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Superseding
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MILITARY SPECIFICATION
DETECTING-RANGING SET, SONAR AN/AQS-13A

This specification has been approved by the Naval Air Systems Command, Department of the Navy.

1. SCOPE

1.1 Scope - The equipment covered by this specification shall provide a dipped underwater echo ranging system capable of rapid search of the area around the point of immersion of the transducer, determine the range and bearing of any objects located, and provide information to assist in classification of the object. (See 6.1.)

*1.2 Classification - The equipment covered by this specification shall consist of the following items:

Items	Type Designation	Appl. Para.
Transducer, Sonar		3.5.1
Hydrophone, Sonar	DT-299/AQS-13	3.5.1.4.1
Projector, Sonar	MX-6647/AQS-13	3.5.1.4.2
Converter, Frequency, Electronic	CV-1823/AQS-13	3.5.2
Amplifier, Intermediate Frequency	AM-4203A/AQS-13	3.5.3
Control, Detecting-Ranging Set	C-6413B/AQS-13	3.5.4
Indicator, Azimuth and Range	IP-780/AQS-13	3.5.5
Transmitter, Sonar	T-982A/AQS-13	3.5.6
Recorder	RO-358/AQS-13A	3.5.7
Processor, Frequency	FR-184/AQS-13A	3.5.8
Power Supply	PP-4197/AQS-13	3.5.9
Reeling Machine, Cable, Hydraulic	RL-237A/AQS-13	3.5.10

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Items	Type Designation	Appl. Para.
Cable Assembly and Reel	RC-466A/AQS-13	3.5.11
Housing, Transducer	CW-1007/AQS-13A	3.5.12
Housing, Reeling Machine	CW-757A/AQS-13	3.5.13
Circuit Breaker	SA-1263/AQS-13	3.5.14
Indicator, Bearing and Range	ID-786/AQS-10	3.5.15
Visor, Cathode Ray Tube	MX-3275/AQS-10	3.5.16
Mounting (Amplifier Intermediate Frequency)	MT-2201/AQS-10	3.5.17
Mounting (Control, Detecting-Ranging Set and Indicator, Azimuth and Range)	MT-2202/AQS-10	3.5.18
Mounting (Power Supply)	MT-2203/AQS-10	3.5.19
Mounting (Converter, Frequency, Electronic)	MT-2397/AQS-10	3.5.20
Mounting (Transmitter, Sonar)	MT-3335/AQS-13	3.5.21
Mounting (Processor, Frequency)	MT-3972/AQS-13A	3.5.22
Mounting (Recorder)	MT-4035/AQS-13A	3.5.23

1.3 Associated Equipment - This equipment shall operate with the associated equipment listed in 6.8.

2. APPLICABLE DOCUMENTS

*2.1 General - The following documents of the issue in effect on the date of invitation for bids form a part of this specification to the extent specified herein:

SPECIFICATIONS

Military

MIL-C-172 Cases; Bases, Mounting; and Mounts, Vibration (For use with Electronic Equipment in Aircraft)

MIL-C-915 Cable, Cord and Wire, Electrical (Shipboard Use)

MIL-W-5088	Wiring; Aircraft, Installation of
MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
MIL-T-5422	Testing, Environmental, Aircraft Electronic Equipment
MIL-I-6181	Interference Control Requirements, Aircraft Equipment
MIL-C-6781	Control Panel; Aircraft Equipment, Rack or Console Mounted
MIL-P-7788	Plate, Plastic, Lighting
MIL-M-7793	Meter, Time Totalizing
MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
MIL-T-18303	Test Procedures; Preproduction and Inspection, for Aircraft Electronic Equipment, Format for
MIL-N-18307	Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment
MIL-E-19400	Electronic Equipment, Airborne Sonar; General Specification for
MIL-D-81622A(AS)	Classified Addendum
MIL-C-81452	Cable Assembly W-1 of AN/AQS-13

Naval Air Systems Command

AR-5	Microelectronic Devices Used in Avionic Equipment, Procedures for Selection and Approval of

STANDARDS

MIL-STD-704	Electrical Power, Aircraft Characteristics and Utilization of
MIL-STD-781	Reliability Tests, Exponential Distribution
MS17321	Meter, Time Totalizing, 28V DC Miniature Digital
MS17322	Meter, Time Totalizing, 115V, 400 Cycle

MS25245 Connections, Input Power Airborne Electronic Equipment; 28 VDC, 115 V Single Phase AC, or 115/200 V 3-Phase AC, or combinations

MS90386 Meter, Time Totalizing, 28 VDC

PUBLICATIONS

Naval Air Systems Command

EI-451 Avionics Installation Instructions for Detecting-Ranging Set, Sonar AN/AQS-13A

ET-451 Bench, Preflight, and Flight Test Instructions for Detecting-Ranging Set, Sonar AN/AQS-13A

2.1.1 Availability of Documents

(1) When requesting specifications, standards, drawings, and publications, refer to both title and number. Copies of this specification and applicable specifications required by contractors in connections with specific procurement functions may be obtained upon application to the Commanding Officer, Publications and Forms Center, Code 105, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

3. REQUIREMENTS

3.1 Preproduction - This specification makes provisions for preproduction testing.

3.2 Parts and Materials - In the selection of parts and materials, fulfillment of major design objectives shall be the prime consideration. In so doing, the following shall govern:

(1) Microelectronic items shall conform to requirements specified herein.

(2) Other parts and materials requirements shall conform to Specification MIL-E-5400.

(3) Non-repairable subassemblies, as outlined in Specification MIL-E-5400, shall be used when practicable. The general size of the subassembly, and the amount of circuitry to be included therein shall be approved by the procuring activity. Non-repairable subassemblies must be reliable. (See 6.5.)

(4) When previously produced models of this equipment did not use non-repairable sub-assemblies, the design shall not be changed to employ non-repairable assemblies without the approval of the procuring activity.

3.2.1 Non-standard Parts and Material Approval - Approval for the use of non-standard parts and materials shall be obtained as outlined in Specification MIL-E-5400. Microelectronic devices shall be approved as outlined in AR-5.

3.2.2 Microelectronic Modular Assemblies - When used, Microelectronic Modular Assemblies shall meet the requirements of AR-5.

3.3 Design and Construction - The equipment shall conform with all the applicable requirements of Specification MIL-E-5400 for design, construction and workmanship, unless otherwise specified herein.

*3.3.1 Total Weight - The total weight of the equipment, including the cable of 3.5.11, but excluding interconnecting cables, shall be a minimum consistent with good design and shall not exceed 825 pounds.

3.3.2 Reliability

3.3.2.1 Operational Stability - The equipment shall operate with optimum performance for 50 hours, continuously or intermittently, without the necessity for readjustment of any controls which are inaccessible during flight.

3.3.2.2 Operating Life - The equipment shall have a total operating life of 2000 hours with reasonable servicing and replacement of parts. Parts requiring scheduled replacement shall be specified by the manufacturer.

*3.3.2.3 Reliability in Mean Time Between Failure (MTBF) - The equipment shall have a specified MTBF of 150 hours not including the Recorder, RO-358/AQS-13A and the Processor, Frequency, FR-184/AQS-13A which shall each have a specified MTBF of 400 hours, when tested and accepted as outlined under the requirements of Section 4.4.3.

3.3.2.4 Time Totalizing Meter - The following units shall contain time totalizing meters in accordance with Specification MIL-M-7793.

