

PERFORMANCE SPECIFICATION

for the

ACOUSTIC HAILING DEVICE (AHD)

Version 1.7
12 October 2004

Prepared by:
Code 805C, NSW Crane, IN 47522

1.	Introduction	4
1.1	Standards	4
1.2	Order Of Precedence	4
2.	Acoustic Hailing Device (AHD) Top Level Requirements	4
2.1	Height	4
2.2	Width	4
2.3	Depth	4
2.4	Weight	5
2.5	Power (Input)	5
2.6	Heat Dissipation	5
2.7	Sea State	5
2.8	AHD Control	5
2.9	AHD Interface	5
2.10	Cooling/Positive Pressure	6
2.11	Equipment Marking	6
2.12	Radar Cross Section	6
2.13	BIT Diagnostics	6
2.13.1	BIT False Alarms	6
2.13.2	BIT Types	7
2.14	Cable Diameter	7
2.14.1	Cable Type	7
2.14.2	Cable Length	7
2.14.3	Shipboard Fiber Optic Cable	7
2.14.4	Shipboard Fiber Optics Spares	7
2.15	On-time Counter	8
2.16	Connectors	8
2.17	Mean Time Between Failures (MTBF)	8
2.18	Mean Time To Repair (MTTR)	8
2.19	Equipment Finish	9
2.20	Environmental	9
2.21	UID Tag	9
2.22	Safety	9
2.23	Maintenance Level	10
2.24	Maintenance Test Equipment	10
2.25	Local Kill Switch	10
2.26	System Feedback	10
2.27	Fiber Cable Interconnect	11
2.28	Noise Level	11
3.	Acoustic Hailing Device (AHD) Description	11
3.1	AHD Mounting	11
3.2	Transmission Range	11
3.3	Digital Media Device Connection	11
3.4	Analog Microphone Connection	12
3.5	AHD Azimuth	12
3.6	AHD Elevation	12
3.7	AHD Azimuth Slave Rate	12
3.8	AHD Elevation Slave Rate	12
3.9	AHD Stops	12
3.10	Soft Stop Programming	12
3.11	Off-Time for Audio Transmission	12
3.12	Removable Handles	12
3.13	Video Source	12

3.14	Video Source Boresight	13
3.15	Maintenance-based Mechanical Rotation	13
3.16	Audio Level	13
3.17	Adjustable Audio Level	13
3.18	Audio Main Lobe	13
3.19	Audio Side Lobe	13
3.20	Scanning	13
3.21	Programmed Cutout Zones	13
3.22	Harmonic Distortion Of Emitter	13
3.23	Frequency Response	13
3.24	FCC Compliance	13
4.	Ancillary Equipment	14
5.	Acronyms	14
	Appendix A - MIL-STDs	15
	Appendix B – Environmental Specifications	17
	Appendix C – AHD Control Requirements	18

1. Introduction

This document provides the technical specifications for the Acoustic Hailing Device (AHD). The AHD shall be a rugged and lightweight ship mountable loudspeaker system with very high directivity that is intended for long-range hailing and warning.

1.1 Standards

The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. In keeping with the most recent Department of Defense and Secretary of the Navy policy, it is encouraged to propose alternatives to the specifications and standards cited herein for government concurrence. Unless otherwise specified, the issues of the military documents are those listed in the issue of the Department of Defense Index of Specifications and Standards on the date of this specification. The issue of non-government standards is in effect on the date of this specification. Invoked documents and standards specifically called out in Section 2 and Section 3 are to be followed. Guidance documents provide a reference to use a general guide in the development of processes, documents, or data. See **Appendix A** for a list of standards and applicable documents that shall be considered as guidance materials.

1.2 Order of Precedence

In the event of a conflict between the text of this document and the reference cited herein, the text of this document takes precedence. Nothing in this document supersedes applicable Federal, State or Local laws and regulations unless a specific exemption has been obtained.

2. Acoustic Hailing Device (AHD) Top Level Requirements

The AHD shall comply with the following electrical and mechanical specifications. For the purpose of this specification, the suite of speaker system and gimbal or pan/tilt assembly is considered a single AHD unit or system.

