

4.6.1.19. Blackout demonstration. IPADS shall be observed when operated under blackout conditions in full darkness. Visibility of IPADS at distances beyond 10 meters from the center of the system constitutes failure.

4.6.2. Interface and Interoperability requirements verification.

4.6.2.1. Mechanical interface examination. IPADS shall be installed, using the applicable installation kit(s), and operated in the host vehicle(s) specified in the contract (6.2). Incomplete installation kits, permanent modifications to ground vehicles, any modifications to aircraft, or interference with or from normal operation of the host vehicle or vehicle accessories constitutes failure.

4.6.2.2. Ground vehicle power test. IPADS shall be operated from power meeting the extreme limits of MIL-STD-1275 under fault free and single fault conditions. Damage, failure to operate or maintain operation, and failure to perform as specified herein constitutes failure.

4.6.2.3. Multiple fault demonstration. An operating IPADS shall be subjected to the extreme multiple fault malfunction condition as specified in MIL-STD-1275. Damage to IPADS constitutes failure.

4.6.2.4. Power connection examination. Installation kit power cables for host ground vehicles shall be examined for the requirements of 3.4.2.1.2. Failure to meet the requirements of 3.4.2.1.2 constitutes failure.

4.6.2.5. Aircraft power test. When an aircraft is identified as a host vehicle in the contract (6.2), IPADS shall be operated with power meeting MIL-STD-704 extreme limits for normal, abnormal, starting and transfer conditions. Damage, failure to operate or maintain operation, and failure to perform as specified herein constitutes failure.

4.6.2.6. Reverse polarity demonstration. IPADS shall be connected to DC power with reverse polarity and turn-on shall be attempted. Damage to IPADS constitutes failure.

4.6.2.7. Power consumption test. The power consumption of an operating IPADS shall be measured with the DC power voltage at the nominal value and high and low limits, and the back-up battery fully discharged and fully charged. Failure to meet the specified power consumption for any combination of power voltage and state of back-up battery charge constitutes failure.

4.6.2.8. Power disconnect test. With IPADS operating from host power, the power disconnect capability shall be activated and the power drain from the host measured. With IPADS connected to host power and not operating, the power disconnect capability shall be activated and the power drain from the host measured. Power drain in excess of one milliwatt or disconnection of cables or fuses to meet the requirement constitutes failure.

4.6.2.9. Digital data interface demonstration. Exchange of digital data between IPADS and an external host system shall be demonstrated for all messages in FSS-SS-0011-ICD. Failure to correctly communicate the exchanged data constitutes failure.

4.6.2.10. Hot connect/disconnect demonstration. While operating, the digital interface between IPADS and an external host shall be disconnected and connected by unmating and

mating the cable at the host device. The disconnect/connect cycle shall be repeated 25 times. Failure to establish and maintain serial communications when connected, damage to the host system or IPADS, or interruption of IPADS or host system operation constitutes failure.

4.6.2.11. Time synchronization demonstration. Synchronization of IPADS date and time of day to that provided by an external host system shall be demonstrated. Failure to synchronize date and time within two seconds to that provided by the host system constitutes failure.

4.6.2.12. Reprogramming demonstration. Software download from a Soldier's Portable On-System Repair Tool (SPORT) (standard configuration) or equivalent IBM-compatible Personal Computer to all LRUs, which utilize software or firmware, shall be demonstrated. Failure to correctly download software/firmware to any LRU constitutes failure.

4.6.2.13. Control and display interface demonstration. The IPADS operator control and display interface shall be demonstrated. Inability of an operator to control the IPADS mode of operation; accomplish data entry, readout, and update; observe system status; display survey and other operational parameters; and initiate data transfer to an external host system from a single location constitutes failure.

4.6.2.14. Control and display location examination. The location(s) of control and display functions shall be examined. Failure to meet the criteria of 3.4.4.1 constitutes failure.

4.6.2.15. Display parameter demonstration. Display of the parameters specified in 3.4.4.2 shall be demonstrated. Failure to display the specified parameters constitutes failure.

4.6.2.16. Display field characteristic demonstration. Display field characteristics shall be demonstrated. Failure to meet the requirements of Appendix A constitutes failure of this demonstration.

4.6.2.17. Survey data page demonstration. The survey data page shall be demonstrated. Failure to display all the parameters specified in 3.4.4.2.2 constitutes failure.

4.6.2.18. Display field selection demonstration. Selection of the display fields specified in 3.4.4.2.3 shall be demonstrated during initialization, travel during a survey, and when establishing a SCP. Failure to be able to select or display a specified field constitutes failure.

4.6.2.19. Horizontal position display demonstration. UTM and geodetic coordinates for a SCP shall be observed while the ellipsoid and datum are changed. The displayed coordinates shall be compared to those obtained from reference datum shifting software, such as GEOTRANS. Comparisons shall be made for at least 10 different ellipsoids and datums, including WGS 72. Differences between the IPADS displayed and reference coordinates outside the range ±0.1 meter constitutes failure.

4.6.2.20. UTM zone width demonstration. The geodetic coordinates in Table 9 shall be input into IPADS, horizontal position display type switched to UTM, and the UTM coordinates compared to those in Table 9. Lack of agreement by more than 0.1 meter constitutes failure.

Table 9 - UTM Zone Demonstration Coordinates

Datum	Latitude	Longitude	Zone	Easting	Northing
WGS 84	73° N	8° E	32	467367.7	8100752.1
WGS 84	73° N	10° E	32	532632.3	8100752.1
WGS 84	73° N	20° E	34	467367.7	8100752.1
WGS 84	73° N	22° E	34	532632.3	8100752.1
WGS 84	73° N	32° E	36	467367.7	8100752.1
WGS 84	73° N	34° E	36	532632.3	8100752.1

4.6.2.21. UTM zone boundary crossing demonstration. IPADS shall be operated using the following scenarios:

a. IPADS shall be initialized at a SCP that is greater than 40 Km west of an actual or simulated UTM zone boundary. IPADS shall be moved eastward, until the UTM zone boundary is crossed, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. Continued operation in the previous zone shall be selected and the coordinates recorded. IPADS shall be moved eastward more than 40 Km and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved westward, to inside the extended zone boundary, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved westward to cross the UTM zone boundary and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded.

b. IPADS shall be initialized at a SCP that is greater than 40 Km west of an actual or simulated UTM zone boundary. IPADS shall be moved eastward, until the UTM zone boundary is crossed, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. Operation in the new zone shall be selected and the coordinates recorded. IPADS shall be moved eastward more than 40 Km and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved westward, to inside the extended zone boundary, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved westward to cross the UTM zone boundary and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded.

c. IPADS shall be initialized at a SCP that is greater than 40 Km east of an actual or simulated UTM zone boundary. IPADS shall be moved westward, until the extended UTM zone boundary is crossed, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. Continued operation in the normal zone shall be selected and the coordinates recorded. IPADS shall be moved westward until the zone boundary is crossed and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved westward, more than 40 Km, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved eastward to

cross the UTM zone boundary and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded.

d. IPADS shall be initialized at a SCP that is greater than 40 Km east of an actual or simulated UTM zone boundary. IPADS shall be moved westward, until the extended UTM zone boundary is crossed, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. Operation in the extended western zone shall be selected and the coordinates recorded. IPADS shall be moved westward until the zone boundary is crossed and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved westward, more than 40 Km, and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded. IPADS shall be moved eastward to cross the UTM zone boundary and stopped at a known SCP. IPADS shall be observed for alerts and prompts and the coordinates recorded.

Failure to meet the requirements of 3.4.4.2.5, 3.4.4.4, and the accuracy requirements of Table 1 constitutes failure.

4.6.2.22. Altitude display demonstration. Altitude for a SCP shall be observed while the ellipsoid and datum are changed for at least 10 different ellipsoids and datums, including WGS 72. Any difference between the IPADS displayed and initial altitude constitutes failure.

4.6.2.23. Operator control functions and data entry demonstration. The operator control and data entry functions specified in 3.4.4.3 shall be demonstrated. Failure to perform the specified function or incorrect entry of data constitutes failure.

4.6.2.24. Status indication demonstration. Each of the status indications specified in 3.4.4.4 shall be demonstrated. Failure to provide the correct indication constitutes failure.

4.6.3. Environmental tests.

4.6.3.1. General Conditions.

4.6.3.1.1. Pre and post exposure testing. Before and after each environmental test, normal operation of the IPADS shall be simulated, including operation of all switches, controls, input and output devices, displays, indicators, and azimuth transfer devices. IPADS performance shall be monitored using system displays as much as possible. IPADS shall be operated in a manner that simulates travel in the high accuracy survey mode after initialization is complete. IPADS shall be operated with the input supply voltage at the normal level, lowest limit, and highest limit. Survey parameter accuracy (horizontal position, altitude, and azimuth), and initialization, simulated travel, and times shall be recorded. Any indicated failure or failure to achieve the performance specified in Table 1 constitutes failure.

Should the test setup remain the same from one environmental test to the next, the post-functional test may serve as the pre-functional test for the following test.

4.6.3.1.2. Operation during environmental exposure. Normal operation of the IPADS shall be simulated during operational portions of environmental test. IPADS shall be operated in a manner that simulates travel in the high accuracy survey mode after initialization is complete. IPADS shall be operated with the input supply voltage at the normal level, lowest limit, and highest limit. Survey parameter accuracy (horizontal position, altitude, and azimuth), and

initialization, simulated travel, and times shall be recorded. Any indicated failure or failure to achieve the performance specified in Table 1 constitutes failure.

4.6.3.1.3. Post-test inspection. The equipment shall be inspected for damage after each environmental test. Unless otherwise specified, any damage constitutes failure. Damage includes, but is not limited to:

a. Any condition which will present a hazard to personnel or equipment if operated further.
b. Loose or missing hardware or components.
c. Inability of a part or component to perform its normal function.
d. Broken components.
e. Embrittlement, discoloration, cracking or breaking of material.
f. Binding of parts.
g. Loss of lubrication.
h. Deterioration of closures and seals.
i. Oxidation and/or corrosion of metals.

4.6.3.2. Order of inspection. Laboratory environmental tests shall be performed in the order specified in Table 10.

Table 10 - Order of Laboratory Environmental Tests

Test	Order of Test			
	Unit 1	Unit 2	Unit 3	Unit 4 *
High Temperature Storage	5			6
High Temperature And Solar Radiation Operation	6			
Low Temperature Storage	7			5
Low Temperature Operation	8			
Operational Low Pressure	9			1
Storage/Transport Low Pressure		1		
Rapid Decompression			4	
Blowing Dust		3		
Blowing Sand		4		
Rain	10			
Humidity	11			
Fungus Resistance		2		
Salt Fog			3	
Ground Vehicle Vibration	1			
Helicopter Vibration	2			
Loose Cargo Vibration				2

Table 10 - Order of Laboratory Environmental Tests

Test	Order of Test			
	Unit 1	Unit 2	Unit 3	Unit 4 *
Operational Shock	3			
Non-Operating Shock	4			
Crash Hazard Shock			5	
Transit Drop			1	3
Leakage			2	4

* For verification of LRU transit cases.

4.6.3.3. High temperature storage. IPADS, in its transit case, and LRUs, in their transit cases, shall be tested in accordance with MIL-STD-810, Method 501.4, Procedure I at a constant +160° F (71° C) ambient temperature, for at least four hours after achieving temperature stabilization.

4.6.3.4. High temperature and solar radiation operation. IPADS shall be tested in accordance with MIL-STD-810, Method 505.4, Procedure I for a minimum of three A1 cycles using full spectrum lamps. IPADS shall be turned on and operated for six hours during the peak temperature portion of each cycle. One hour after starting operation in the second cycle, external power shall be turned off and IPADS operated on its back-up power for 15 minutes. External power shall be restored at the conclusion of the 15-minute period. Four hours after restoring external power, external power shall be turned off and IPADS operated on its back-up power for 15 minutes. External power shall be restored at the conclusion of the 15-minute period. In addition to the criteria in 4.6.3.1.2, failure to maintain operation while on back-up power constitutes failure.