Unit	Type of Meter
CV-1823/AQS-13	MS17322
AM-4203A/AQS-13	MS17322
C-6413B/AQS-13	MS17322
IP-780/AQS-13	MS17322
T-982A/AQS-13	MS17322

Unit	Type of Meter
PP-4197/AQS-13	MS17322
RL-237A/AQS-13	MS17321
FR-184/AQS-13A	MS17322-6
RO-358/AQS-13A	MS17322-6 & MS90386-2

3.3.3 Cabling and Connections

3.3.3.1 Cabling and Connectors - The equipment shall provide for the use of cables and connectors in accordance with Specification MIL-E-5400.

3.3.3.2 Interconnection Cabling - The equipment shall be capable of satisfactory operation using external wiring in accordance with the applicable requirements of Specification MIL-W-5088. The external wiring shall be unshielded, except that a minimum number of the individual wires may be shielded when demonstrated as necessary to meet interference control requirements and system performance requirements. External cables and that portion of the connectors attached to the cables shall not be supplied as part of the equipment.

3.3.4 Control Panels - All rack or console mounted control panels shall conform to the applicable requirements of Specification MIL-C-6781 for type II control panels except for the light assembly, illuminating control, circuit grounding, fasteners, receptacles, cover box, and weight. The configuration of all control panels must be approved by the procuring activity prior to preproduction testing.

3.3.5 Interchangeability - The equipment shall meet the interchangeability requirements as defined in Specification MIL-E-19400. This shall be further extended to include interchangeability of units of this equipment with the latest model of any previously produced equipment. This shall include interchangeability down to "replaceable parts" so that all provisioned parts bought on a previous contract must be useable in units bought on the present contract, and vice versa. Such interchangeability shall be measured against the designated model, manufacturing drawings or other technical information provided for the purpose as set forth in MIL-E-5400.

3.3.6 Interference Control - The generation of radio interference by the equipment and the vulnerability of the equipment to radio interference shall be controlled within the limits of Specification MIL-I-6181, except as modified herein:

3.3.6.1 Transmitter, Sonar T-982A/AQS-13 - The broadband conducted interference may exceed the limits of MIL-I-6181 by 25 dB from 1 MHz to 25 MHz. The broadband radiated interference may exceed the limits of MIL-I-6181 by 45 dB at 0.15 MHz, the limit decreasing at 13 dB per decade to a point 11 dB above the limits of MIL-I-6181 at 1000 MHz.

*3.3.6.2 Recorder RO-358/AQS-13A - The broadband conducted interference measured by the methods of MIL-I-6181 shall not exceed the limits of straight line curves plotted on semi-log paper between the following points: 136 dB above 1 microvolt per MHz at 0.15 MHz; 136 dB above 1 microvolt per MHz at 0.68 MHz; 104 dB above 1 microvolt per MHz at 25 MHz. The broadband radiated interference measured by the methods of MIL-I-6181 shall not exceed the limits of straight line curves plotted on semi-log paper between the following points: 120 dB above 1 microvolt per MHz at 0.15 MHz; 76 dB above 1 microvolt per MHz at 25 MHz; and from 54 dB above 1 microvolt per MHz at 25 MHz; 70 dB above 1 microvolt per MHz at 120 MHz; 61 dB above 1 microvolt per MHz at 1000 MHz.

3.3.7 Maintenance Provisions and Field Testing - Provisions for maintenance shall be specified in Specification MIL-E-5400. Specific test points and test facilities shall be provided to the greatest extent practicable for ease of field testing and maintenance.

3.3.8 Nomenclature and Nameplates - Nomenclature and serial number assignment, nameplate approval and equipment identification shall be in accordance with Specification MIL-N-18307.

3.3.9 Standard Conditions - The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

Temperature	Room Ambient (25°C ±5°C)
Altitude	Normal Ground
Vibration	None
Humidity	Room Ambient up to 90% relative humidity
Input Power Voltage	115 ±1.0V AC and 27.5 ±0.5V DC
Hydraulic Input	5.6 gpm ±0.1 gpm at 2550 psi
Return Line Pressure	25 psi maximum at 5.6 gpm

3.3.10 Service Conditions - The equipment shall operate satisfactorily under any of the environmental service conditions or reasonable combination of these conditions as specified in Specification MIL-E-19400 for the helicopter-borne equipment, except as modified herein.

*3.3.10.1 Shock - All units of the Detecting-Ranging Set, Sonar AN/AQS-13A shall meet the shock requirements of MIL-E-19400 except for the Reeling Machine, Cable, Hydraulic; Cable Assembly and Reel; Transducer, Sonar; and Housing, Transducer. The test set up shall include a sonar cable, which will be inserted through the wiper assembly of the transducer housing, and shall have attached the transducer suspended from the reeling machine in the normal seated position. The shock loads will be applied at the reeling machine mounting points and shall be as follows: Crash safety shock - To be based upon ultimate strength of the reeling machine frame and not to be less than 10 g acting down, 10 g acting forward, and 5 g acting laterally; Operating shock - To be based upon yield strength of the reeling machine frame and not to be less than 6 g acting down, 6 g acting forward, and 3 g acting laterally.

*3.3.10.2 Salt Spray - All units of the Detecting-Ranging Set, Sonar AN/AQS-13A shall meet the salt spray requirements of MIL-E-19400 and in addition, the exposure time shall be increased to 200 hours on the following units:

Unit	Nomenclature
Cable Assembly and Reel	RC-466A/AQS-13
Hydrophone, Sonar	DT-299/AQS-13
Projector, Sonar	MX-6647/AQS-13
Housing, Transducer	CW-1007/AQS-13A

3.3.10.3 Vibration - All units of the Detecting-Ranging Set, Sonar AN/AQS-13A shall meet the vibration requirements of Curves II and III of Specification MIL-E-5400 except as modified herein. The predominant frequency of the SH-3D helicopter of 17 Hz shall be substituted for resonance vibration testing of the Reeling Machine, Cable, Hydraulic; Cable Assembly and Reel; Transducer, Sonar; and Housing, Transducer at any resonant frequency occurring below 20 Hz in each of the 3 mutually perpendicular axes. The test set up for these units shall include a pulley system for the purpose of cycling the cable during vibration testing with a simulated transducer load of approximately 150 pounds applied to the cable.

3.3.10.4 Humidity - All units of the Detecting-Ranging Set, Sonar AN/AQS-13A shall meet the humidity requirements of MIL-E-19400 except the Recorder's chart paper.

3.3.10.5 Explosive Conditions - All units of the Detecting-Ranging Set, Sonar AN/AQS-13A shall meet the explosive conditions requirements of MIL-E-5400 except for the Recorder. Compliance with the explosive requirements for the recorder shall be limited to operating but non-writing conditions.

3.3.11 Warm-Up Time - The time required for the equipment to warm up prior to operations shall be kept to a minimum and shall not exceed 2 minutes under standard conditions and 3 minutes at extreme service conditions.

*3.3.12 Primary Input Power Requirements - The equipment shall meet all applicable requirements of MIL-STD-704 and shall give specified performance from the following power sources with characteristics as defined in MIL-STD-704 having limits as specified therein. The power required shall not exceed the specified amounts:

(1) AC Power (Single Phase) 115V, 400 Hz, Category "B" 20 VA (For height-depth and drift sensing system, from aircraft)

(2) AC Power (Three Phase) 115/200V, 400 Hz, Category "B" 2000 VA

(3) DC Power 28V, Category "B" 180 Amps (Emergency Use Only)

(4) DC Power 28V, Category "B" 40 Amps (Sonar Guillotine)

(5) DC Power 28V, Category "B" 1.5 Amps (Intermediate Speed)

3.3.12.1 Undervoltage Protection - The equipment shall not be damaged by voltages below the minimum specified herein and shall automatically resume normal operation when the voltage returns within limits.