PARAGRAPH NUMBER	TOP LEVEL ATTRIBUTE	THRESHOLD	OBJECTIVE
2.1	Height	System height shall not exceed 60.0 Inches	System height shall not exceed 48.0 Inches
2.2	Width	System width shall not exceed 48.0 Inches	System width shall not exceed 36.0 Inches
2.3	Depth	System depth shall not exceed 48.0 Inches	System depth shall not exceed 36.0 Inches

2.4	Weight	AHD weight shall not exceed 135.0 Pounds	AHD weight shall not exceed 100.0 Pounds
2.5	Power (Input)	<p>System shall be capable of running on ship's power:</p> <p>115VAC ± 5% ≤ 10 Amps ± 5% 60 Hz ± 5% Single Phase</p> <p>Or</p> <p>440VAC ± 5% ≤ 5 Amps ± 5% 60 Hz ± 5% Three Phase</p>	N/A
2.6	Heat Dissipation	<p>Above Deck Equipment: 2.3kw / 7,855 BTUs/hour</p> <p>Below Deck Equipment: 2.3kw / 7,855 BTUs/hour</p>	N/A
2.7	Sea State (Based On Pierson –Moskowitz Sea Spectrum Scale)	<p>Operational: System shall operate up to and including sea state 3.</p> <p>Survival: System shall survive up to and including sea state 8, and be functional after being subjected to these conditions.</p>	N/A
2.8	AHD Control	See Appendix C	See Appendix C
2.9	AHD Interface	AHD Interface shall be RS-232, RS-422, or Ethernet.	N/A

2.10	Cooling/Positive Pressure	<p>If OEM requires, dry air shall be provided.</p> <p>The AHD shall be cooled at ≤ 6 cfm at ≤ 100 psi.</p> <p>No chilled water shall be provided</p> <p>No hazardous material shall be used to keep the AHD cool</p>	The AHD shall not require dry air, desiccant packs, or chilled water to cool the system
2.11	Equipment Marking	Nameplates and markings for all pieces of equipment shall be clean, concise, legible, and durable. Markings shall be provided for all controls, lamps, switches, fuses, jacks, test points, and other components	N/A
2.12	Radar Cross Section	<p>The Radar Cross Section (RCS) shall be in accordance with Radar Cross Section Requirements for IROS³</p> <p>CONFIDENTIAL/NO FORN letter dated 30 December 2002.</p> <p>The AHD shall have a RCS no greater than the value for gun mount assembly called out in above letter.</p>	N/A
2.13	BIT Diagnostics	<p>The AHD shall be capable of running BIT Diagnostics to determine faults within the AHD to the LRU level without the aid of separate test equipment.</p> <p>The AHD in BIT mode shall detect $\geq 80\%$ of all specified faults or failures to within one LRU.</p>	<p>The AHD in BIT mode shall detect $\geq 90\%$ of all specified faults or failures to within two LRU.</p> <p>The BIT should complete testing in ≤ 2 minutes.</p>
2.13.1	BIT False Alarm	The percentage of BIT false alarms shall be $\leq 10\%$.	The percentage of BIT false alarms shall be $\leq 5\%$.

2.13.2	BIT Types	<p>The AHD shall have a Manual BIT Test</p> <p>Manual BIT: A test that excludes rebooting or refreshing of default settings. This shall be an operator-initiated test.</p>	<p>The AHD Shall have the following BIT Tests:</p> <p>Power-On BIT: Automatic BIT that diagnosis the system during the power on procedure.</p> <p>Continuous BIT: System test that is active during regular system use. It can be triggered by momentary functions such as zoom or focus.</p>
2.14	Cable Diameter	No shipboard cable shall exceed 2 Inches in diameter	No shipboard cable shall exceed 1 Inch in diameter
2.14.1	Cable Type	All shipboard cables shall be low smoke in accordance with MIL-C-24643A (See Appendix A).	N/A
2.14.2	Cable Length	All shipboard cables shall support cable runs up to and including 300 feet.	All shipboard cables shall support cable runs up to and including 1 kilometer.
2.14.3	Shipboard Fiber Optic Cable	If shipboard fiber optic cabling is used, it shall adhere to the specifications and requirements per MIL-STD-2042B, MIL-C-28876D, and MIL-PRF-85045F.	N/A
2.14.4	Shipboard Fiber Optics Spares	If single mode fiber optic or multimode fiber optic is used in a shipboard fiber optic cable, there shall be at least a one to one ratio of fibers utilized to spare fibers in the fiber optic cable.	N/A