4.6.3.5. Low temperature storage. IPADS, in its transit case, and LRUs, in their transit cases, shall be tested in accordance with MIL-STD-810, Method 502.4, Procedure I. at a constant -50° F (-46° C) ambient temperature, for at least 24 hours after achieving temperature stabilization.

4.6.3.6. Low temperature operation. IPADS shall be tested in accordance with MIL-STD-810, Method 502.4, Procedure II at a constant -50° F (-46° C) ambient temperature. After achieving temperature stabilization, IPADS shall be turned on and operated for six hours. One hour after starting operation, external power shall be turned off and IPADS operated on its back-up power for 15 minutes. External power shall be restored at the conclusion of the 15-minute period. Four hours after restoring external power, external power shall be turned off and IPADS operated on its back-up power for 15 minutes. External power shall be restored at the conclusion of the 15-minute period. In addition to the criteria in 4.6.3.1.2, failure to maintain operation while on back-up power constitutes failure.

4.6.3.7. Operational low pressure test. IPADS shall be tested in accordance with MIL-STD-810, Method 500.4, procedure II at a simulated altitude of 15,000 feet above sea level. After achieving altitude stabilization, IPADS shall be turned on and operated for six hours. The altitude change rate during test shall not exceed 2,000 ft/min (10 m/s).

4.6.3.8. Storage/transport low pressure test. IPADS, in its transit case, and LRUs, in their transit cases, shall be tested in accordance with MIL-STD-810, Method 500.4, procedure I at a simulated altitude of 15,000 feet above sea level. The altitude change rate during test shall not exceed 2,000 ft/min (10 m/s).

4.6.3.9. Rapid decompression test. IPADS, in its transit case, and LRUs, in their transit cases, shall be tested in accordance with MIL-STD-810, Method 500.4, procedure III.

4.6.3.10. Blowing dust test. IPADS shall be tested in accordance with MIL-STD-810, Method 510.4, procedure I with dust concentrations of 0.3 ± 0.2 grams per cubic foot and air velocity from 300 ft/min (1.5 m/s) to 1750 ft/min (8.9 m/s). Each face of IPADS, normally exposed to the elements, shall be exposed to blowing dust for equal time during each exposure. The first six-hour exposure shall be at a temperature of +74° F, with IPADS non-operating. The second six-hour exposure shall be at a temperature of +125° F, with IPADS operating. In addition to the criteria in 4.6.3.1, entry of dust into electronic compartments or optical devices constitutes failure.

4.6.3.11. Blowing sand test. IPADS shall be tested in accordance with MIL-STD-810, Method 510.4, procedure II with sand concentrations of 1.32×10^{-4} lb/ft^3 (2.19×10^{-3} kg/m^3) and air velocity from 3540 ft/min (18 m/s) to 5700 ft/min (29 m/s). Each face of IPADS, normally exposed to the elements, shall be exposed to blowing sand for 90 minutes. IPADS shall be operated during the last hour of exposure. In addition to the criteria in 4.6.3.1, entry of sand into electronic compartments or optical devices, or damage to optical components, which doesn't allow them to meet the intended purpose, constitutes failure.

4.6.3.12. Rain test. IPADS shall be tested in accordance with MIL-STD-810, Method 506.4, procedure I with 4 in/hr (10 cm/hr) rain and a wind velocity of 40 mph (18 m/s). All surfaces onto which the rain could fall or be driven shall be exposed to the test conditions for a minimum of 30 minutes per surface. Test item temperature shall be 18°F (10°C) higher than the rain temperature at the beginning of each exposure. IPADS shall be operated throughout the test and switches and keys shall be manipulated during the last 10 minutes of the exposure on each surface. In addition to the criteria in 4.6.3.1, entry of water into electronic compartments or optical devices constitutes failure.

4.6.3.13. Humidity test. IPADS shall be tested in accordance with MIL-STD-810, Method 507.4 for five, 48 hour, cycles.

4.6.3.14. Fungus resistance test. IPADS, its transit case, and LRU transit cases shall be tested in accordance with MIL-STD-810, Method 508.5 for 28 days using the U.S. standard set of fungi. In addition to the criteria in 4.6.3.1, growth of fungus on electronic or optical components constitutes failure.

4.6.3.15. Salt fog test. IPADS, in its operational configuration, shall be tested in accordance with GM9540P for eight 24 hour cycles. IPADS installation in the test chamber shall simulate the pooling of liquids and splash that would be experienced when installed in an open HMMWV. IPADS shall be operated during the humidity chamber exposure portion of the fourth and eighth cycles.

4.6.3.16. Ground vehicle vibration test. An operating IPADS shall be exposed to the vibration profiles in Table 2 for 120 minutes in each of three mutually perpendicular axes in accordance with MIL-STD-810, Method 514.5, Procedure I.

4.6.3.17. Helicopter vibration test. An operating IPADS shall be exposed to the vibration profiles in Figure 1 and Table 3 for 60 minutes in each of three mutually perpendicular axes in accordance with MIL-STD-810, Method 514.5, Procedure I. The frequencies of the sine wave components of the profile shall be swept between 95 and 110 percent of their nominal frequencies. Exposure to the sine wave components shall be equal for each of the helicopter types listed in Table 3.

4.6.3.18. Loose cargo vibration test. IPADS LRUs, in their transit cases, shall be tested in accordance with MIL-STD-810, Method 514.5, Procedure II. Test duration shall be 40 minutes.

4.6.3.19. Operational shock test. An operating IPADS shall be tested in accordance with MIL-STD-810, Method 516.5, Procedure I. IPADS shall be subjected to three shock pulses, with peak acceleration of 40 g's, effective transient duration (T_E) of 15 - 23 ms., and cross over frequency of 45 Hz, along each direction of each of three mutually orthogonal axes.

4.6.3.20. Non-operating shock test. A non-operating IPADS shall be tested in accordance with MIL-STD-810, Method 516.5, procedure I. IPADS shall be subjected to three shock pulses, with peak acceleration of 40 g's, effective transient duration (T_E) of 15 - 23 ms., and cross over frequency of 45 Hz, along each direction of each of three mutually orthogonal axes.

4.6.3.21. Ground vehicle crash hazard shock test. An IPADS, in its ground vehicle configuration, shall be tested in accordance with MIL-STD-810, Method 516.5, procedure V. IPADS shall be subjected to two shock pulses, with peak acceleration of 75 g's, effective transient duration (T_E) of 8 - 13 ms., and cross over frequency of 80 Hz, along each direction of each of three mutually orthogonal axes. Failure of any component to remain secured during and after exposure constitutes failure. Mass mock-ups, with the same mounting provisions, mount strength, mass and center of gravity, may be substituted for IPADS LRUs during this test.

4.6.3.22. UH-60 crash hazard analysis. A crash loads structural analysis shall be performed for IPADS mounted in a UH-60 helicopter for application of all combinations of load factors specified in Table 4. Structural failure or failure of any component to remain secured during and after exposure constitutes failure.

4.6.3.23. Transit drop test. IPADS, in its transit case, and LRUs, in their transit cases, shall be tested in accordance with MIL-STD-810, Method 516.5, procedure IV. Drop height(s) shall be as specified in Table 5. IPADS damage or failure to perform in accordance with 4.6.3.1.1 and 4.6.3.1.3 constitutes failure. Transit case damaged seals, impaired structural integrity, malfunctioning latches, damaged carrying devices, damaged pressure relief valves, or impaired opening and closing of the case constitutes failure.

4.6.3.24. Airdrop demonstration in vehicle. A M998 HMWWV, with IPADS installed, shall be rigged for airdrop in accordance with established procedures, and shall be airdropped a minimum of three times from a cargo aircraft. Damage to IPADS or failure to meet the requirements of Table 1 after airdrop constitutes failure.

4.6.3.25. Leakage. The IPADS and LRU transit cases shall be tested in accordance with MIL-STD-810, Method 512.4, procedure I to a depth of 6 inches above the highest point on the case. Prior to immersion, the case shall be preconditioned to a temperature 49° F (27° C) above the water temperature. In addition to the criteria in 4.6.3.1.3, water penetration more than 4 cubic centimeters per 28,000 cubic centimeters constitutes failure.

4.6.3.26. Intra-system electromagnetic compatibility (EMC) verification. IPADS intra-system shall be verified in accordance with requirements 5.2 and 5.2.3 of MIL-STD-464. Failure to meet the requirements of 3.5.14.1 constitutes failure.

4.6.3.27. Electromagnetic pulse (EMP) test. IPADS EMP resistance shall be tested in accordance with MIL-STD-461 requirement RS105 for both the operating and non-operating conditions. IPADS is not required to remain operating through an EMP event. Any damage to IPADS or inability of IPADS to meet the performance requirements of Table 1 after exposure constitutes failure.

4.6.3.28. Conducted emissions, power leads, 30 Hz to 10 kHz, test. IPADS power lead conducted emissions shall be tested in accordance with MIL-STD-461 requirement CE101 (Army aircraft) from 30 Hz to 10 kHz. Any emission exceeding the limits of MIL-STD-461 requirement CE101 constitutes failure.

4.6.3.29. Conducted emissions, power leads, 10 kHz to 10 MHz, test. IPADS power lead conducted emissions shall be tested in accordance with MIL-STD-461 requirement CE102 from 10 kHz to 10 MHz. Any emission exceeding the limits of MIL-STD-461 requirement CE102 constitutes failure.

4.6.3.30. Conducted susceptibility, power leads, 30 Hz to 150 kHz, test. IPADS power lead conducted susceptibility shall be tested in accordance with MIL-STD-461 requirement CS101 from 30 Hz to 150 kHz. Any damage to IPADS or degradation of performance constitutes failure.

4.6.3.31. Conducted susceptibility, bulk cable injection, 10 kHz to 200 MHz, test. IPADS bulk cable injection conducted susceptibility shall be tested in accordance with MIL-STD-461 requirement CS114 from 10 kHz to 200 MHz. Any damage to IPADS or degradation of performance constitutes failure.

4.6.3.32. Conducted susceptibility, bulk cable injection, impulse excitation, test. IPADS bulk cable injection conducted susceptibility to impulse excitation shall be tested in accordance with MIL-STD-461 requirement CS115. Any damage to IPADS or degradation of performance constitutes failure.

4.6.3.33. Conducted susceptibility, damped sinusoidal transients, cables and power leads, 10 kHz to 100 MHz, test**.** IPADS cable and power lead conducted susceptibility to damped sinusoidal transients shall be tested in accordance with MIL-STD-461 requirement CS116 from 10 kHz to 100 MHz. Any damage to IPADS or degradation of performance constitutes failure.

4.6.3.34. Radiated emissions, magnetic field, 30 Hz to 100 kHz, test**.** IPADS magnetic field radiated emissions shall be tested in accordance with MIL-STD-461 requirement RE101 from 30 Hz to 100 kHz. Any emission exceeding the limits of MIL-STD-461 requirement RE101 constitutes failure.

4.6.3.35. Radiated emissions, electric field, 10 kHz to 18 GHz, test**.** IPADS electric field radiated emissions shall be tested in accordance with MIL-STD-461 requirement RE102 from 10 kHz to 18 GHz, with no reduction in the upper limit. Any emission exceeding the limits of MIL-STD-461 requirement RE102 constitutes failure.

4.6.3.36. Radiated susceptibility, magnetic field, 30 Hz to 100 kHz, test**.** IPADS magnetic field radiated susceptibility shall be tested in accordance with MIL-STD-461 requirement RS101 from 30 Hz to 100 kHz. Any damage to IPADS or degradation of performance constitutes failure.

4.6.3.37. Radiated susceptibility, electric field, 2 MHz to 18 GHz, test**.** IPADS electric field radiated susceptibility shall be tested in accordance with MIL-STD-461 requirement RS103 from 2 MHz to 18 GHz. Any damage to IPADS or degradation of performance constitutes failure.