3.3.12.2 Underfrequency Protection - The AN/AQS-13A equipment shall withstand operation at 330 Hertz for 1 minute and resume normal operation when the power returns within proper limits.

3.3.12.3 Electrical Input Power Utilization - The AN/AQS-13A equipment shall utilize 115/200V, 400 Hertz power exclusively, except for 28 V DC. The 28 V DC shall be used for operation of the reeling machine's emergency motor, intermediate speed valve, sonar cable guillotine and for illumination of the Indicator, Bearing and Range and the Reeling Machine, Cable, Hydraulic.

3.3.12.4 Electrical Input Power Connection - Input connections shall be in accordance with MS25245.

3.3.13 Standby Provisions - The equipment shall provide for a standby position whereby rated voltage shall be applied to the following components: vacuum tube filaments, blowers, DC relay supplies, reference voltage for the servo systems, pilot's and sonar operator's indication of drift sensing, reeling machine, transmitter, time delay circuit, frequency processor, and recorder. In addition, the recorder shall have an independent standby position to allow for chart movement.

3.3.13.1 Separate Systems - The following circuits of the AN/AQS-13A do not receive their power from the AN/AQS-13A and may be turned on or off at any time by the pilot. Sonar guillotine, AC drift sensing and height-depth system for the automatic hover system.

3.3.14 Hydraulic Power Requirements - Hydraulic power requirements for the reeling machine shall be a flow rate of 5.6 +0.1 GPM at 2550 PSI pressure. Operation of the reeling machine will not be adversely affected at the maximum flow rate of 5.7 GPM and at a pressure of 3000 PSI. The aircraft return line pressure at 5.6 GPM shall not exceed 25 PSI and at 0.0 GPM it shall not exceed 4 PSI.

3.4 Performance - Unless otherwise specified, values set forth to establish the requirements for satisfactory performance apply to performance under both standard and extreme service conditions. When reduced performance under the extreme condition is acceptable, tolerances or values setting forth acceptable variations from the performance under the standard conditions will be specified.

*3.4.1 Operation - The Detecting-Ranging Set, Sonar shall operate from a hovering helicopter for the purpose of detecting submerged objects. The sonar transducer shall be lowered from the aircraft into the water to any depth allowed by the maximum cable length. In the active mode, there shall be three selectable active frequencies to prevent interference from adjacent sonars. Provision shall be made for transmission and reception of CW communication signals on any of the specified operating frequencies and single sideband voice communication signals on a suppressed carrier frequency of 8.0875 kHz. In the active mode, provisions shall be made for listening to the returning echoes from selected targets. In the passive mode, provisions shall be made for listening to signal sources from any bearing, without transmitting. Provisions shall be made for limiting the area searched in order to facilitate tracking of targets. A graphic recorder shall be provided for displaying bathythermograph, range and ASPECT classification information. Moving target detection capability shall be provided. Position sensing information from the sonar cable and transducer shall be provided for the aircraft automatic hovering system. A complete Built-In Test Equipment (BITE) capability shall be provided for the purpose of preflight and inflight performance verification of the AN/AQS-13A sonar system. These performance checks shall be accomplished without external test equipment. A graphic recorder shall be provided for displaying bathythermograph, range, ASPECT classification data, and MAD magnetic anomaly traces.

3.4.2 Transmission Characteristics

3.4.2.1 Detecting-Ranging and C.W. Telegraphy

3.4.2.1.1 Frequency - Each equipment supplied shall be capable of three selectable operating frequencies. The operating frequencies shall be 9.25, 10.00 or 10.75 kHz ±25 Hertz.

3.4.2.1.2 Acoustic Output - The sound pressure level at high power (3K yard or longer range scale and ASPECT modes) as measured with the 500 foot cable and at any of the 3 operating frequencies, shall be at least 111 decibels (dB) ref. 1 dyne per cm^2 at 1 yard. The sound pressure level during handkey communicate, TEST, and 1K yard range operations shall be at least 99 dB (ref. 1 dyne per cm^2 at 1 yard) at any of the 3 operating frequencies.

*3.4.2.1.2.1 This measurement shall be made at the linear midpoint in time of the 35 millisecond pulse.

*3.4.2.1.3 Pulse Width - The transmitted pulse shall be either 3.5 or 35 milliseconds ±15 percent. The CW communication pulse width shall be handkey-controlled. The transmitter shall be capable of putting out a train or burst of pulses for the ASPECT mode with a pulse width between 2 and 7 ms.

3.4.2.1.4 Pulse Rate - In the active mode, the pulse rate shall be controlled by the range scale selected. The range scales shall be 1K, 3K, 8K, 12K, and 20K yards. In the ASPECT mode the equipment shall be capable of transmitting bursts up to 20 KYD duration at a 300 yard separation at full power with no decrease in the power per pulse throughout the duration of the burst of pulses. Following the burst transmission, the transmitter shall be off for an equal amount of time. During the communication function the CW pulses shall be at a rate up to 50 characters per minute at a level 10 dB below full power.

3.4.2.2 Voice Communication

3.4.2.2.1 Frequency - Upper sideband suppressed carrier shall be employed. The carrier shall be 8.0875 kHz ±25 Hertz.

3.4.2.2.2 Acoustic Output - The maximum amplitude of the voice modulated signal shall be at least 99 dB ref. 1 dyne per cm^2 at 1 yard.

3.4.3 Receive Characteristics

3.4.3.1 Detecting-Ranging and C.W. Telegraphy

3.4.3.1.1 Frequencies - The receivers shall be capable of receiving signals within 450 Hertz bandwidths centered about 9.25, 10.0 and 10.75 kHz ±25 Hz.

3.4.3.1.2 Bandwidth - The receiver bandwidth shall be at least 450 Hertz, at the 3 dB points, centered on the operating frequency. This is for the purpose of accommodating a 30 knot target doppler.

3.4.3.1.3 Minimum Signal - See MIL-D-81622A(AS) Addendum 1.

3.4.3.1.3.1 Wide Band Detection Capability (MTI-OFF) - See MIL-D-81622A(AS) Addendum 1.

3.4.3.1.3.2 Narrow Band Detection Capability (MTI-ON) - See MIL-D-81622A(AS) Addendum 1.

3.4.3.2 Voice Communication

3.4.3.2.1 Frequency - The receiver shall be capable of receiving AN/UQC-1 transmissions which consist of an upper sideband suppressed carrier signal with a carrier frequency of 8.0875 kHz.

3.4.4 Indications

3.4.4.1 Visual - Visual indication of the searched area shall be made on a CRT. It shall present 180 degrees of the total area, or the entire 360 degree area by alternately displaying the north 180 degree sector and then the south 180 degree sector. It shall be possible to select any 180 degree sector in eight 45 degree steps. The CRT display shall be stabilized such that the top of the display is always north regardless of the rotation of the transducer.

3.4.4.2 Aural - An aural indication shall be made simultaneously from each of the four 45 degree sectors displayed. Targets in each of these sectors shall present a different audible tone, one from another. Provisions shall be made to disable all aural response in three of the four sectors, thus allowing a single 45 degree sector response with a single tone. Furthermore, it shall be possible to select this sector as any one of the eight sectors of the display.

*3.4.4.3 Chart - The recorder shall provide a permanent recording of bathythermograph plots, target range, and ASPECT classification data, and MAD magnetic anomaly traces.