2.15	On-time Counter	The AHD shall place an easily accessible and visible on time counter on all major components. The counter shall record operating hours of each major component. Counter shall be a minimum of 4 digits with minimum lowest valued digit in hours.	N/A
2.16	Connectors	All exterior AHD connectors shall be in accordance with MIL-DTL-38999K (See Appendix A)	N/A
2.17	Mean Time Between Failures (MTBF)	<p>Mean Time Between Failures (MTBF) is the predicted mean time between failures, in terms of operating hours.</p> <p>MTBF is calculated by the following formula:</p> <p>MTBF = Average Uptime/Number of Failures</p> <p>The AHD shall have a MTBF \geq 720 hours</p>	The AHD shall have a MTBF \geq 1,440 hours
2.18	Mean Time To Repair (MTTR)	<p>Mean Time To Repair (MTTR) is the predicted mean time to repair the item, in elapsed hours. This factor is used to compute A_0 of the equipment and to provide estimates of maintenance shop workloads.</p> <p>The AHD shall have a MTTR \leq 1 hour</p>	The AHD shall have a MTTR \leq 30 minutes

2.19	Equipment Finish	<p>All equipment shall be Navy Haze Gray, Color #26270 per FED-STD-595B</p> <p>Per one of the following as applicable:</p> <ul style="list-style-type: none"> a.) Hard coat anodize per MIL-A-8625F, type III, class1 or, b.) Commercial grade powder coat epoxy with appropriate priming system 	N/A
2.20	Environmental	The AHD shall be functional in the Environmental Requirements in Appendix B	N/A
2.21	UID Tag	The AHD shall have Unique IDentification (UID) tags at the LRU level Government shall provide UID tag part numbers prior to production of the AHD.	N/A
2.22	Safety	The AHD shall be designed to ensure system is safe to use, and there shall be no electrical, mechanical, or radiation hazard to users as specified in MIL-STD-882D.	N/A

2.23	Maintenance Level	<p>Organizational: The AHD shall be able to provide a level of maintenance performed by a ship's force. This includes utilization of BIT, preventive maintenance, and corrective maintenance.</p> <p>Intermediate: The AHD shall not require intermediate level maintenance at the system level</p> <p>Depot: The AHD shall require depot level maintenance only for items that have been agreed to by the Government as being non-repairable by the ship's force.</p>	N/A
2.24	Maintenance Test Equipment	Organizational level preventive/corrective maintenance shall not require any special purpose test equipment. General-purpose test equipment is allowed if necessary.	N/A
2.25	Local Kill Switch	The AHD shall be equipped with a local kill switch that shall secure the power during manual troubleshooting or manipulation of the system.	N/A
2.26	System Feedback	The AHD shall have sense lines that provide feedback to system operating characteristics.	N/A

2.27	Fiber Cable Interconnect	N/A	All AHD fiber optic equipment shall utilize International Fiber Systems hardware, and shall be configured prior to delivery to be optimum.
2.28	Noise Level	The AHD mechanical audible noise level shall be no louder than 63 decibels in accordance with MIL-STD-740-1, Grade A3. This requirement does not include the audio output of the AHD required for sound/message annunciation.	N/A

3. Acoustic Hailing Device (AHD) Description

The AHD shall allow for long range acoustic hailing and warning using an input microphone or recorded sound file. With the AHD, audio transmission beyond 500 meters shall be feasible with minimal lobing and rear radiation. The AHD shall meet the following operational and reliability requirements.