4.6.3.38. Electrostatic charge control verification. IPADS susceptibility to electrostatic charges shall be verified in accordance with ANSI C63.16-1993 for an uncontrolled environment, using the hand/metal, air discharge method. The voltage range shall be from 1 kV to 15 kV, in 2 kV steps. Any non-recoverable or destructive response constitutes failure. IPADS susceptibility to electrostatic charges when sling hoisted by helicopter shall be verified in accordance with requirement 5.7.1 of MIL-STD-464. Failure to meet the requirements of 3.5.14.3.11 constitutes failure.

4.6.3.39. Electrical bonding verification. IPADS electrical bonding shall be verified in accordance with requirements 5.10, 5.10.1, 5.10.3 (Army aircraft) and 5.10.4 of MIL-STD-464. Failure to meet the requirements of 3.5.14.4 constitutes failure.

4.6.3.40. Nuclear, Biological & Chemical (NBC) Survivability verification. The IPADS and transit case designs shall be analyzed for survival when exposed to NBC contaminates and when decontaminated using the procedures of FM 5-3, and for entrapment of contaminates after decontamination. Tests shall be performed on materials that will be exposed to NBC contamination and decontamination when authoritative information on their survivability is not available. Deterioration of materials such that IPADS operation would be impaired or leaves IPADS vulnerable to leakage, or entrapment of contaminates constitutes failure.

4.6.4. Support and ownership requirements verifications.

4.6.4.1. Battery selection verification. All IPADS batteries shall be examined for approval. Lack of approval in accordance with 3.6.1.1 constitutes failure.

4.6.4.2. Color verification. The color of IPADS and transit case external surfaces shall be examined. Failure to conform with 3.6.1.2 constitutes failure.

4.6.4.3. Connector cap verification. IPADS shall be examined for connector caps. Failure to conform with 3.6.1.3 constitutes failure.

4.6.4.4. Interchangeability demonstration. Components supplied as spare or repair parts shall be substituted for those, with the same part number, they are intended to replace in the IPADS. They shall be examined for form and fit, with respect to their interface with mating and adjoining components. Failure to install, or the modification of any component to accommodate, constitutes failure. After replacement, normal IPADS operation shall be simulated, including operation of all switches, controls, input and output devices, displays, indicators, and azimuth transfer devices. Surveying parameter errors (horizontal position, altitude, and azimuth) and initialization times shall be recorded. Any erroneous reading, malfunction, or failure to meet specified values for any parameter specified in Table 1 constitutes failure.

4.6.4.5. Nameplates and product marking examination. Identification plates and product markings shall be examined. Non-conformance with the requirements of 3.6.3 constitutes failure.

4.6.4.6. Transit case examination. Product drawings shall be examined to verify a transit case is supplied with each IPADS and that transit cases have been designed for each LRU. Lack of a transit case constitutes failure.

4.6.4.7. Transit case size examination. The IPADS transit case maximum exterior dimensions shall be measured. Non-conformance with the requirements of 3.6.4.1.1 constitutes failure.

4.6.4.8. Transit case weight examination. The empty and loaded IPADS transit case weights shall be measured and the transit case shall be examined for handling provisions. Non-conformance with the requirements of 3.6.4.1.2 constitutes failure.

4.6.4.9. Pressure relief valve examination. The transit case shall be examined for the presence of an automatic pressure relief valve. Lack of a pressure relief valve constitutes failure.

4.6.4.10. Handle examination. Transit cases shall be examined for handles conforming to the requirements of 3.6.4.4. Non-conformance with the requirements of 3.6.4.4 constitutes failure.

4.6.4.11. Accessory storage examination. IPADS storage provisions shall be examined. Non-conformance with the requirements of 3.6.5 constitutes failure.

4.6.4.12. Tool kit examination. The IPADS tool kit shall be examined. Non-conformance with the requirements of 3.6.5.1 constitutes failure.

4.6.4.13. Reliability analysis. The IPADS Mean-Time-Between-Failure (MTBF) shall be calculated using the Reliability Analysis Center (RAC) PRISM software tool or equivalent. The MTBF shall be calculated for a Ground, Mobile, Light Wheeled, Chassis Mounted environment, at an ambient temperature of +35 degrees C, dormant temperature of +14 degrees C, relative humidity of 40% and vibration levels of 4.0 G RMS. The reliability time is measured while IPADS is operational. A peacetime scenario will be used for the MTBF calculation. A calculated MTBF less than that specified in 3.6.6 constitutes failure.

4.6.4.14. Reliability demonstration. The IPADS Mean-Time-Between-Failure (MTBF) shall be demonstrated to a consumer's risk of a nominal 20 percent or lower. MIL-HDBK-781 provides guidance. Operating time may be accumulated from operation in host vehicles and simulated operation when subjected to shock, vibration and temperature conditions typical of the operational environment. A demonstrated MTBF less than that specified in 3.6.6 constitutes failure.

4.6.4.15. Maintenance level demonstration. IPADS manuals shall be examined for scheduled maintenance tasks above the Unit (first echelon) maintenance level. All scheduled maintenance tasks shall be demonstrated using skill levels and tools available at Unit level. Any scheduled maintenance task identified for performance above the Unit level or that is outside the capability of Unit level maintenance constitutes failure.

4.6.4.16. Fault isolation verification. IPADS BIT/BITE fault isolation capability shall be analyzed. Failure to meet the fault isolation requirements of 3.6.7.2 constitutes failure.

4.6.4.17. False removal rate verification. IPADS false removal rate shall be analyzed. Failure to meet the false removal rate requirements of 3.6.7.2.1 constitutes failure.

4.6.4.18. False alarm rate. IPADS false alarm rate shall be analyzed. Failure to meet the false alarm rate requirements of 3.6.7.2.2 constitutes failure.

4.6.4.19. Fault display demonstration. IPADS capability to determine and display faults or errors and indicate corrective actions shall be demonstrated by introducing simulated fault conditions. Failure to display faults, errors, or corrective actions constitutes failure.

4.6.4.20. Replacement time demonstration. Removal and replacement of all LRUs replaced at the Unit level shall be demonstrated using the procedures in the technical manuals. Remove/replace and adjustment/calibration times shall be measured. Proper IPADS operation after replacement shall be verified. A remove/replace or adjustment/calibration time outside the limits of 3.6.7.3, or a malfunction or a failure to meet the performance requirements of Table 1 constitutes failure.

4.6.4.21. Maintenance items examination. IPADS and its manuals shall be examined to identify any maintenance items. Maintenance items shall be examined. Non-conformance with the requirements of 3.6.7.4 constitutes failure.

4.6.4.22. Special support equipment examination. IPADS manuals shall be examined for the identification of any special equipment requirements at the user, Unit, DS, or GS levels. Any special equipment requirement at the user, Unit, DS, or GS levels constitutes failure.

4.6.4.23. Calibration and adjustment demonstration. IPADS manuals shall be examined to identify any calibrations or adjustments required periodically or after a repair action. All calibrations and adjustments shall be demonstrated. Non-conformance with the requirements of 3.6.7.6 constitutes failure.

4.6.4.24. Environment, Safety, and Occupational Health (ESOH) verification. IPADS ESOH shall be analyzed. Non-conformance with the requirements of 3.6.8 constitutes failure.

4.6.4.25. Safety examination. IPADS and its transit cases, installations in host vehicles, and operation shall be examined by a qualified safety engineer for safety hazards, using SEL Form 1183 as a guide, information provided in the System Safety Assessment Report (if required), System Health Hazard Assessment Report (if required), and information obtained during testing. Non-conformance with the requirements of 3.6.9 constitutes failure.

4.6.4.26. Weight and balance verification. Weight and balance computations shall be made for IPADS installed in all host vehicles specified in the contract (6.2). Non-conformance with the requirements of 3.6.9.1 constitutes failure.

4.6.4.27. Electrical connections demonstration. Mating of all IPADS connectors and cables shall be attempted. The ability to mate connections not intended to be mated, or mismate and make electrical connections, constitutes failure.

4.6.4.28. Electrical overload protection verification. The IPADS design shall be analyzed for protection of IPADS and the vehicle from damage resulting from electrical overloads induced by normal or abnormal (fault) IPADS operation and conditions. Protective devices shall be examined for listing or certification by a nationally recognized testing laboratory. Inadequate

conductor current capacity, lack of protection or use of non-listed or non-certified protective devices constitutes failure.

4.6.4.29. Ground fault protection verification. The IPADS design shall be analyzed to verify that personnel are protected from ground fault leakage currents when connected to 115 VAC power. Protective devices shall be examined for listing or certification by a nationally recognized testing laboratory. Failure to meet the requirements of 3.6.9.4 constitutes failure.

4.6.4.30. Battery safety verification. The battery installation shall be examined for safety. The design shall be analyzed for explosive gas concentrations build-up under normal operating and fault conditions. Non-conformance with the requirements of 3.6.9.5 constitutes failure.

4.6.4.31. Battery installation markings examination. IPADS battery installation markings shall be examined. Non-conformance with the requirements of 3.6.9.5.1 constitutes failure.

4.6.4.32. Caution label examination. IPADS caution label shall be examined. Non-conformance with the requirements of 3.6.9.5.2 constitutes failure.

4.6.4.33. Human factors engineering demonstration. The capabilities of the specified personnel to operate, maintain, and support the IPADS wearing the specified clothing shall be demonstrated. Failure to comply with the requirements of 3.6.10 constitutes failure of this demonstration.

4.6.4.34. Soldier performance demonstration. The capability for personnel to perform the required tasks with the required accuracy shall be demonstrated. Failure to comply with the provisions of 3.6.10.1 constitutes failure of this demonstration.

4.6.4.35. Human factors design examination. The IPADS shall be examined by a qualified human factors engineer for conformance with the requirements of 3.6.10.2. Failure to comply with the provisions of 3.6.10.2 constitutes failure of this examination.

4.6.4.36. Noise limits test. IPADS shall be tested for conformance with 3.6.11 in accordance with MIL-STD-1474. Nonconformance to the requirements of 3.6.11 constitutes failure.

4.6.4.37. Workmanship examination. Workmanship shall be examined for conformance with the requirements of 3.6.13. The presence of any defect constitutes failure.

5. PACKAGING

5.1. Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DOD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This Section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1. Intended use. The Improved Position and Azimuth Determining System is intended for use in the conduct of field artillery surveys to determine the horizontal coordinates and altitudes of locations critical in the fire control function, such as battery centers, launcher positions, orientating stations, target acquisition devices, and survey control points. The system will determine the azimuth of the orienting lines for weapons and target acquisition systems. The system will operate in any geographic area except within 15° latitude of the poles. IPADS will operate when the Global Positioning System (GPS), and other systems relying on radio frequency transmissions, are not available. IPADS will exchange data with the Forward Observer System (FOS) via a wired serial data link. FOS, in turn, exchanges data with fire control nodes via radio communications.

IPADS is intended to replace the Position and Azimuth Determining System (PADS) AN/USQ-70. PADS installation and operation is described in Army TM 5-6675-308-12, Operator's and Organizational Maintenance Manual for Position and Azimuth Determining System AN/USQ-70.

The IPADS covered by this specification is military unique because it must operate after exposure to low velocity airdrop, high altitude electromagnetic pulses, and the nuclear, biological and chemical (NBC) warfare environments and subsequent decontamination. Commercial equipment is not designed to withstand such extreme environments and would experience catastrophic failure.

6.2. Ordering data. Acquisition documents should specify the following:

a. Title, number and date of this specification.
b. Issue of DODISS to be cited in the solicitation, and, if required, the specific issue of individual documents referenced (2.2.1, 6.2.1)
c. Requirements for submission of first article sample.
d. Requirements for submission of design verification sample.
e. Packaging requirements.
f. Serialization requirements.
g. Reprogramming cables required and type of reprogramming device (3.4.3.2).
h. Installation kit(s) required and type of host vehicle (3.4.1.1).
i. LRU transit cases required (3.6.4.2).