*3.4.4.4 BITE - The following BITE indications shall be provided:

(1) Stave and Hydrophone Test - Test meter, IN-TEST light, and CRT presentation. CRT traces indicate stave and system performance, and north markers indicate compass servo performance.

(2) Bearing and Range Test - Test meter, IN-TEST light, and CRT presentation. CRT traces verify system bearing and range accuracy with sixteen off-axis bearing signals and range notches at 500 yard intervals.

(3) Minimum Detectable Signal (MDS) - Test meter, IN-TEST light, Recorder, and CRT presentation. Test meter indicates system self-noise with staves shorted.

(4) MDS (SEA) Test - Test meter, IN-TEST light, Recorder, and CRT presentation. Test meter indicates sea noise with staves open.

(5) Listen Test - Test meter, IN-TEST light, and CRT presentation. Test meter indicates open loop gain.

(6) AGC Test - Test meter, IN-TEST light, and CRT presentation. Test meter indicates closed loop gain.

*3.4.4.5 Additional Indications - The following indications and outputs shall also be provided:

(1) Transducer depth - to the sonar operator

(2) Water temperature - to the sonar operator

(3) Transmitter true power indication - to the sonar operator

(4) Transducer seated indication - to the sonar operator

(5) Range and bearing - to both sonar operator and pilot

(6) Aircraft height - to automatic hover system and to the pilot

(7) Transducer cable angle - to automatic hover system and to the pilot, copilot and sonar operator

(8) Transducer submerged indication - to the pilot

(9) Power supply test meter - for test only

(10) Transmitter module test light for test only

(11) Transmitter overload protection - to sonar operator

(12) Range rate - to the sonar operator

(13) Performance meter - to the sonar operator

(14) IN-TEST light indicator - to the sonar operator.

*3.4.5 Bearing Accuracy - See MIL-D-81622A(AS) Addendum 1.

3.4.6 Range Accuracy

*3.4.6.1 Cathode Ray Tube Display - See MIL-D-81622A(AS) Addendum 1.

3.4.6.2 Recorder Display - See MIL-D-81622A(AS) Addendum 1.

3.4.7 Depth Height System - This system shall furnish aircraft height above water to a maximum of 80 feet to the automatic hover system and pilot, and transducer depth to the sonar operator.

3.4.7.1 Depth Height Accuracy - The depth height system shall provide electrical outputs proportional to the length of sonar cable between a datum reference point and water surface. The overall height system accuracy shall be ±14.5 feet, inclusive of the readout device. The electrical output from the depth system shall be accurate within ±12.5 feet for a static transducer depth condition. During transducer raise/lower cycles, the electrical output from the depth system shall track within ±10 feet of the reading obtained for a static depth condition. The graphic display of the recorder shall be within ±3 percent of full scale of the AN/AQS-13A depth input signal.

3.4.8 Water Temperature Sensing Accuracy - The water temperature sensing system shall be accurate to within ±5°F inclusive of the readout device.

3.4.9 MTI Range Rate Measurement Accuracy - See MIL-D-81622A(AS) Addendum 1.

*3.4.10 BITE System Accuracy - See MIL-D-81622A(AS) Addendum 1.

3.5 Detail Requirements

3.5.1 Transducer, Sonar - The Transducer, Sonar is composed of two components; the Hydrophone, Sonar DT-299/AQS-13, and Projector, Sonar MX-6647/AQS-13. The transducer shall meet the following requirements:

*3.5.1.1 Function - The primary function of the transducer is to radiate pulsed acoustic power, omnidirectionally in the horizontal plane, into the water and detect returning echoes by means of a directional, phase sensitive, receiving array. Auxiliary detectors within the sonar transducer provide signals to indicate the direction and depth of the transducer and water temperature. The transducer shall contain analog decoding circuits to provide remote control of BITE test functions within the transducer. These BITE functions shall provide a 1) magnetic north reference, 2) open circuit stave test, 3) short circuit stave test, and 4) bearing accuracy test.

3.5.1.2 Form Factor - The maximum dimensions of the Transducer, Sonar shall be 16.3 inches in diameter and 56.8 inches in length.

3.5.1.3 Operating Frequency - The transducer shall meet all requirements over three 500 Hertz frequency bands centered around 9.25, 10, and 10.75 kHz except in those paragraphs in which a frequency is specified. It shall also be capable of receiving and transmitting the required signals for voice communiction specified elsewhere.

3.5.1.4 Contents of Unit - The Transducer, Sonar shall contain the following assemblies, subassemblies and circuits:

(1) Hydrophone, Sonar - DT-299/AQS-13

(2) Projector, Sonar - MX-6647/AQS-13

3.5.1.4.1 Hydrophone, Sonar - The Hydrophone, Sonar shall meet the following requirements:

3.5.1.4.1.1 Form Factor - The maximum dimensions of the hydrophone shall be 16.3 inches in diameter and 32.0 inches in length.

*3.5.1.4.1.2 Weight - The weight of the hydrophone assembly shall not exceed 96 pounds.

*3.5.1.4.1.3 Contents of Hydrophone, Sonar - The hydrophone assembly shall contain a receiving hydrophone array, preamplifiers, beam forming, output amplifiers, temperature sensing element, a BITE compass control circuit, and a stave switching BITE circuit.

3.5.1.4.1.4 Receiving Hydrophone Array - The receiving hydrophone array shall include 16 vertical staves mounted on the outside of a cylindrical baffle. The following parameters are specified at a water depth of 10 feet.

3.5.1.4.1.4.1 Stave Response - The receiving sensitivity for each stave shall be at least -88 +2 dBV versus one dyne per square centimeter at each of the three transmitting frequencies. The stave impedance will be less than 65 ohms resistive in series with a capacitance of 3600 picofarads to 5800 picofarads at 10 kHz.

3.5.1.4.1.4.2 Horizontal Beam Patterns - The horizontal sum beam width at -6 dB points shall be at least 38 degrees and not more than 50 degrees. The horizontal half beam width shall be at least 44 degrees and not more than 58 degrees.

3.5.1.4.1.4.2.1 Side Lobes - The side lobe amplitude shall not exceed -20 dB for the horizontal sum beam and -14 dB for the horizontal half beam.

3.5.1.4.1.4.3 Vertical Pattern

3.5.1.4.1.4.3.1 Width - The vertical beam width at the -6 dB points shall be at least 18 degrees and not more than 23 degrees.

3.5.1.4.1.4.3.2 Side Lobe - The maximum amplitude of a side lobe shall be -20 dB.

3.5.1.4.1.4.3.3 Response - The maximum response within 10 degrees of the vertical shall be -30 dB.

3.5.1.4.1.4.3.4 Vertical Rejection - The maximum response at the vertical shall be -40 dB at 10.00 kHz and -35 dB at 9.25 kHz and 10.75 kHz.

3.5.1.4.1.4.4 Directivity Index

3.5.1.4.1.4.4.1 Sum Beam - The directivity index of the sum beam shall not be less than 17 dB.

3.5.1.4.1.4.4.2 Half Pattern - The directivity index of the half pattern shall be not less than 16 dB.

3.5.1.4.1.4.4.3 Stave Pattern - The directivity index of the stave pattern shall be not less than 10 dB.

3.5.1.4.1.4.4.4 Stiffness Ratio - See MIL-D-81622A(AS) Addendum 1.

3.5.1.4.1.4.5 The following hydrophone parameters are specified for a water depth of 450 feet.

3.5.1.4.1.4.5.1 Staves Response - The receiving sensitivity for each stave shall be -91 ±2 dBV vs 1 dyne/cm^2.

3.5.1.4.1.4.5.2 Horizontal Beam Patterns - The horizontal sum beam width at the -6 dB points shall be at least 38 degrees and not more than 50 degrees. The horizontal half beamwidth shall be at least 44 degrees and not more than 58 degrees.