PARAGRAPH NUMBER	OPERATIONAL ATTRIBUTE	THRESHOLD	OBJECTIVE
3.1	AHD Mounting	The AHD shall be exposed to the environment and shall be capable of being mounted upright or inverted.	N/A
3.2	Transmission Range	The AHD shall be capable of producing a SPL that shall be ≥ 98 dB at 500 yards.	The AHD shall be capable of producing a SPL that shall be ≥ 95 dB at 1000 yards.
3.3	Digital Media Device Connection	The AHD shall be capable of having standard commercial audio files played. These audio files shall include but not be limited to high quality .WAV and MPEG-3 compression files.	N/A

3.4	Analog Microphone Connection	The AHD shall have the ability to allow the connection of an external microphone as well as accept near real time voice input with a latency ≤ 25 ms. The external microphone frequency response range shall at least include the 600 Hz – 6 kHz frequency range.	N/A
3.5	AHD Azimuth	Azimuth operational range shall be at least 360°.	Azimuth operational range shall be at least 360° continuous.
3.6	AHD Elevation	Elevation shall be between 0° and -90°	Elevation shall be between 90° and -90°
3.7	AHD Azimuth Slave Rate	Slave rate shall be $\geq 20^\circ$ per second.	Slave rate shall be $\geq 25^\circ$ per second.
3.8	AHD Elevation Slave Rate	Slave rate shall be $\geq 6^\circ$ per second.	Slave rate shall be $\geq 25^\circ$ per second.
3.9	AHD Stops	The AHD shall have configurable mechanical stops and configurable software/electrical stops. Both sets of stops shall not allow physical movement of the AHD past these configurable positions.	N/A
3.10	Soft Stop Programming	The AHD shall have the ability to set soft stops either remotely or locally through standard interface applications per paragraph 2.9.	N/A
3.11	Off-time for Audio Transmission	The AHD shall have a disengagement period of ≤ 5 seconds.	The AHD shall have a disengagement period of ≤ 2 seconds
3.12	Removable Handles	The AHD shall have removable handles that permits lifting and moving the AHD during corrective and preventive maintenance.	N/A
3.13	Video Source	The AHD shall have a fixed field of view video source. The FOV shall closely match the beam pattern of the AHD. The video source shall be low-light capable.	The AHD shall have a variable field of view video source. The FOV shall never be smaller than the beam pattern of the AHD.

3.14	Video Source Boresight	The AHD shall have a boresight feature to align the video source to the center of the audio beam pattern.	N/A
3.15	Maintenance-based Mechanical Rotation	The AHD Pan/Tilt shall have the ability to be manually rotated for maintenance.	N/A
3.16	Audio Level	Audio volume level shall be ≥ 125 dB at 4 meters.	Audio volume level shall be ≥ 135 dB at 4 meters
3.17	Adjustable Audio Level	The AHD shall have an adjustable audible level from 3 dBA to maximum dBA.	N/A
3.18	Audio Main Lobe	The AHD Main Lobe of audio transmission shall be \leq than 30° .	The AHD Main Lobe of audio transmission shall be \leq than 15°
3.19	Audio Side Lobe	The AHD Side Lobe of audio transmission shall be \leq than 75° .	The AHD Side Lobe of audio transmission shall be \leq than 30°
3.20	Scanning	N/A	The AHD shall be capable of being programmed to scan a certain area in a random or non-random pattern.
3.21	Programmed Cutout Zones	The AHD shall be capable of being programmed to not search a single area of interest.	The AHD shall be capable of being programmed to not search multiple areas (>5 areas) of interest
3.22	Harmonic Distortion Of Emitter	The AHD shall have harmonic distortion of less than 1% THD at 120 dB (2 meters 2.5 kHz)	N/A
3.23	Frequency Response	The AHD frequency response range shall at least include the 2000 – 8000 Hz frequency range.	The AHD frequency response range shall at least include the 20 – 20000 Hz frequency range.
3.24	FCC Compliance	The AHD shall comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.	N/A

4. Ancillary Equipment

This specification has been written with the intent of only documenting requirements for a single AHD. As an objective, ancillary equipment to support the AHD shall not be required. As a threshold, ancillary equipment is permissible to support the AHD. Ancillary equipment shall be evaluated in conjunction with the AHD requirements. Preference shall be given in regards to the ancillary equipment in the following order: no ancillary equipment, 19" rack mountable ancillary equipment, bulkhead mountable ancillary equipment. Less ancillary equipment shall have preference over more ancillary equipment, and smaller/lighter ancillary equipment shall have preference over larger/heavier ancillary equipment.

It is anticipated that this component shall be integrated into a larger ship system. As such, it is not anticipated or desired that ancillary equipment such as hand controllers, displays, shipboard cables, etc.. be provided as part of this contract. As a threshold shipboard cable drawings shall be provided with enough detail for the IROS³ system integrator to build independently.