6.2.1. Government standards referenced in this document. The specific versions of government standards listed below were used in the preparation of this specification. Prior to use in acquisition, these documents should be compared to the latest DODISS issue. If any of the documents has changed, the version cited in DODISS should be reviewed for applicability to this specification.

FED-STD-595B(1)	Colors Used In Government Procurement
MIL-STD-130K	Identification Marking of U.S. Military Property
MIL-STD-461E	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems And Equipment
MIL-STD-464	Electromagnetic Environmental Effects
MIL-STD-704E	Aircraft Electric Power Characteristics
MIL-STD-810F With Notice 1	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1275B	Characteristics of 28 Volt DC Electrical Systems in Military Vehicles
MIL-STD-1472F	Human Engineering
MIL-STD-1474D(1)	Noise Limits

6.3. Definitions. For the purposes of this specification, the following definitions apply.

6.3.1. Accident probability of occurrence. Accident probability levels are defined in Table 11.

Table 11 - Accident Probability of Occurrence

Accident Probability Level	Frequency of Occurrence			
	Single Item	**Inventory of Items**	**Individual Soldier**	**All Soldiers Exposed**
Frequent. Occurs very often, continuously experienced.	Occurs very often in service life. Expected to occur several times over duration of a specific mission or operation. Always occurs.	Occurs continuously during a specific mission or operation, or over a service life.	Occurs very often in career. Expected to occur several times during mission or operation. Always occurs.	Occurs continuously during a specific mission or operation.
Likely. Occurs several times.	Occurs several times in service life. Expected to occur during a specific mission or operation.	Occurs at a high rate, but experienced intermittently (regular intervals, generally often).	Occurs several times in career. Expected to occur during a specific mission or operation.	Occurs at a high rate, but experienced intermittently.
Occasional. Occurs sporadically.	Occurs some time in service life. May occur about as often as not during a specific mission or operation.	Occurs several times in service life.	Occurs some time in career. May occur during a specific mission or operation, but not often.	Occurs sporadically (irregularly, sparsely, or sometimes).

Table 11 - Accident Probability of Occurrence

Accident Probability Level	Frequency of Occurrence			
	Single Item	**Inventory of Items**	**Individual Soldier**	**All Soldiers Exposed**
Seldom. Remotely possible; could occur at some time.	Occurs in service life, but only remotely possible. Not expected to occur during a specific mission or operation.	Occurs as isolated incidents. Possible to occur some time in service life, but rarely. Usually does not occur.	Occurs as isolated incident during a career. Remotely possible, but not expected to occur during a specific mission or operation.	Occurs rarely within exposed population as isolated incidents.
Unlikely. Can assume will not occur, but not impossible.	Occurrence not impossible, but can assume will almost never occur in service life. Can assume will not occur during a specific mission or operation.	Occurs very rarely (almost never or improbable). Incidents items may occur over service life.	Occurrence not impossible, but may assume will not occur in career or during a specific mission or operation.	Occurs very rarely, but not impossible.

6.3.2. Altitude. Altitude is the height above (positive) or below (negative) the reference surface for the vertical datum. The reference surface typically is mean-sea-level (msl) or the WGS 84 geoid. For the purposes of this specification, the reference surface is never the ellipsoid.

6.3.3. Autoreflection. Autoreflection is a method of creating a perpendicular line by projecting an image of a theodolite or AISI sight to a reflecting porro prism, then back to the telescope.

6.3.4. Azimuth. Azimuth is the horizontal angle measured clockwise from geodetic (true) north (geodetic or true azimuth), or from grid north (grid azimuth), to a line through an observed or designated point.

6.3.5. Circular Error Probable (CEP). CEP is the radius of a circle, centered about true, such that any measured position, selected from the total sample population, has a 50 percent probability of lying inside the circle. When the RMS errors in easting and northing are similar and the errors are normally distributed about the true position, CEP may be calculated as:

$$CEP = 1.1774 \times \frac{RMS_N + RMS_E}{2}$$

Where: RMS_N and RMS_E are the RMS errors in Northing and Easting, respectively.

6.3.6. Datum. A set of constants specifying the coordinate system used for geodetic control, i.e. for calculating coordinates of points on Earth. The datum for a defined area contains the start point from which all survey in that area ultimately originates.

6.3.7. 5^{th} Order Survey. Field Artillery survey performed to an accuracy of 1 unit of error in 1,000 similar units of survey, for position accuracy. It is usually written as 1:1,000. 5^{th} order

survey azimuth accuracy is an azimuth of a line used in the extension of 5th order survey which, from its point of origin, has depreciated by a PE of 0.090 mils per main scheme angle turned.

6.3.8. 4th Order Survey. Field Artillery survey performed to an accuracy of 1 unit of error in 3,000 similar units of survey, for position accuracy. It is usually written as 1:3,000. 4th order survey azimuth accuracy is an of a line used in the extension of 4th order survey that, from its point of origin at a 4th order astronomic azimuth line or higher-order direction, has depreciated by a PE of 0.030 mils per main scheme angle turned.

6.3.9. End Orienting Line (EOL). The EOL is a survey station used as an azimuth mark for the OS. The EOL must be located so that it is visible and at least 100 meters from the OS.

6.3.10. Ground fault. An unintentional electrical path between a part operating normally at some potential to ground, and ground.

6.3.11. Hazard severity. Hazard severity levels are defined in Table 12.

Table 12 - Hazard Severity Levels

Hazard Severity	Description
Catastrophic	Loss of ability to accomplish the mission or mission failure. Death or permanent total disability (accident risk). Loss of major or mission-critical system or equipment. Major property (facility) damage. Severe environmental damage. Mission-critical security failure. Unacceptable collateral damage.
Critical	Significantly (severely) degraded mission capability or unit readiness. Permanent partial disability, temporary total disability exceeding 3 months time (accident risk). Extensive (major) damage to equipment or systems. Significant damage to property or the environment. Security failure. Significant collateral damage.
Marginal	Degraded mission capability or unit readiness. Minor damage to equipment or systems, property, or the environment. Lost day due to injury or illness not exceeding 3 months (accident risk). Minor damage to property or the environment.
Negligible	Little or no adverse impact on mission capability. First aid or minor medical treatment (accident risk). Slight equipment or system damage, but fully functional and serviceable. Little or no property or environmental damage.

6.3.12. High Order Survey. IPADS equivalent to 4th order survey. Requires a position accuracy of 4 meters (CEP), altitude of 2 meters (PE), an azimuth of 0.4 mils (PE).

6.3.13. Hub. A hub is a temporary traverse-station marker, usually of wood. The stake is driven flush with the ground with a tack or small nail on top to mark the exact point of reference for angular and linear measurements.

6.3.14. Interchangeable. Interchangeable parts are defined as two or more parts possessing such functional and physical characteristics as to be equivalent in performance and durability, and capable of being exchanged one for the other without alteration of the parts, of mating or adjoining parts, except for adjustment, and without selection for fit or performance.

6.3.15. Leakage current. All currents, including capacitively coupled currents, which may be conveyed between energized parts of a circuit and ground or other parts.

6.3.16. Lower Order Survey. IPADS equivalent to 5th order survey. Requires a position accuracy of 7 meters (CEP), altitude of 3 meters (PE), an azimuth of 0.4 mils (PE).

6.3.17. Malicious Code Insertion. An attack on a computer designed to install a malicious code. This attack can come from an external source (infected email or infected shareware) or may come in software that has been infected at the manufacturer's plant.

6.3.18. Mean-Time-Between-Failure (MTBF). The operating time divided by the number of equipment failures, including hardware and software. For example, a system operating 500 hours before suffering a hardware and a software failure would have a MTBF of 250 hours.

6.3.19. Mean-Time-Between-System-Abort (MTBSA). The operating time divided by the number of system aborts. For example, a system operating 500 hours before suffering 2 system aborts would have a MTBSA of 250 hours.

6.3.20. Mils. Unit for angular measurements used by the Field Artillery. A circle (360°) contains 6400 mils.

6.3.21. Orienting Line (OL). A line of direction from an orienting station (OS) to an end of orienting line (EOL)

6.3.22. Orienting Station (OS). A station used by the personnel of a firing battery or platoon to orient the weapons. The coordinates and height of the OS and a line of known direction are required for use.

6.3.23. Probable Error (PE). PE is the equally likely deviation (50 percent probability) of a set of linear measurements about the true (reference) value. Where the measurements are normally distributed about the reference value(s), PE may be calculated as:

$$PE = 0.6745 \times RMS_x$$

6.3.24. Radial error (RE). Radial error is the horizontal distance between the reference horizontal coordinates and IPADS determined horizontal coordinates of a SCP.

$$RE = \sqrt{(E_R - E_I)^2 + (N_R - N_I)^2}$$

Where:

E_R and E_I are the reference and IPADS eastings, respectively.

N_R and N_I are the reference and IPADS northings, respectively.

6.3.25. Root-Mean-Square (RMS) error. RMS error is the square root of the mean of the sum of the squared errors, relative to the reference value(s), for all measurements in the sample population.

$$RMS_x = \sqrt{\frac{\sum_{i=1}^{N} (x_i)^2}{N}}$$

Where:

N is the total number of measurements in the sample.

$X_i = m_i - M_i$ for linear or angular errors.

m_i is the i'th measurement in the sample. (m_0 is the initial measurement)

M_i is the reference value associated with the i'th measurement.

6.3.26. Survey Control Point (SCP). A point on the earth, with known coordinates, altitude and a starting azimuth, that is used to start a survey. The Commander is responsible for providing SCPs for those units under his control requiring them. In a Corps area of operations the Corps Topographic Survey Company would be responsible for providing the SCPs that would be utilized by the Division Artilleries and Corps Artillery units supporting the Corps.

6.3.27. 3rd Order Survey. Survey performed to an accuracy of 1 unit of error in 5,000 similar units of survey, for position accuracy. It is usually written as 1:5,000.

6.3.28. Trap Door. Malicious software designed to allow a non-authorized user to access a computer, through its own systems, bypassing security requirements.

6.3.29. Two-position method. The two-position method of azimuth transfer utilizes inverse computations between two positions established by the system. Typically, distances between the two positions range from 100 to 1000 meters.

6.3.30. Universal Transverse Mercator (UTM). The grid projection system upon which all U.S. Army maps are based.

6.3.31. Virus/Viruses. Malicious software designed to cause a computer to act in a manner other than that intended by its users.

6.3.32. Witness stake. A witness stake is a stake driven into the ground at an angle, usually with a piece of highly visible cloth attached. Used as an aid in recovery of a survey station or hub.

6.4. Acronyms and abbreviations. The following acronyms and abbreviations may be used in the main text or appendices of this specification.