3.5.1.4.1.4.5.2.1 Side Lobes - Side lobe amplitude shall not exceed 14 dB.

3.5.1.4.1.4.5.3 Vertical Pattern

3.5.1.4.1.4.5.3.1 Width - The vertical pattern width at the -6 dB points shall be at least 18 degrees and not more than 23 degrees.

3.5.1.4.1.4.5.3.2 Side Lobe - The maximum amplitude of the side lobe shall be -14 dB.

3.5.1.4.1.4.5.3.3 Response - The maximum response within 10 degrees of the vertical shall be no more than -30 dB.

3.5.1.4.1.4.5.3.4 Vertical Rejection - The maximum response at the vertical shall be no more than -35 dB at 10.00 kHz and -30 dB at 9.25 kHz and 10.75 kHz.

3.5.1.4.1.4.5.4 Directivity Index

3.5.1.4.1.4.5.4.1 Sum Beam - The directivity index of the sum beam shall not be less than 16 dB.

3.5.1.4.1.4.5.4.2 Half Pattern - The directivity index of the half pattern shall be not less than 15 dB.

3.5.1.4.1.4.5.4.3 Stave Pattern - The directivity index of the stave pattern shall be not less than 9 dB.

3.5.1.4.1.4.5.5 Stiffness Ratio - See MIL-D-81622A(AS) Addendum 1.

3.5.1.4.1.5 Preamplifier Assembly

*3.5.1.4.1.5.1 Contents - The preamplifier assembly shall form an integral part of the transducer and shall consist of 16 gain controlled preamplifiers, 16 beamforming networks, 16 output amplifiers, a time varied gain control circuit, and a BITE switching logic circuit.

3.5.1.4.1.5.1.1 Preamplifiers - There shall be one preamplifier for each stave. It shall have the following characteristics:

3.5.1.4.1.5.1.1.1 Sensitivity - The preamplifier equivalent input noise shall be less than -124 dBV across an input terminating impedance of a 3900 pf capacitor in series with a 65 ohm resistor. This noise level shall apply in the equivalent of a 4700 Hertz rectangular bandwidth centered at 10,000 Hertz.

3.5.1.4.1.5.1.1.2 Voltage Gain shall be 75 ±0.2 dB at 10 kHz.

3.5.1.4.1.5.1.1.3 The Dynamic Range shall be a minimum of 50 dB at a maximum preamplifier gain (zero TVG attenuation).

3.5.1.4.1.5.1.1.4 The Bandwidth shall be approximately 3 kHz.

3.5.1.4.1.5.1.1.5 Gain Control - The preamplifiers shall include a gain control circuit capable of attenuating the preamplifier gain by at least 50 dB. Control of attenuation shall be effected by a control voltage furnished by the TVG circuit in the Control, Detecting-Ranging Set.

*3.5.1.4.1.5.1.1.6 Shunting and Shorting Circuits - The preamplifier shall include a shunting and a shorting network for BITE operation.

3.5.1.4.1.5.1.2 Beamforming Networks shall be employed to form 16 half beams. Beamforming network loss for any half beam shall not exceed -20 dB.

3.5.1.4.1.5.1.3 Output Amplifiers shall have a gain of 30 dB exclusive of the beamforming losses. It shall be capable of driving the converter-mixer utilizing 500 feet of cable and associated wiring.

3.5.1.4.1.5.1.4 TVG Networks - The time varied gain shaping circuit shall produce a gain versus time characteristic which will produce essentially a constant output to an echo from a constant target strength, target at any range between approximately 100 yards to 1500 yards. In the voice communication mode these circuits are employed to provide additional receiver gain control by adjustment of the listen gain control.

3.5.1.4.1.5.1.5 BITE Switching Logic - The input shall consist of an ac signal superimposed on dc control voltages. The BITE switching logic output shall provide: (1) Signals for testing open or shorted staves; (2) control signal for compass north slewing; and (3) inject pre-amplifier signal for checking phase and minimum detectable signal of the system.

*3.5.1.4.1.5.1.6 Test Points - The TVG assembly shall contain the following test points.

Reference Designation	Location	Function
Q3033	Top mounting plate TVG assembly	Collector of Q3033
TVG In	Top mounting plate TVG assembly	TVG driver input
TVG Out	Top mounting plate TVG assembly	TVG driver output to preamps
TVG +30	Top mounting plate TVG assembly	30V input for TVG

3.5.1.4.1.6 Temperature Sensing Element - A temperature probe in the top of the hydrophone assembly shall provide information used to indicate the temperature of the water surrounding the Transducer, Sonar. It shall operate in conjunction with the circuits in the Control, Detecting-Ranging Set to indicate temperature from +25°F to +95°F. The thermal time constant of the sensor shall be no greater than 200 milliseconds for 63 percent of a temperature change in water flowing at a 3 feet per second rate. The temperature sensor shall be capable of an accuracy of ±0.6 degree F through the temperature range of 32 degrees F through 100 degrees F.

3.5.1.4.2 Projector, Sonar - The Projector, Sonar shall meet the following requirements.

3.5.1.4.2.1 Form Factor - The maximum dimensions of the projector shall be 7.82 inches in diameter and 26.1 inches in length.

*3.5.1.4.2.2 Weight - The weight of the projector shall not exceed 50.8 pounds.

3.5.1.4.2.3 Projector - Transmitting projector with matching transformer.

3.5.1.4.2.3.1 Elements - Transmitting elements shall be barium titanate cylinders.

3.5.1.4.2.3.2 Azimuth Pattern - The azimuth pattern shall be omnidirectional within ±1.5 dB.

3.5.1.4.2.3.3 Vertical Pattern

3.5.1.4.2.3.3.1 The width of the main lobe at the -6 dB points shall be 18 to 25 degrees.

3.5.1.4.2.3.3.2 The side lobe amplitude shall not exceed -9 dB.

3.5.1.4.2.3.3.3 The directivity index shall be not less than 7.5 dB.

3.5.1.4.2.3.4 Efficiency - The efficiency shall be not less than 35 percent including losses in matching transformer for each of the three operating frequencies.

3.5.1.4.2.3.5 Power Input - The transmitting projector and matching transformer shall be capable of accepting an electrical input of 10 kilowatts.

3.5.1.4.2.3.6 Impedance - The transmitting projector and matching transformer shall present a primary impedance of 25, -5, +4 ohms and a phase angle not exceeding ±20 degrees at 10 kHz.

*3.5.1.4.2.4 Fluxgate Compass - A fluxgate magnetic compass shall be mounted in the transducer assembly to provide a bearing signal output from the transducer assembly with a deviation error no greater than ±1 degree when the transducer assembly is vertical. It shall be capable of driving a servo system to position remote equipment to an accuracy of ±1 degree. In addition, a north slewing signal shall be provided to cause the fluxgate compass to slave to the north position to eliminate variations in the sweep bearing axis due to transducer rotation. The north signal shall not be present in BITE test position MDS (SEA).