5. Acronym Definitions

A _o	Operational Availability
AHD	Acoustic Hailing Device
BIT	Built-In Test
BTU	British Thermal Unit
FCC	Federal Communications Commission
IROS ³	Integrated Radar Optical Surveillance and Sighting System
LRU	Lowest Replaceable Unit
MDT	Mean Down Time
MTBMCF	Mean Time Between Mission Critical Failures
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NFOV	Narrow Field Of View
NSWC	Naval Surface Warfare Center
SPL	Sound Pressure Level
THD	Total Harmonic Distortion
OEM	Original Equipment Manufacturer
RFID	Radio Frequency Identification
WFOV	Wide Field Of View

Appendix A

MIL-HDBK-2036	01 NOV 1999	Preparation Of Electronic Equipment Specifications
Federal Acquisition Register	JAN 1998	Y2K Document
MIL-HDBK-46855A	17 MAY 1999	Human Engineering Requirements For Military Systems, Equipment, And Facilities
MIL-STD-2525B	30 JAN 1999	Common Warfighting Symbology
MIL-DTL-38999K	12 JUL 2002	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, And Breech Coupling), Environment Resistant, Removable Crimp And Hermetic Solder Contacts, General Specification For
MIL-DTL-5015H	18 MAY 2000	Connectors, Electrical, Circular Threaded, AN Type, General Specification For
MIL-C-24643A	14 MAR 1994	Cable And Cords, Electric, Low Smoke, For Shipboard Use, General Specification For
MIL-STD-2042B	25 JUL 2002	Fiber Optic Cable Topology Installation Standard Methods For Naval Ships
MIL-C-28876D	04 MAY 1995	Connectors, Fiber Optic, Circular, Plug And Receptacle Style, Multiple Removable Termini, General Specification For
MIL-PRF-85045F	12 AUG 1999	Cables, Fiber Optics, (Metric), General Specification For
FED-STD-595B	11 JAN 1994	Colors Used In Government Procurement
MIL-A-8625F	10 SEP 1993	Anodic Coatings For Aluminum And Aluminum Alloys

MIL-STD-810F	30 AUG 2002	Department Of Defense Test Method Standard For Environmental Engineering Considerations And Laboratory Tests
MIL-STD-167-1	19 JUN 1987	Mechanical Vibrations Of Shipboard Equipment (Type 1 – Environmental And Type II - Internally Excited)
MIL-S-901D	17 MAR 1989	Shock Tests. H.I. (High Impact) Shipboard Machinery, Equipment, And Systems, Requirements For
DOD-STD-1399/70-1	30 NOV 1989	Interface Standard For Shipboard Systems Section 070 - Part 1 D.C. Magnetic Field Environment (Metric)
MIL-STD-461E	20 AUG 1999	Requirements For The Control Of Electromagnetic Interference Characteristics Of Subsystems And Equipment
OPNAVINST 3000.12	30 SEP 1999	Operational Availability Handbook
MIL-STD-882D	10 FEB 2000	Standard Practice For System Safety
MIL-STD-1399-300A	11 MAR 1992	Interface Standard For Shipboard Systems Section 300A Electric Power, Alternating Current (Metric)
MIL-STD-1472F	23 AUG 1999	Department Of Defense Design Criteria Standard, Human Engineering
MIL-STD-740-1	30 DEC 1986	Airborne Sound Measurements And Acceptance Criteria Of Shipboard Equipment
ANSI Z136.1-2000	26 OCT 2000	Safe Use Of Lasers
CONFIDENTIAL/NO FORN	30 DEC 2002	Radar Cross Section (RCS) Requirements For Integrated Radar Optical Surveillance And Sighting System (IROS ³)