AC	Alternating Current
AISI	Automated Integrated Survey Instrument
BIT	Built-In-Test
BITE	Built-In-Test-Equipment
BTU	British Thermal Unit
C	Centigrade
CEP	Circular Error Probable
cm	Centimeter
D/M/S	Degrees, Minutes, Seconds
DC	Direct Current
DEG	Degrees
DODISS	Department of Defense Index of Specification and Standards
E	East
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference

EMP	Electromagnetic Pulse
E.O.	Executive Order
EOL	End of Orienting Line
ESOH	Environment, Safety, and Occupational Health
F	Fahrenheit
ft	Feet
g, G	Gravity
GHz	Giga-Hertz
GVW	Gross Vehicle Weight
hr	Hour
Hz	Hertz
ICD	Interface Control Document
ID	Identifier
in	Inch
IPADS	Improved Position and Azimuth Determining System
K	One thousand
kg	Kilogram
kHz	Kilohertz
km	Kilometer
kV	Kilovolt
Lat	Latitude
lbs	Pounds
Lon	Longitude
LRU	Line Replaceable Unit
m	Meter
M	Mil
m/s	Meters per Second
MHz	Megahertz
min	Minutes
msl	Mean-Sea-Level
MTBF	Mean-Time-Between-Failure
MTBSA	Mean-Time-Between-System-Abort
N	North

N/A	Not Applicable
NBC	Nuclear-Biological-Chemical
OL	Orienting Line
ORD	Operational Requirements Document
OS	Orienting Station
PE	Probable Error
PSD	Power Spectral Density
RE	Radial error
RMS	Root Mean Square
S	South
sec	Second
S/N	Serial Number
SPORT	Soldier's Portable On-System Repair Tool
SUSV	Small Unit Support Vehicle
UTM	Universal Transverse Mercator
V	Volts
W	West
WGS	World Geodetic System

6.5. Personnel duties.

6.5.1. IPADS operator. IPADS will be operated by MOS 82C20 or 82C30 Field Artillery Surveyors. Operator duties include:

a. IPADS preoperational checks and services.
b. IPADS turn-on and initialization (cold and hot start).
c. IPADS operation.
d. Providing directions to the driver/pilot on positioning/orienting the vehicle.
e. Set up and tear down theodolites and total station instruments used for remote transfer of position and azimuth.
f. Performing operations necessary to transfer position to and from SCPs remote from the vehicle. (e.g. auto-reflection operations.)
g. Performing operations necessary to transfer azimuth to OLs remote from the vehicle.
h. Establishing and storing SCP and Mark data.
i. Updating IPADS position.
j. Performing traverse closure (survey adjustment) operations.

k. Performing data communication operations.

l. Notifying driver/pilot when zero-velocity stops are required.

m. IPADS shutdown and post operational checks and services.

n. IPADS installation and transfer between vehicles.

o. Failure diagnosis, LRU replacement, battery replacement, other unit level repair actions, and repair verification.

p. Performing driver duties, as required to conduct the mission.

6.5.2. Vehicle driver. IPADS ground vehicles will be operated by MOS 82C20 or 82C30 Field Artillery Surveyors. Driver duties include:

a. Vehicle preoperational checks and services.

b. Vehicle operation.

c. Positioning/orienting the vehicle per IPADS operator instructions.

d. Occupying, as necessary, positions remote from the vehicle to transfer position and azimuth.

e. Setting hubs (temporary survey markers).

f. Setting witness stakes.

g. Recording data on witness stakes.

h. Stopping the vehicle when zero-velocity stops are required.

i. Vehicle shutdown and post operational checks and services.

j. IPADS installation and transfer between vehicles.

k. Performing IPADS operator duties, as required to conduct the mission.

6.5.3. Helicopter pilot. Helicopter pilot duties include:

a. Conduct pre-mission planning to determine locations for setting down the helicopter when zero-velocity stops are required.

b. Verifying weight and balance are within safe limits when IPADS and its crew and ancillary equipment are loaded.

c. Helicopter operation.

d. Positioning/orienting the helicopter per IPADS operator instructions.

e. Occupying, as necessary, positions remote from the vehicle to transfer position and azimuth.

f. Setting down the helicopter when zero-velocity stops are required.

6.6. Airdrop environment. Airdropped materiel is extracted from a C-130 aircraft at 140 knots, from C-141 and C-5 aircraft at 150 knots by extraction parachutes at an altitude of 700 feet or more. Recovery parachutes are attached to the load to slow the descent and to allow an impact velocity of approximately 28.5 ft/sec. The vertical impact is approximately equivalent to that from a freefall from 12.7 ft. The load is placed on energy absorbing material and rigged for airdrop as described in MIL-HDBK-669, Loading Environment and Related Requirements for Platform Rigged Airdrop Materiel. The Government performs the rigging design. Equipment secured to a M998 HMMWV, at a GVW of 8400 pounds, will experience approximately 21 G's

deceleration for about 60 milliseconds duration upon impact. These values should not be used as design limits, as they are theoretical and not based on test data. Actual values may be higher or lower. Rigging for HMMWVs is described in FM 4-20.117, Rigging High Mobility Multipurpose Wheeled Vehicles (available at http://155.217.58.58/atdls.htm).

6.7. Reliability relationships. The IPADS Operational Requirements Document (ORD) specifies a 2,000 hour Mean-Time-Between-System-Abort (MTBSA). Experience indicates approximately 80% to 90% of Operational "failures or aborts" are hardware/software related. The remainder are operator/maintainer related. The equipment MTBF is specified at 2,400 hours to meet the ORD requirement.

6.8. Subject term (key words) listing.

Altitude
Azimuth
Easting
Latitude
Longitude
Northing

APPENDIX A

CHARACTERISTICS OF REQUIRED DISPLAY FIELDS

A.1. SCOPE

A.1.1. Scope. This appendix provides standardized display field characteristics for interoperability with the Forward Observer System (FOS) survey software. This appendix is a mandatory part of this specification. The information herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS

A.2.1. General. The documents listed in this section are specified in section 3 of this appendix. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in section 3 of this appendix, whether or not they are listed.

A.2.2 Government documents.

A.2.2.1. 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.

PUBLICATIONS

NIMA TR 8350.2 Third Edition Amendment 1	Department of Defense World Geodetic System 1984, Its Definition and Relationships with Local Geodetic Systems

(Copies of NIMA TR8350.2 may be downloaded from http://164.214.2.59/GandG/tr8350_2.html)

A.2.3. Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

A.3. REQUIREMENTS

A.3.1. Display field characteristics. The characteristics of display fields for displayed parameters listed in Table A-1 shall be as specified in Table A-1.

A.3.1.1. Ellipsoid and datum names. Ellipsoid and datum names shall be displayed as specified in Table A-2. Display ellipsoid and datum names may be cross-referenced to ellipsoid and datum shift parameters in NIMA TR8350.2 using the identifier codes listed in Table A-2.

A.3.1.2. Other display fields. The characteristics of display fields for parameters not listed in Table A-1 or Table A-2 shall be selected to minimize operator errors in exercising control functions, inputting data, and reading out data.

Table A-1 – Characteristics of Required Display Fields

Parameter	Field Layout *	Range	Comment
Survey control point identifier	**PNT NAME:** *aaaaaaaaaaaaaaa*		
UTM Easting	**EAST:** *######.##* **M**	100000.00 – 900000.00	
UTM Northing	**NORTH:** *########.##* **M**	0.00 – 10000000.00	
Altitude	**ALTITUDE:** *####.#* M	-400.0 to 9999.9	
UTM grid zone	**GRID ZONE:** *###*	-60 to 60, except 0	Negative in southern hemisphere; positive in northern hemisphere
Mark 1 identifier	**MARK** *n*: *aaaaaaaa*		
Azimuth 1 (mils)	**AZIMUTH** *n*: *####.###* **MILS**	0.000 to 6399.999	
Azimuth 1 (decimal degrees)	**AZIMUTH** *n*: *###.####* **DEG**	0.0000 to 359.9999	
Azimuth 1 (degrees, minutes, seconds)	**AZIMUTH** *n*: *###/##/##* **D/M/S**	0/0/0 to 359/59/59	
Azimuth type	tttt	TRUE or GRID	
Latitude (degrees, minutes, seconds)	**LAT:** *##/##/##.###/*t	84/59/59.999/S to 84/59/59.999/N	*t* = **N** in northern hemisphere; *t* = **S** in southern hemisphere
Longitude (degrees, minutes, seconds)	**LONG:** *###/##/##.###/*t	180/00/00.000/W to 180/00/00.000/E	*t* = **E** in eastern hemisphere; *t* = **W** in western hemisphere
Ellipsoid name	**ELLIP:** *ttttttttttttttt*	See Table A-2.	
Semi-major axis of user defined ellipsoid (meters)	**MAJOR:** *#######.###* **M**	6360000.000 to 6380000.000	
Flattening or semi-minor axis indicator	**FLAT/MINOR:** *ttttttttt*	FLATTENING or SEMI-MINOR	
Semi-minor axis of user defined ellipsoid (meters)	**MINOR:** *#######.###* **M**	6330000.000 to 6360000.000	

Table A-1 – Characteristics of Required Display Fields

Parameter	Field Layout *	Range	Comment
Inverse flattening of user defined ellipsoid	**FLAT:** *###.#########*	290.000000000 to 310.000000000	
Datum name	**DATUM:** *ttttttttttttttt*	See Table A-2.	
X-shift for user defined datum (meters)	**X-SHIFT:** *#####*	-9999 to 9999	
Y-shift for user defined datum (meters)	**X-SHIFT:** *#####*	-9999 to 9999	
Y-shift for user defined datum (meters)	**X-SHIFT:** *#####*	-9999 to 9999	
Date set	**DATE SET:** *##/##/##*	Day 01 to 31 Month 01 to 12 Year 00 to 99	
Time set	**TIME SET:** *##:##:##*	Hour 00 to 23 Minute 00 to 59 Second 00 to 60	
Time zone designator	**TIME ZONE:** *t*	A-Z (excluding ‘J’)	Z = GMT A = GMT + 1 hr … M = GMT + 12 hrs N = GMT – 1 hr … Y = GMT – 12 hrs
Daylight savings time indicator	**DAYLIGHT SAVINGS:** *ttt*	YES or NO	

Table A-1 – Characteristics of Required Display Fields

Parameter	**Field Layout ***	**Range**	**Comment**
Time display	##:##:##	Hour 00 to 23 Minute 00 to 59 Second 00 to 60	
* Displayed field labels are in bold text. *a* = alpha-numeric characters in the range of A-Z; 0-9; and space. *t* = specified text. # = numeric digit 0-9; +; -. *n* = index number from 1 to the maximum value.			

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
AA	AIRY 1830	OGB-M	OSGB 36 (MEAN)
		OGB-A	OSGB 36 (ENG)
		OGB-B	OSGB 36(ENG&WL)
		OGB-C	OSGB 36 (SCOT)
		OGB-D	OSOB 36 (WALES)
			USER DEFINED *n*
AN	AUSTRALIAN NATL	ANO	ANNA 1 ASTRO 65
		AUA	AUSTRLN GEOD 66
		AUG	AUSTRLN GEOD 84
			USER DEFINED *n*
BR	BESSEL 1841	BUR	BUKIT RIMPAH
		BAT	DJAKARTA BATAV
		EST	ESTONIA
		GSE	GUNUNG SEGARA
		HER	HERMANNSKOGEL
		MAS	MASSAWA
		CCD	S-JTSK
		TOY-M	TOKYO (MEAN)
		TOY-A	TOKYO (JAPAN)
		TOY-B1	TOKYO (KOREA)
		TOY-C	TOKYO (OKINAWA)
			USER DEFINED *n*
BN	BESSEL (NAMIBIA)	SCK	SCHWARZECK
			USER DEFINED *n*
CC	CLARKE 1866	AMA	AM SAMOA 1962
		BER	BERMUDA 1957
		CAC	CAPE CANAVERAL
		GUA	GUAM 1963
		LCF	L C 5 ASTRO 61
		LUZ-A	LUZON (PHILPNS)
		LUZ-B	LUZON (MIND IL)
		NAS-C	NA 27 (CONUS)

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
CC	CLARKE 1866	NAS-B	NA 27 (WEST US)
		NAS-A	NA 27 (EAST US)
		NAS-D	NA 27 (ALASKA)
		NAS-V	NA 27 (ALN IS E)
		NAS-W	NA 27 (ALN IS W)
		NAS-Q	NA 27 (BAHAMAS)
		NAS-R	NA 27 (SAN SLV)
		NAS-E	NA 27 (CANADA)
		NAS-F	NA 27 (ALB&BC)
		NAS-G	NA 27 (E CANDA)
		NAS-H	NA 27 (MAN&ONT)
		NAS-I	NA 27 (NW TERR)
		NAS-J	NA 27 (YUKON)
		NAS-O	NA 27 (CANL ZN)
		NAS-P	NA 27 (CARIBAN)
		NAS-N	NA 27 (C AMER)
		NAS-T	NA 27 (CUBA)
		NAS-U	NA 27 (GREENLD)
		NAS-L	NA 27 (MEXICO)
		OHA-M	OLD HWN (MEAN)
		OHA-A	OLD HWN (HAWAI)
		OHA-B	OLD HWN (KAUAI)
		OHA-C	OLD HWN (MAUI)
		OHA-D	OLD HWN (OAHU)
		PUR	PUERTO RICO
			USER DEFINED *n*
CD	CLARKE 1880	ADI-M	ADINDAN (MEAN)
		ADI-E	ADINDAN (BURK)
		ADI-F	ADINDAN (CAMRN)
		ADI-A	ADINDAN (ETHOP)
		ADI-C	ADINDAN (MALI)
		ADI-D	ADINDAN (SENEG)