3.5.1.4.2.5 Depth Sensing Element

3.5.1.4.2.5.1 A pressure sensitive element to indicate sea water depth of the Transducer, Sonar shall be provided. In combination with the cable out measuring device specified elsewhere, this element shall present height information for the helicopter autopilot, as well as depth to the sonar operator and a recorder. The depth element shall be shock isolated from the projector to insure proper operation during transmit. The depth sensing element shall have the following characteristics:

3.5.1.4.2.5.1.1 The range of the element shall be 0 to 500 feet of sea water.

3.5.1.4.2.5.1.2 The accuracy of the element shall be ±4 feet of sea water including all errors.

3.5.1.4.2.5.1.3 The element shall be sensitive to a change of depth of 6 inches.

3.5.1.4.2.5.1.4 Any short circuit of the pressure element or any opening in the circuit shall be positively indicated to the pilot. In no case of failure or leakage of sea water into the element or leads shall an indication of increased height be displayed on the pilot's indicator.

3.5.1.5 Controls - No operating controls shall be located on or within the Transducer, Sonar.

3.5.1.6 Electrical Connections - The connection to external circuits shall be:

Reference Designation	Receptacle Type	Function
J7001	Special screw type, load supporting connector with a 28-21P insert and including "O" ring seal	To connect to sonar cable

3.5.1.7 Mounting - Attachment of the Cable, Sonar to the top end of the Transducer, Sonar shall be by means of a watertight connector utilizing an "O" ring seal.

3.5.1.8 Configuration - The envelope of the Transducer, Sonar shall consist of two cylinders of different sizes connected end to end.

3.5.1.9 Separation of Transducer Projector and Hydrophone - The Projector, Sonar and Hydrophone, Sonar shall be separate assemblies connected together by a waterproof electrical and mechanical connection. Each half shall be itself a watertight assembly. The transducer halves normally will be joined prior to installation in the aircraft. An index pin between the two halves shall insure correct orientation of fluxgate compass in projector assembly with the receiving array.

3.5.1.10 Impact Resistance

3.5.1.10.1 Water Entry - The transducer shall be capable of withstanding a water entry shock of 3 g both laterally and vertically.

3.5.1.10.2 Crash Loading - The transducer when stowed within the aircraft and suspended by its cable shall be capable of operating following shock loads of 6 g directed forward and downward and 3 g laterally. During crash conditions the transducer must withstand 10 g forward and downward and 5 g laterally without breaking away. The equipment may be non-operative thereafter. These loads are applied with the transducer in its stowed position and will apply at the point of attachment of the reeling machine to the airframe.

3.5.1.11 Hydrostatic Pressure - The transducer shall not leak when subjected to a hydrostatic pressure of 230 psi. All seals providing watertight integrity shall be not readily subject to damage by normal servicing conditions in the field and shall be replaceable by service personnel without special tools or equipment. The acoustic performance parameters in 3.5.1.4.1.4.1 through 3.5.1.4.1.4.4.4 shall be maintained as minimums throughout the range of depths down to 150 feet. The parameters in 3.5.1.4.1.4.5 through 3.5.1.4.1.4.5.5 shall be maintained as minimums throughout the range of depths from 150 to 500 feet.

3.5.1.12 Exterior Finish - The outer surface of the transducer shall be finished in a dark color and all parts exposed to sea water shall be suitable protected to prevent corrosion. Such protection shall be adequate for not less than 2000 hours of service.

3.5.1.13 Serviceability - It shall be possible to replace individual staves, transmitting projector, electronic components, and necessary devices in the field without excessive disassembly and without special tools whenever possible.

3.5.1.14 Interchangeability - The hydrophone staves, circuit boards in the preamplifier assembly, temperature sensing element, depth sensing element, and projector assembly shall be interchangeable without recalibration.

3.5.2 Converter, Frequency, Electronic CV-1823/AQS-13 - The Converter, Frequency, Electronic unit shall meet the following requirements.

3.5.2.1 Function - The frequency converter shall provide the general function of converting signal outputs of the Transducer, Sonar to the frequency and amplitude required for input to the Amplifier, Intermediate Frequency. The unit shall provide for remote switch selected operation at three input frequencies, beam selecting relays, and output IF filtering. These functions shall be provided in four sector outputs, each sector output consisting of a left and a right channel.

3.5.2.2 Form Factor - The maximum dimensions of the frequency converter shall be 7.9 inches in height, 15.9 inches in width and 21.0 inches in depth.

3.5.2.3 Weight - The weight of the frequency converter shall not exceed 20.0 pounds.

3.5.2.4 Contents of Unit - The frequency converter shall contain the following assemblies, subassemblies.

(1) Relay Board Assembly
(2) Oscillator Assembly
(3) Input Filters and Mixer Assembly
(4) I.F. Filters and Output Amplifier Assembly.

3.5.2.4.1 Relay Board Assembly - Beam selection relays, controlled by the display stabilization and direction reception switches in the Control, Detecting-Ranging Set, shall provide the proper connection of Transducer, Sonar beam outputs to the Converter, Frequency, Electronic. This switching shall provide proper receiver input to coincide with the display orientation. Attenuators shall be provided for voice communication and a relay shall be included to provide single or multiple sector voice reception.

3.5.2.4.2 Oscillator Assembly - Crystal controlled local oscillator circuitry shall be provided to supply the mixer circuits with 90.75 kHz, 90.00 kHz, and 89.25 kHz. Frequency shall be relay selected by switching in the Control, Detecting-Ranging Set. Frequency tolerances shall be ±25 Hertz. Output voltage and impedance shall be as required to properly drive eight mixers.

3.5.2.4.3 Input Filters and Mixer Assembly - The frequency converter shall contain eight mixer channels. These circuits shall provide input filters at 10 kHz, ±1 kHz bandpass at the minus 1 dB points and ±1.5 kHz bandpass at the minus 3 dB points. The mixer circuits shall provide adequate cancellation of input and local oscillator frequencies. Output circuits of the mixer shall provide necessary driving impedance for the I.F. filters.

3.5.2.4.4 I.F. Filters and Output Amplifier Assembly - I.F. filters shall be included in the frequency converter output circuits. There shall be eight filters, one pair for each sector output. These filters, as applied in the system shall provide a receiver bandpass of at least 450 Hertz, to the minus 3 dB points, at a center frequency of 100 kHz ±10 Hz. Filter response shall be at least -50 dB at 99,250 ±25 Hz and 100,750 ±25 Hz points. Filters used in each sector output (left and right channel pair) shall phase track within 2 degrees over the bandpass of ±225 Hertz about the center frequency. Output amplifiers in the frequency converter unit shall provide the required I.F. filter termination impedance and provide a single ended low impedance output.

3.5.2.5 Controls - The frequency converter shall contain the following controls: (1) Mixer balance adjustments (8 circuits) - R1703, R1708, R1714, R1719, R1725, R1730, R1736, R1741; (2) Phase adjustment (4 sectors) - R1702, R1713, R1724, R1735.

3.5.2.6 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
J1801	MS3102E-18-1P	Power Input
J1802	MS3102E-28-15P An integral part of a contour cable	Signal Input

Reference Designation	Receptacle Type	Function
J1803	MS3102E-20-29P	Control Input
J1804	MS3102E-28-21P	Output Signals

3.5.2.7 Relative Channel Gain and Phase Tracking - See MIL-D-81622A(AS) Classified Supplement.

3.5.3 Amplifier, Intermediate Frequency, AM-4203A/AQS-13 - The Amplifier, Intermediate Frequency unit shall meet the following requirements:

3.5.3.1 Function - The Amplifier, Intermediate Frequency will receive eight signal inputs (4 sector pairs) from the Converter, Frequency, Electronic and compass information from the Transducer, Sonar. It will in turn supply the Control, Detecting-Ranging Set with required deflection, video, compass and audio signals. It will provide the transducer the required compass excitation. The Amplifier, Intermediate Frequency unit shall provide the receiver functions of intermediate frequency amplification, automatic gain control (AGC), phase comparison, range modulation, audio mixing, video amplification and detection, and 22.5 degrees limiting. Four receiver sector channels providing these functions shall be included. Recorder signal input and recorder pulse shaping circuit shall be provided.