Appendix B

ENVIRONMENTAL SPECIFICATIONS (OPERATING)			
Ambient Temperature	-28 °C to 65 °C	MIL-STD-810F Method 501.4 and 502.4, Procedure II	Above Deck Equipment
Ambient Temperature	0 °C to 50 °C	MIL-STD-810F Method 501.4 and 502.4, Procedure II	Below Deck Equipment
Storage Ambient Temperature	-40 °C to 70 °C	MIL-STD-810F, Method 501.4 and 502.4, Procedure I	Above Deck Equipment And Below Deck Equipment
Solar Radiation	350 BTU/hr/ft ²	MIL-STD-810F, Method 505.4, Procedure II, Basic Hot	Above Deck Equipment
Rain	Rainfall rate 6 cm/hr, wind speed 18 m/s, water pressure 377 kPa	MIL-STD-810F, Method 506.4 Procedure I (Blowing rain).	Above Deck Equipment
Humidity	100% condensing	MIL-STD-810F, Method 507.4	Above Deck Equipment And Below Deck Equipment
Salt Fog	MIL-STD-810F, Method 509.4 Procedure I	MIL-STD-810F, Method 509.4 Procedure I	Above Deck Equipment And Below Deck Equipment
Ice	4.5 lbs/ft ²	MIL-STD-810F, Method 521.2 Procedure I	Above Deck Equipment
Fungus	MIL-STD-810F, Method 508.5	MIL-STD-810F, Method 508.5	Above Deck Equipment And Below Deck Equipment
Sand/Dust	MIL-STD-810F, Method 510.4 Procedure I (Blowing Dust)	MIL-STD-810F, Method 510.4 Procedure I (Blowing Dust)	Above Deck Equipment
Wind velocity	90 knots	To be incorporated into design and supported by analyses	Above Deck Equipment
Vibration	MIL-STD-167-1 Type 1 and MIL-STD-810F, Method 514.5 Categories 2 and 21 (Transportation and Shipboard vibration)	MIL-STD-167-1 Type 1 and MIL-STD-810F, Method 514.5 Categories 2 and 21 (Transportation and Shipboard vibration)	Above Deck Equipment And Below Deck Equipment
Shock	Grade B, Type A, Class III	MIL-HDBK-2036 (Shock); MIL-S-901D	Above Deck Equipment
Shock	Grade B, Type A, Class III	MIL-HDBK-2036 (Shock); MIL-S-901D	Below Deck Equipment
DC Magnetic Field	DOD-STD-1399-70-1	DOD-STD-1399-70-1	Below Deck Equipment
Non-Operating Altitude	MIL-STD-810F, Method 500.3 Procedure I	MIL-STD-810F, Method 500.3 Procedure I	Above Deck Equipment And Below Deck Equipment
EMI/EMC	MIL-STD-461E surface ships	MIL-STD-461E surface ships	Above Deck Equipment And Below Deck Equipment

Appendix C

2.8 AHD CONTROL REQUIREMENTS			
PARAGRAPH NUMBER	TOP LEVEL ATTRIBUTE	THRESHOLD	OBJECTIVE
2.8.1	AHD Power On/Off	AHD shall be able to receive a remote message to turn AHD on/off	AHD shall be able to receive a remote message to turn AHD on/off and give an AHD on/off status
2.8.2	AHD Positional Data	AHD shall give current positional data (elevation and azimuth). AHD shall accept positional commands to move AHD. AHD shall provide a positional data accuracy of ≤ 10 milliradians.	AHD shall give current positional data (elevation and azimuth). AHD shall accept positional commands to move AHD. AHD shall provide a positional data accuracy of ≤ 5 milliradians.
2.8.3	AHD Movement Commands	AHD shall be able to be given movement commands in which it will slew to a given position (elevation and azimuth) at a given rate	N/A
2.8.4	AHD Status Reports	AHD shall periodically update (≤ 1 sec) status	AHD shall periodically update (≤ 1 sec) status and be able to give status report when queried
2.8.5	AHD Stow Position	AHD shall have a configurable stow position	N/A
2.8.6	AHD Software Updates/Upgrades	AHD shall have the capability to receive software updates and upgrades	N/A
2.8.7	AHD Software Stops/Keep-out Zones	AHD shall have programmable software stops/keep-out zones	N/A
2.8.8	AHD BIT	AHD BIT shall communicate with software when a fault occurs detailing what fault occurred	N/A
2.8.9	AHD Camera	AHD camera functions shall be fully controllable by software	N/A
2.8.10	AHD Volume	AHD volume shall be software controlled and the AHD shall provide a volume feedback stating the current volume setting	N/A