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
CD	CLARKE 1880	ADI-B	ADINDAN (SUDAN)
		AIA	ANTIGUA IL AST
		ARF-M	ARC 1950 (MEAN)
		ARF-A	ARC 1950 (BOTS)
		ARF-H	ARC 1950 (BURU)
		ARF-B	ARC 1950 (LESO)
		ARF-C	ARC 1950 (MALA)
		ARF-D	ARC 1950 (SWZL)
		ARF-E	ARC 1950 (ZAIR)
		ARF-F	ARC 1950 (ZAMB)
		ARF-G	ARC 1950 (ZIMB)
		ARS-M	ARC 1960 (MEAN)
		ARS-A	ARC 1960 (KENA)
		ARS-B	ARC 1960 (TANZ)
		PHA	AYABELLE LIGHT
		CAP	CAPE
		CGE	CARTHAGE
		DAL	DABOLA
		DID	DECEPTION IS
		FOT	FT THOMAS 1955
		LEH	LEIGON
		LIB	LIBERIA 1964
		MIK	MAHE 1971
		MER	MERCHICH
		MIN-A	MINNA (CAMRN)
		MIN-B	MINNA (NIGERIA)
		ASM	MONTSERRAT IL
		MPO	M'PORALOKO
		NAH-A	NAHRWAN (OMAN)
		NAH-B	NAHRWAN (UAE)
		NAH-C	NAHRWAN (SAUDI)
		NSD	NOR SAHARA 1959

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
CD	CLARKE 1880	FAH	OMAN
		PTB	POINT 58
		PTN	POINTE NOIRE 48
		SRL	SIERRA LEONE 1960
		VOI	VOIROL 1874
		VOR	VOIROL 1960
		MVS	VITI LEVU 1916
			USER DEFINED *n*
EB	EVEREST (BRUNEI)	TIL	TIMBALAI 1948
			USER DEFINED *n*
EA	EVEREST (1830)	IND-B	INDIAN (BANGLD)
		INF-A	INDIAN 1954
		ING-A	IND 1960 (VIET)
		ING-B	IND 1960 (CS IS)
		INH-A1	INDIAN 1975
		KAN	KANDAWALA
			USER DEFINED *n*
EC	EVEREST (1956)	IND-I	INDIA & NEPAL
			USER DEFINED *n*
EF	EVEREST (PAKIS)	IND-P	INDIAN (PAKIS)
			USER DEFINED *n*
EE	EVEREST (1948)	KEA	KERTAU 1948
			USER DEFINED *n*
RF	GRS 80	NAR-A	NA 83 (ALASKA)
		NAR-E	NA 83 (ALUT IS)
		NAR-B	NA 83 (CANADA)
		NAR-C	NA 83 (CONUS)
		NAR-H	NA 83 (HAWAII)
		NAR-D	NA 83 (MX&C AM)
		SIR	SIRGAS
			USER DEFINED *n*

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
HE	HELMERT	OEG	OLD EGYPT 1907
			USER DEFINED *n*
HO	HOUGH 1960	ENW	WAKE-ENIWETOK
			USER DEFINED *n*
ID	INDONESIAN 1974	IND	INDONESIAN 1974
			USER DEFINED *n*
IN	INTERNATIONAL	AIN-A	AIN ABD 70 (BAR)
		AIN-B	AIN ABD 70 (SAU)
		ASC	ASCENSION IL 58
		ATF	ASTRO BEACON E
		SHB	ASTRO DOS 71/4
		TRN	ASTRO TERN IL
		ASQ	ASTRO STA 1952
		IBE	BELLEVUE IGN
		BID	BISSAU
		BOO	BOGOTA OBSERVTY
		CAZ	CAMP AREA ASTRO
		CAI	CAMPO INCHAUSPE
		CAO	CANTON ASTRO 66
		CHI	CHATHAM IL 71
		CHU	CHUA ASTRO
		COA	CORREGO ALEGRE
		GIZ	DOS 1968
		EAS	EASTER IL 67
		EUR-M	EUR 50 (MEAN)
		EUR-E	EUR 50 (CYPRUS)
		EUR-F	EUR 50 (EGYPT)
		EUR-G	EUR 50 (BRT IL)
		EUR-B	EUR 50 (GREECE)
		EUR-H	EUR 50 (IRAN)
		EUR-S	EUR 50 (IRAQ)
		EUR-I	EUR 50 (SARDIN)

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
IN	INTERNATIONAL	EUR-J	EUR 50 (SICILY)
		EUR-L	EUR 50 (MALTA)
		EUR-C	EUR 50 (NOR&FN)
		EUR-D	EUR 50 (PGL&SP)
		EUR-A	EUR 50 (W EUR)
		EUR-T	EUR 50 (TUNISA)
		EUS	EUR 79
		GAA	GAN 1970
		GEO	GEOD DATUM 49
		GRA	GRACIOS BASE SW
		DOB	GUX 1 ASTRO
		HEN	HERAT NORTH
		HJO	HJORSEY 1955
		HKD	HONG KONG 1963
		HTN	HU-TZU-SHAN
		ISG	ISTS 061 AST 68
		IST	ISTS 073 AST 69
		JOH	JOHNSTON IL 61
		KEG	KERGUELEN IL 49
		KUS	KUSAIE ASTRO 51
		MID	MIDWAY ASTRO 61
		NAP	NAPARIMA BWI
		FLO	OBSERVIO MET 39
		OHI-M	OLD HWN (MEAN)
		OHI-A	OLD HWN (HAWAI)
		OHI-B	OLD HWN (KAUAI)
		OHI-C	OLD HWN (MAUI)
		OHI-D	OLD HWN (OAHU)
		PLN	PICO DE LAS NVS
		PIT	PITCAIRN AST 67
		POS	PORTO SANTO 36
		PRP-M	PR SA 56 (MEAN)

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
IN	INTERNATIONAL	PRP-A	PR SA 56 (BOLV)
		PRP-B	PR SA 56 (N CH)
		PRP-C	PR SA 56 (S CH)
		PRP-D	PR SA 56 (COLM)
		PRP-E	PR SA 56 (ECUD)
		PRP-F	PR SA 56 (GUYN)
		PRP-G	PR SA 56 (PERU)
		PRP-H	PR SA 56 (VENZ)
		HIT	PR S CHILE 1963
		QAT	QATAR NATIONAL
		QUO	QORNOQ
		REU	REUNION
		MOD	ROME 1940
		SAE	SANTO DOS 1965
		SAO	SAO BRAZ
		SAP	SAPPER HILL 43
		SGM	SELVAGEM GRANDE
		TAN	TANANARIVE OBS
		TDC	TRISTAN AST 68
		WAK	WAKE ISLAND AST
		YAC	YACARE
		ZAN	ZANDERIJ
			USER DEFINED *n*
KA	KRASSOVSKY 1940	AFG	AFGOOYE
		PUK	PULKOVO 1942
		SPK-A	S-42 (HUNGARY)
		SPK-B	S-42 (POLAND)
		SPK-C	S-42 (CZECH)
		SPK-D	S-42 (LATVIA)
		SPK-E	S-42 (KAZAKSTN)
		SPK-F	S-42 (ALBANIA)
		SPK-G	S-42 (ROMANIA)

Table A-2 – Ellipsoid and Datum Display Names

Ellipsoid		Associated Datum	
ID*	**Display Name**	**ID***	**Display Name**
KA	KRASSOVSKY 1940		USER DEFINED *n*
AM	MOD AIRY	IRL	IRELAND 1965
			USER DEFINED *n*
FA	MOD FISCHER 60	SOA	SOUTH ASIA
			USER DEFINED *n*
SA	SO AMERICAN 69	SAN-M	SA 69 (MEAN)
		SAN-A	SA 69 (ARGENTA)
		SAN-B	SA 69 (BOLIVIA)
		SAN-C	SA 69 (BRAZIL)
		SAN-D	SA 69 (CHILE)
		SAN-E	SA 69 (COLMBIA)
		SAN-F	SA 69 (ECUADOR)
		SAN-J	SA 69 (GALP IL)
		SAN-G	SA 69 (GUYANA)
		SAN-H	SA 69 (PARAGUA)
		SAN-I	SA 69 (PERU)
		SAN-K	SA 69 (TRN&TBG)
		SAN-L	SA 69 (VENEZLA)
			USER DEFINED *n*
WD	WGS 72		WGS 72
			USER DEFINED *n*
WE	WGS 84	KGS	KOREAN GS 1995
			WGS 84
			USER DEFINED *n*
	USER DEFINED *n*		USER DEFINED *n*

* ID per NIMA TR 8350.2, third edition, January 2000 update.

n = index number from 1 to the maximum value.

APPENDIX B

TAILORING OF MIL-STD-704E FOR THE UH-60 HELICOPTER

B.1. SCOPE

B.1.1. Scope. This appendix tailors the requirements of MIL-STD-704E for the UH-60, which was developed using MIL-STD-704A. Since IPADS is considered utilization equipment, only the worst-case aircraft power system characteristics applicable to utilization equipment have been tailored. This appendix is a mandatory part of this specification. The information herein is intended for compliance.

B.2. APPLICABLE DOCUMENTS

(This section is not applicable to this appendix.)

B.3. REQUIREMENTS

B.3.1. MIL-STD-704E changes. The requirements of MIL-STD-704E shall be tailored in accordance with the changes specified in Table B-1.

Table B-1 – Tailoring of MIL-STD-704E for IPADS.

MIL-STD-704E	Change
4.2.1	Change last sentence to: “Electromagnetic interference is not covered by this standard.”
4.2.4	Add after last sentence: “Utilization equipment power factor shall be within the limits of figure 3a.”
5.2.3	Change “table I” to “table Ia”.
5.2.4	Change to “Overvoltage and undervoltage values shall be within the limits of figure 4a. Spikes less than 50 microseconds duration shall be within ±260 volts, peak. Overfrequency and underfrequency values shall be within the limits of figure 5a.”
5.3.2 – 5.3.2.3	Delete
5.3.3.1	Change “table II” to “table IIa”.
5.3.3.2	Change to “Overvoltage and undervoltage values shall be within the limits of figure 7a. Spikes shall be within the limits of figure 8a.”
5.3.3.3	Change “18” to “16”
TABLE I	Replace with TABLE Ia.
TABLE II	Replace with TABLE IIa.
FIGURE 3	Replace with FIGURE 3a.
FIGURE 4	Replace with FIGURE 4a.
FIGURE 5	Replace with FIGURE 5a.

Table B-1 – Tailoring of MIL-STD-704E for IPADS.

MIL-STD-704E	**Change**
FIGURE 6	Replace with FIGURE 6a.
FIGURE 7	Replace with FIGURE 7a.
FIGURE 8	Replace with FIGURE 8a.
FIGURE 9 - 13	Delete.