3.5.3.2 Form Factor - The maximum dimensions of the I.F. Amplifier shall be 12.7 inches in height, 15.9 inches in width and 28.9 inches in depth, exclusive of the Mounting Base, MT-2201/AQS-10.

3.5.3.3 Weight - The weight of the I.F. Amplifier shall not exceed 46.9 pounds.

3.5.3.4 Contents of Unit - The I.F. Amplifier shall contain the following assemblies and subassemblies.

(1) I.F. Amplifier Assembly and AGC Assembly

(2) Phase Comparator Assembly (A and B)

(3) Video Control Assembly

(4) Audio Oscillator Assembly and Audio Mixer Assembly

(5) Compass Follower System

(6) Compass Frequency Divider Assembly

(7) Recorder Take-Off Assembly

3.5.3.4.1 I.F. Amplifier Assembly and AGC Assembly - The intermediate frequency amplifier circuitry in the I.F. Amplifier Unit shall provide a nominal zero AGC gain of 54 dB. Automatic gain circuits shall provide control of the I.F. Amplifier circuits. A minimum flatness factor of 20 to a continuous wave signal input of from -60 dB to 0 dB ref. 1 volt shall be provided. The I.F. AGC circuits shall handle a minimum dynamic range of input pulse signal (35 ms pulse) of 10 dB above a CW input of 0 dBV at one end of the AGC control range and 30 dB at -60 dBV CW input at the other. Output I.F. Amplifier amplitudes of each sector channel pair shall be within ±1.5 dB. Relative overall I.F. Amplifier phase shift, between channels of any one sector pair shall be ±1 degree over the above amplitude conditions and over the 100 kHz ±250 Hertz bandpass. A manual I.F. gain control (MGC) function will be provided for use in the Listen mode of system operation. This MGC function shall disable and replace the AGC control used during all other modes of operation. The MGC control range shall be 60 dB minimum. The effective AGC time constant to an increase or decrease in level shall be nominally 200 milliseconds. An AGC hold circuit shall be incorporated to restore I.F. Amplifier gain to the required dynamic operating level after completion of the transmit period. Each of the I.F. channels shall provide one left and one right signal for input to the phase comparator circuits, a summed output (left and right) for input to the audio mixer circuitry and a summed output for input to the video control circuits.

3.5.3.4.2 Phase Comparator Assembly (A and B) - Phase comparison circuits shall be incorporated in each sector receiver of the I.F. Amplifier unit. These phase comparator circuits shall provide the function of limiting, phase comparison, range modulation and stiffness ratio conversion. In addition, a phase difference signal will be supplied for use in the video control circuit. The limiter circuits of the phase comparator shall supply the phase comparator circuits with acceptable input levels over the input range of -40 dB to 0 dB input ref. 1 volt. Range modulation circuitry shall be provided by each of the four phase comparator channels to form the 45 degree sector segments of the display. Modulator output shall be proportional to sweep voltage input ±5 percent of the maximum value. Sector width shall be controlled by range modulation circuits to provide the electrical to mechanical bearing stiffness ratio dictated by the transducer specifications. The phase comparison circuitry provides a balanced DC output of the required impedance proportional in amplitude and polarity to electrical phase shift between the left and right channel inputs ±5 percent of full sector deflection when measured at maximum range modulation.

3.5.3.4.3 Video Control Assembly - Video output from the I.F. Amplifier-AGC circuits shall be amplified and detected in the video control circuits. A video output of +2.5 vdc, corresponding to an I.F. output of 30 mv rms shall be provided. The video circuit shall be capable of supplying outputs over the range of 0 to 30 vdc. The detector time constant shall not exceed 0.2 millisecond. The video control contains the MTI gate. The MTI gate shall be located directly after the video detector. It shall pass the video signal when a logic level less than +0.6 vdc is present at its control point, and shall inhibit the video signal when a

level greater than +7.0 vdc is present at its control point. The ON to OFF ratio of the MTI gate circuit shall exceed 40 dB. The 22.5 degree blanking threshold shall be contained in the video control circuit. This circuit shall provide a logic level greater than +7.4 vdc at its output when the AC difference signal from the phase comparator exceeds an amplitude proportional to 25.0 ±2.5 degrees mechanical bearing. For bearing less than this value, the logic level shall be less than +0.6 vdc. An interlock circuit shall be contained in the video control that allows the 22.5 degree blanking circuit output to control the MTI gate, when the interlock input is an open circuit. When the interlock input is greater than +15 vdc, the MTI gate shall be controlled only by the voltage at the MTI gate control point.

3.5.3.4.4 Audio Oscillator Assembly and Audio Mixer Assembly - Four audio beat frequency oscillators shall be incorporated to provide beat frequency oscillator inputs to the four audio mixer circuits. Oscillator frequencies shall be crystal controlled at 99.350 kHz, 99.000 kHz, 98.600 kHz, and 98.250 kHz for sectors 1, 2, 3, and 4, respectively. Frequency tolerance shall be ±25 Hz. Sector 1, 3, and 4 oscillator outputs shall be applied to their respective mixers in the ALL mode only. This ONE-ALL switching function shall be controlled remotely from the Control, Detecting-Ranging Set. No warm-up time shall be required for the oscillators during this ONE-ALL switching operation. Four audio mixer circuits shall be employed to convert the 100 kHz I.F. audio signal to the required four audio tones. Outputs of all audio mixer boards shall be summed in the proper impedance network for application to the audio gain control in the Control, Detecting-Ranging Set.

3.5.3.4.5 Compass Follower System - A servo receiver, frequency divider and amplifier shall be provided to operate from the Sonar Transducer's fluxgate compass. This servo loop shall position an indicator to visually read the Sonar Transducer's heading. This system shall also position a synchro-transmitter to drive the servo system of the Control, Detecting-Ranging Set's bearing servo package. These systems shall be capable of following transducer turn rates up to 15 degrees per second with a lag of no greater than 1 degree. Overshoot shall not exceed 3 degrees.

3.5.3.4.6 Compass Frequency Divider Assembly - The compass frequency divider shall utilize the 800 Hertz compass output component, be mixed with the 400 Hertz excitation and present a 400 Hertz output component to the compass follower system.

3.5.3.4.7 Recorder Take-Off Assembly - The Amplifier, Intermediate Frequency shall provide an output for the Recorder. The output circuitry shall be a full wave envelope type detector with an RC filter capable of smoothing the modulated envelope of short pulses (2-3 ms) so that ASPECT type highlights can be effectively passed to the recorder. The detector circuit shall receive a sum signal from sector two of the Amplifier, Intermediate Frequency. The time constant of the RC filter in the detector shall be variable with a switching circuit to permit selection of proper filter constants for reception of 3.5 and 35 ms pulses. A circuit for proper matching of the recorder detector circuit to the recorder input shall be incorporated at the output of the detector circuit.

3.5.3.5 Controls - The I.F. Amplifier shall contain the following internal controls, located on the top plate of their respective modules.