TABLE Ia. AC normal operation characteristics

Steady state characteristics	**Limits**
Steady state voltage (individual phase)	104.0 to 118.0 volts, rms
Voltage unbalance	3.0 volts, rms maximum
Voltage modulation	3.5 volts peak to valley
Voltage phase difference	116° to 124°
Total harmonic content	8 percent (rms) of the fundamental component, maximum.
Individual harmonic content	5 percent (rms) of the fundamental component, maximum.
Deviation factor	The waveform shall not deviate from corresponding points of the fundamental by more than 5 percent of the peak value of the fundamental.
Crest factor	1.31 to 1.51
DC component	-0.10 to +0.10 volts
Steady state frequency	380 to 420 Hz
Frequency modulation	4 Hz

TABLE IIa. DC normal operation characteristics

Steady state characteristics	Limits
Steady state voltage	22.0 to 29.0 volts
Ripple amplitude	2.0 volts peak
Ripple spectrum	Figure 6a

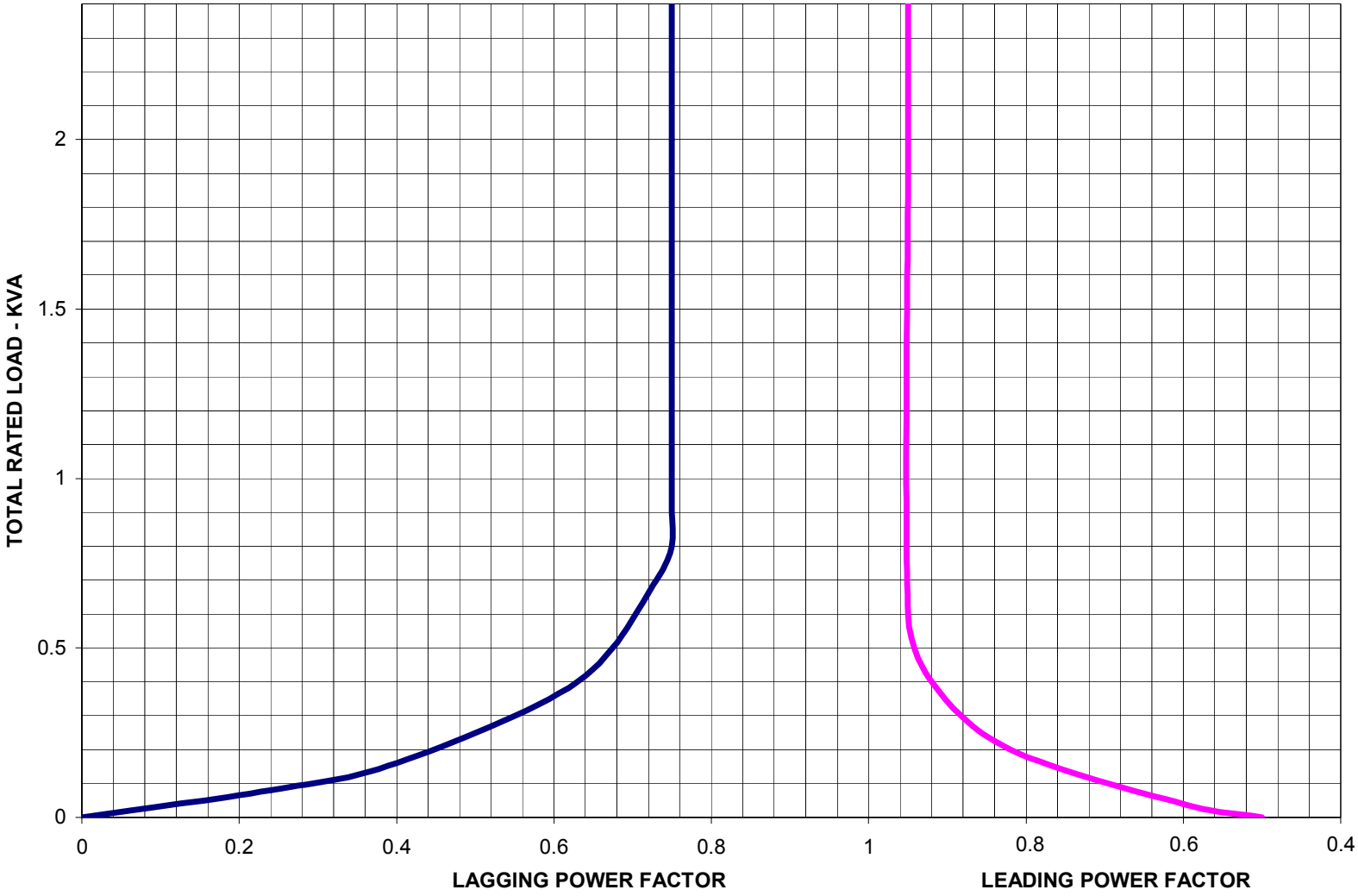

FIGURE 3a. Power factor limits for utilization equipment.

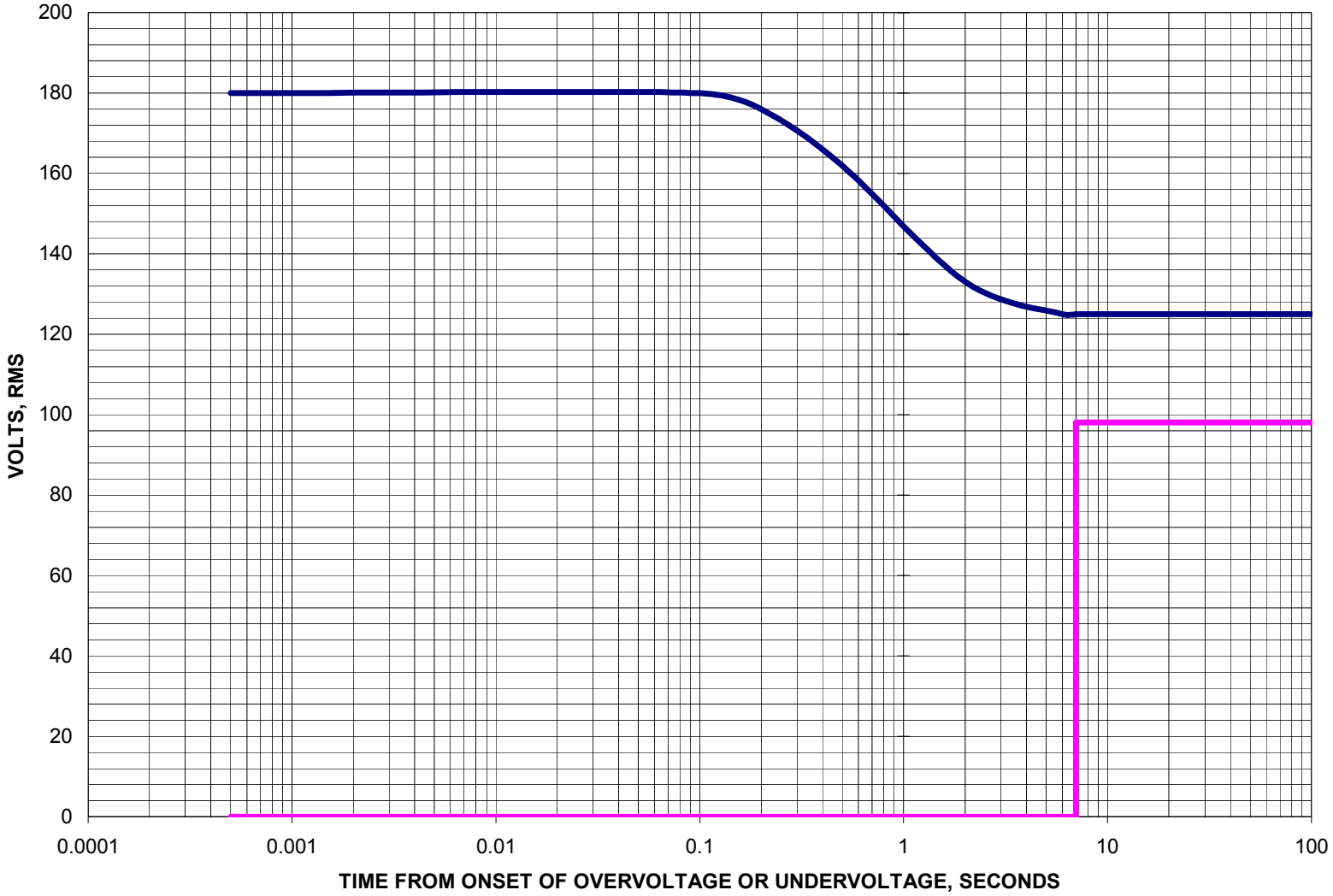

FIGURE 4a. Limits for AC overvoltage or undervoltage.

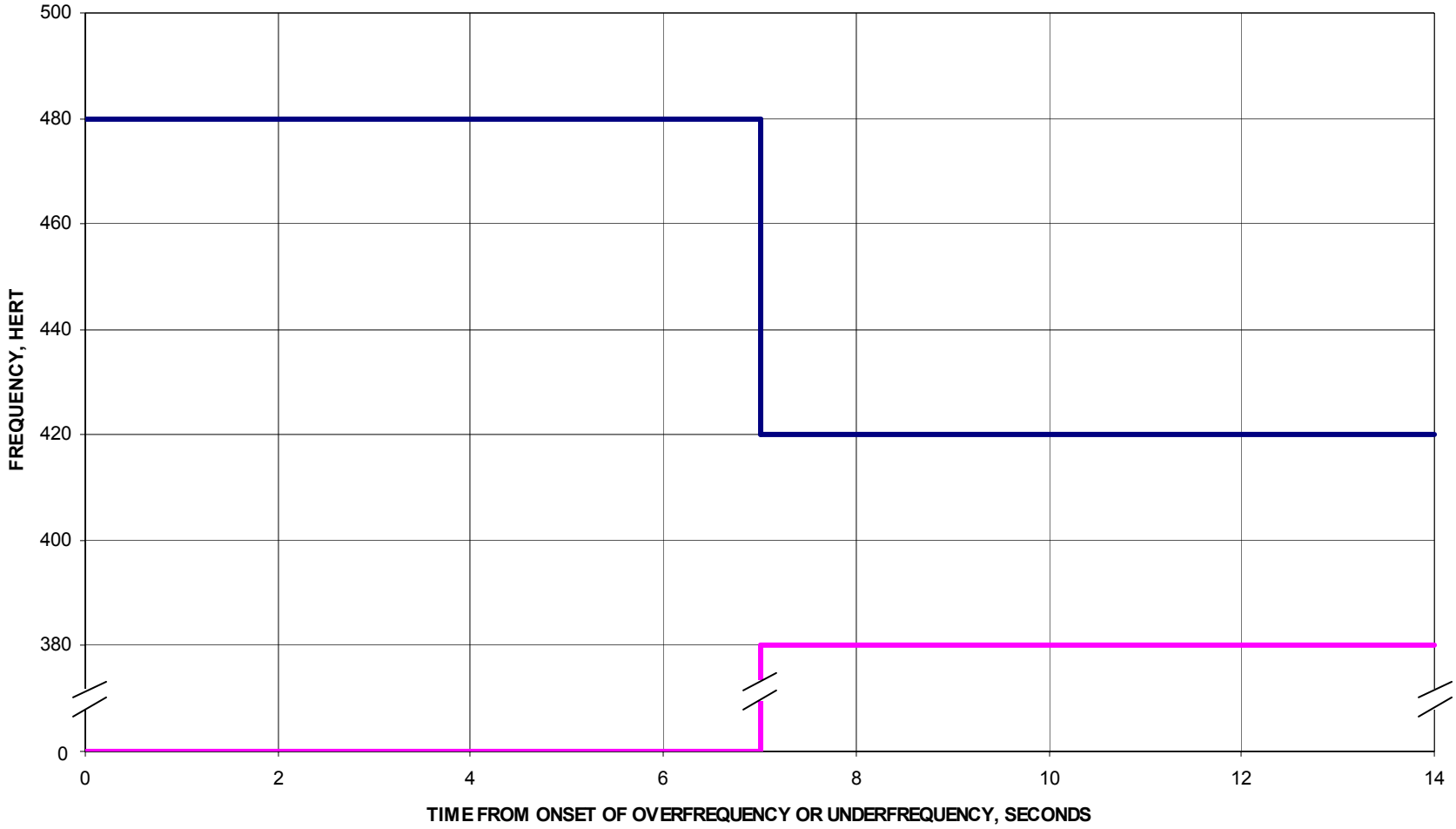

FIGURE 5a. Limits for AC overfrequency or underfrequency.

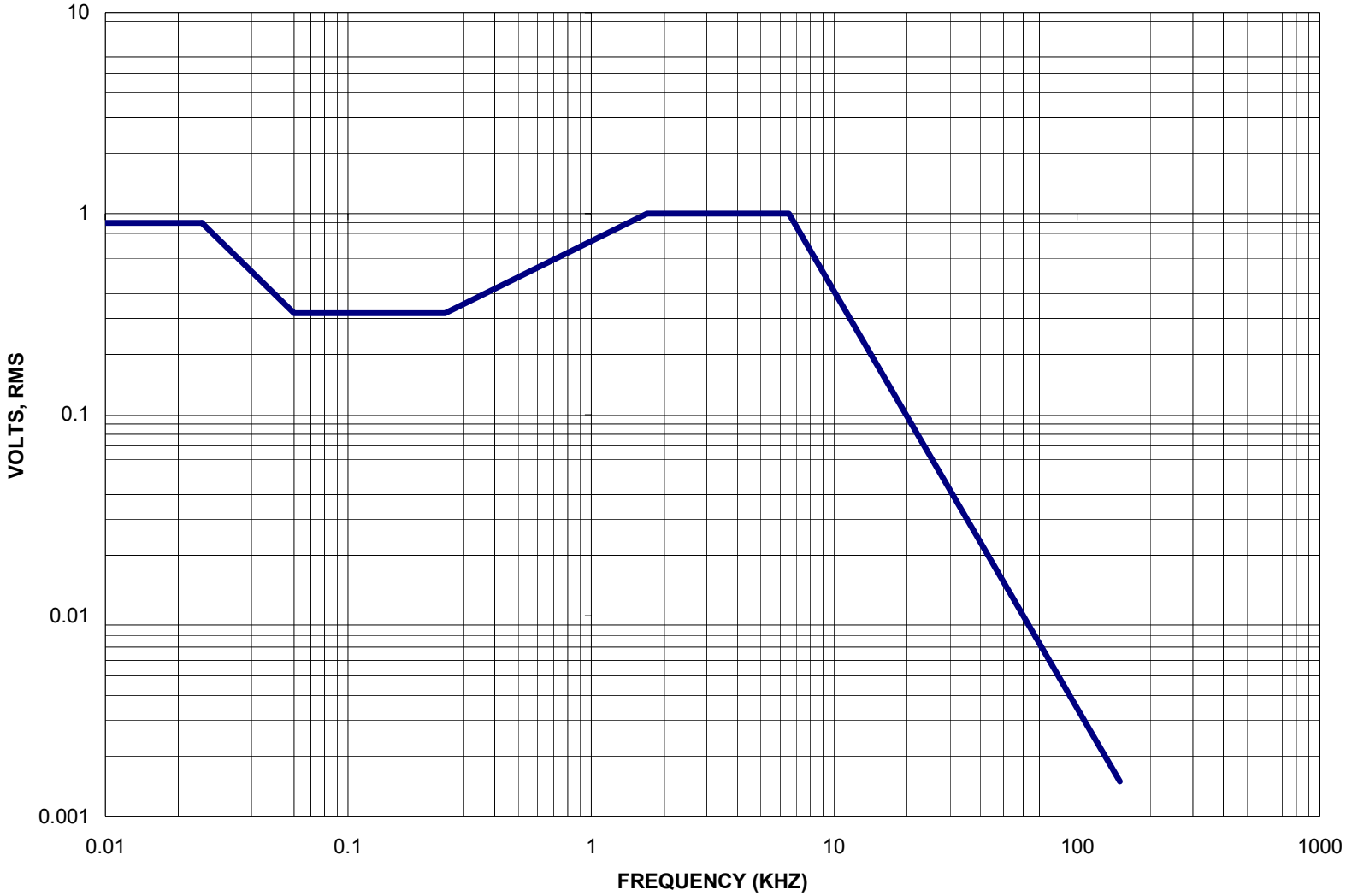

FIGURE 6a. Frequency characteristics of ripple in 28 VDC electric systems.

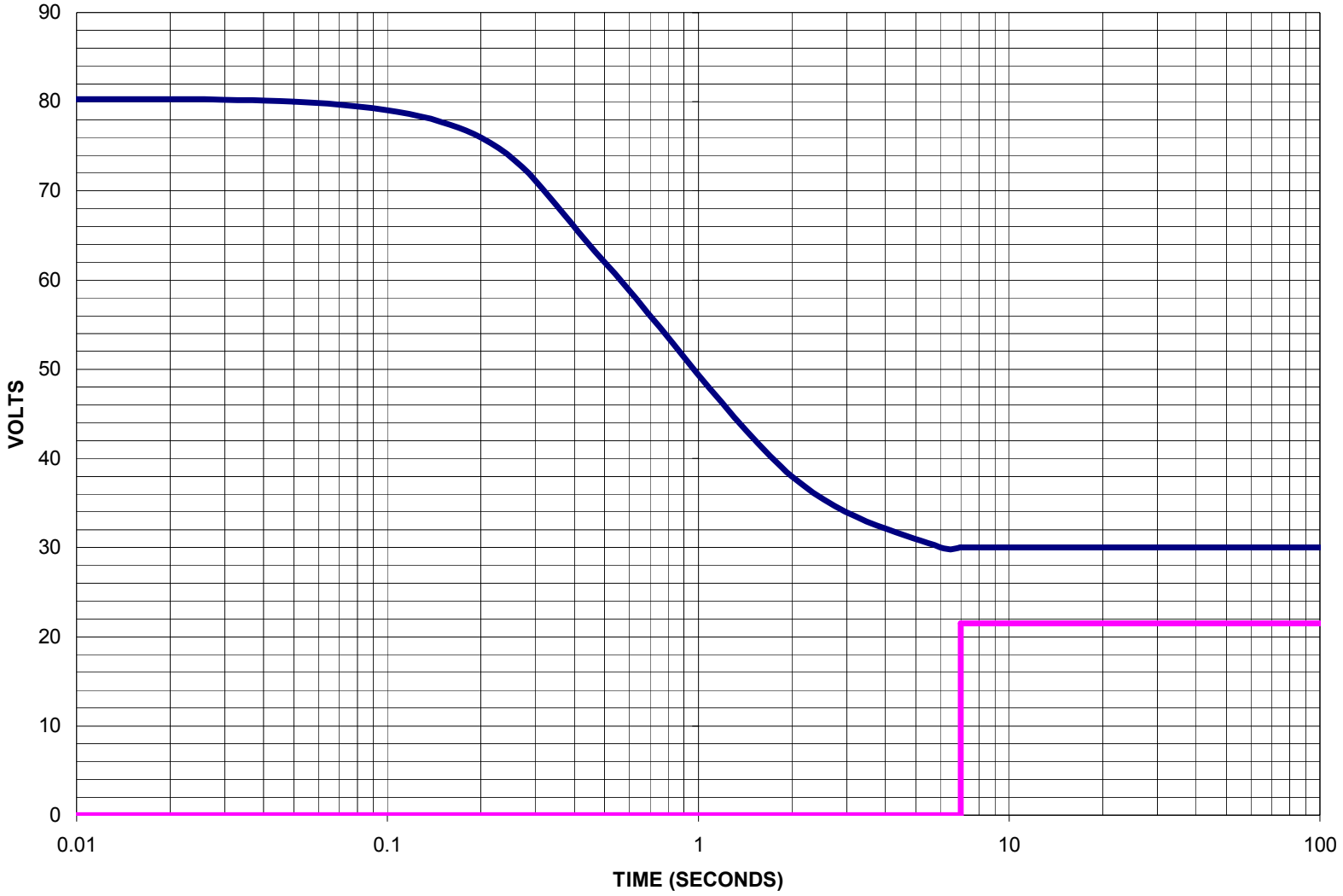

FIGURE 7a. Limits for 28 VDC overvoltage or undervoltage.

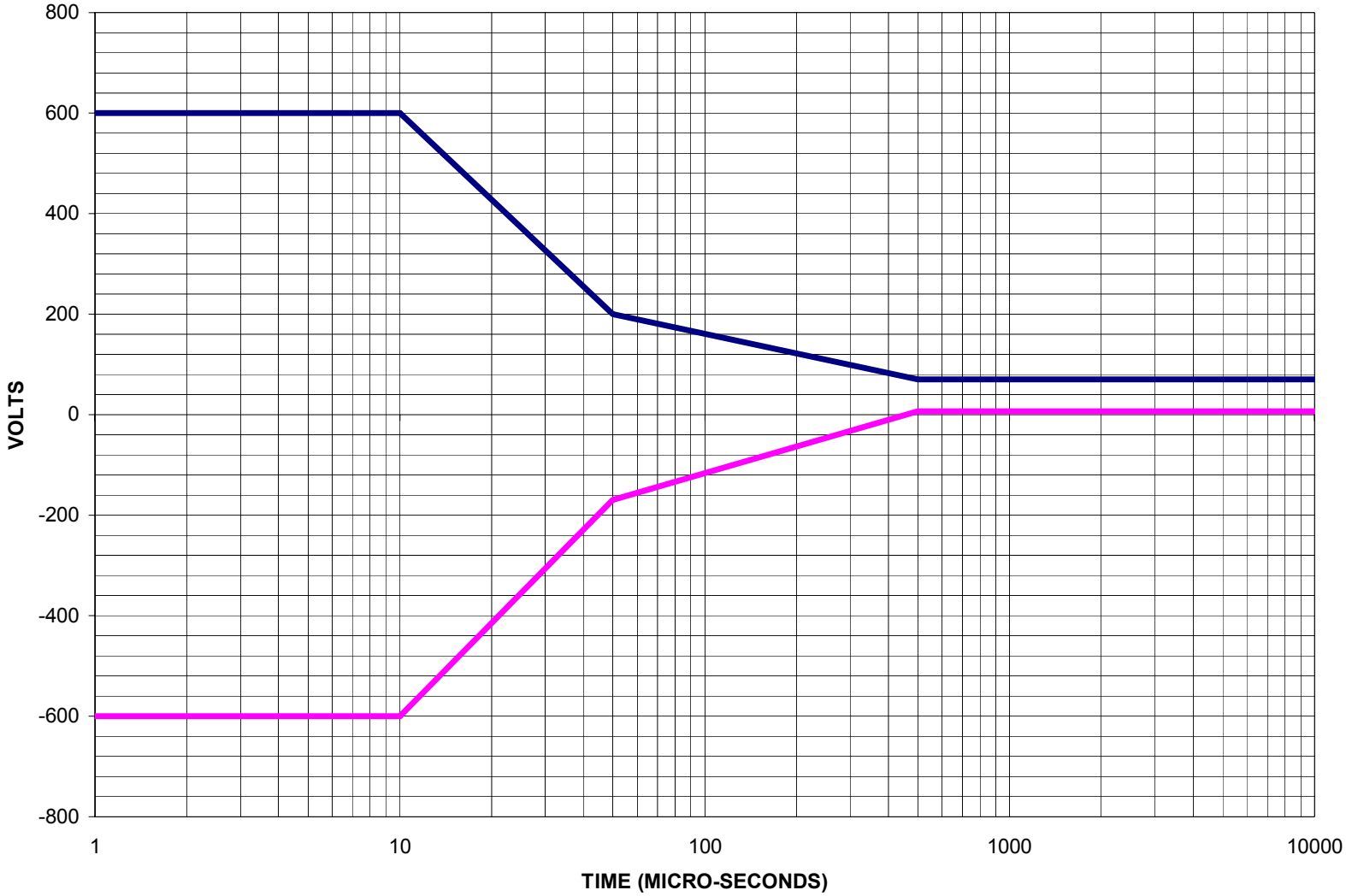

FIGURE 8a Envelope of spike voltages for DC equipment

Custodian:

Army – CE3

Navy – MC

Preparing activity:

Army – CE3

(Project 6675–0158)

Review activity:

DLA – GS

Navy – AS

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-52955C	2. DOCUMENT DATE *(YYYYMMDD)* 20021108

3. DOCUMENT TITLE
IMPROVED POSITION AND AZIMUTH DETERMINING SYSTEM (IPADS)

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) DSN *(If applicable)*	7. DATE SUBMITTED *(YYYYMMDD)*

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