	Reference Symbol	Function
(1)	R1928	I.F. Amplifier Gain (8 channels)
(2)	L1901	I.F. Amplifier Phase Adjust (8 channels)
(3)	R2328	Video Output, I.F. sum (4 channels)
(4)	R2326	Audio Output, I.F. sum (4 channels)
(5)	R2331	AGC level (4 channels)
(6)	R2047	Servo Amplifier Phase Adjust
(7)	R2098	AC Balance (Frequency Divider)
(8)	L4501	Tuning Coil (4 channels)
(9)	R4524	22.5° Limiter (4 channels)
(10)	R4531	Sector Width (4 channels)
(11)	R4543	Phase Balance (4 channels)
(12)	R4545	AC Balance (4 channels)
(13)	R4552	DC Balance (4 channels)
(14)	L4601	Tuning Coil (4 channels)
(15)	R4617	AC Balance (4 channels)
(16)	R4639	DC Balance (4 channels)

3.5.3.6 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
J2001	MS3102R-22-14P	Power Input
J2002	MS3102E-28-15P	Output to Control Unit
J2003	MS3102R-18-1P	Power Output

Reference Designation	Receptacle Type	Function
J2004	MS3102R-28-21P	Converter Input
J2005	MS3102R-20-27P	Transducer Input
J2006	MS3112E-16-26P	Output to MTI

3.5.3.7 Test Jacks - The following test jacks shall be located on the top plate of their respective modules:

Reference Symbol	Function
J1903	I.F. Amplifier Input (8 channels)
J1901	I.F. Amplifier Output (8 channels)
J2301	I.F. Amplifier - AGC Output (4 left channels)
J2302	I.F. Amplifier - AGC Output (4 right channels)
J2303	I.F. Audio Output (4 channels)
J2304	I.F. Video Output (4 channels)
J2401	AGC Input (4 channels)
J2402	AGC Detector Input (4 channels)
J2403	AGC Detector Output (4 channels)
J2404	AGC Output (4 channels)
J2553	Video Output (4 channels)
J2554	DC Video Output (4 channels)
J2555	22.5 Degree Blanking (4 channels)
J4501	Input Signal (4 channels)
J4502	Clipper Tuning (4 channels)
J4503	Clipper Check (4 channels)
J4504	Filter Output (4 channels)
J4505	DC Out (4 channels)
J4506	22.5 Blanking Null (4 channels)

Reference Symbol	Function
J4601	Input Signal (4 channels)
J4602	Clipper Input (4 channels)
J4603	Clipper Check (4 channels)
J4604	AC Balance (4 channels)
J4605	AC Balance (4 channels)
J4606	DC Out (4 channels)
J4607	DC Balance Sweep Reference Injection (4 channels)

3.5.4 Control, Detecting-Ranging Set C-6413B/AQS-13 - The Control, Detecting-Ranging Set shall meet the applicable requirements of Specification MIL-C-6781 (per 3.2.5) for type II control panel, and MIL-P-7788 for plastic plate lighting.

*3.5.4.1 Function - The control unit, in addition to housing programming, control and indicator circuits, shall provide the sonar operator with a control panel to control the various functions and modes of operation of the AN/AQS-13A system and shall also provide the following indications:

(1) Transmitter True Power output

(2) Depth of transducer

(3) Water temperature at transducer depth

(4) DOME SEATED light to indicate when transducer is stowed.

3.5.4.2 Form Factor - Maximum dimensions of the control unit shall be 20.5 inches in height, 9.2 inches in width and 32.3 inches in depth, exclusive of the mounting base. It shall be mounted on a damped vibration isolator Mounting Base MT-2202/AQS-10, which also mounts the Indicator, Azimuth and Range IP-780/AQS-13.

3.5.4.3 Weight - The weight of the control unit shall not exceed 52.7 pounds. The weight ratio between the Control, Detecting-Ranging Set and the Indicator, Azimuth and Range shall not exceed 1.2:1.

3.5.4.4 Contents of Unit - The control unit shall contain the following assemblies, subassemblies:

(1) Timing and Timing Expand Assemblies

(2) Sweep Generator Assembly

(3) Relay Arching Circuit Assembly

(4) Bearing Servo System

(5) Power Indicator and Sweep Inverter Assembly

(6) Video Filters and Switching Assembly

(7) Range Handwheel Assembly

(8) Audio Amplifier, Water Entry, and Fail Safe Circuits Assembly

(9) Depth-Height System

(10) Dome Controls and Dome Seated Indicator

(11) Temperature Circuit Assembly

(12) Voice Communication Circuit Assembly

(13) Cable Angle Lockout Circuit and Intermediate Speed Control Assembly

3.5.4.4.1 Timing and Timing Expand Assemblies - The timing circuits shall program the necessary sequence of events to provide: automatic echo-ranging, handkey transmission (telegraphic signaling) with automatic return to receiving condition when handkey is raised, and a recurrent sweep. It shall provide proper switching for BT, ASPECT, and RANGING operations as selected by the Recorder.

3.5.4.4.1.1 Transmission Interlock - Adequate interlocking shall be provided to prevent transmission until all required switching to a transmitting condition has been completed.

3.5.4.4.1.2 Blanking and TVG Voltages - The timer shall provide proper blanking and TVG voltages.

3.5.4.4.1.3 Sweep Timing - The timer shall time the starting of the sweep zero to coincide with the leading edge of the transmit pulse, and shall return to the sweep at the end of the receive cycle.

3.5.4.4.1.4 Reception Direction Reversal - The timer shall control the necessary switching in the mixer and CRT display circuits to simultaneously reverse the direction of reception and display each successive reception cycle, when this mode of operation is selected by the proper operating controls.

3.5.4.1.5 Transmitter Keying - The timer shall provide and time the keying signals required by the transmitter. Selection of either a 3.5 millisecond ±15 percent or a 35 millisecond ±15 percent transmit pulse shall be provided by an operating control.

3.5.4.4.2 Sweep Generator Assembly - The sweep generator shall provide negative and positive going linear ramp voltages balanced in amplitude and linear to ±0.5 percent. Attenuators and/or time constant changes shall be provided for obtaining the necessary range scales of 1K, 3K, 8K, 12K and 20K yards.

3.5.4.4.2.1 Delayed Trigger - A delayed trigger shall be supplied which shall be activated at the reading on the range cursor readout. This function is required for the ASPECT mode as selected by the recorder.

3.5.4.4.3 Relay and Arching Circuit Assembly - A means of switching receiver video and bearing outputs, together with associated sweep signals, on command from the bearing stabilization system to maintain orientation of the displayed area with respect to true or magnetic bearings shall be provided. The arching circuit shall modify the sweep voltage signal by means of a notch which will reduce the deflection in proportion to range and bearing of the target to produce a four chord approximation of a 45 degree arc. This shall provide correction sufficient to maintain the overall range accuracy of the system at any bearing.

3.5.4.4.4 Bearing Servo System - A bearing servo system shall utilize an eight gang sine-cosine pot to give orientation control and to properly position the display orientation of one CRT gun with respect to the others. The servo system shall obtain its directional information from a fluxgate compass mounted in the transducer. The servo system shall rotate the sine-cosine pots in such a manner that target signals will appear at the proper magnetic bearing regardless of the position or rotation of the transducer. A manual control on the front panel of the Indicator, Azimuth and Range, shall be provided to insert the correction for magnetic variation, in which case the bearings of the targets shall be maintained as true bearings.

3.5.4.4.4.1 Bearing Stabilization Switching - A switching mechanism operated by the bearing servo mechanism in conjunction with the reception direction switch and an automatic direction control multivibrator in the programming circuits shall provide the following functions.

3.5.4.4.4.1.1 Display Reversal - Automatic reversal of the 180 degree sector displayed such that the north and south 180 degree sector will be displayed automatically on alternate sweeps when the DIRECTION RECEPTION switch is in the north position and the LISTEN sector switch is on ALL.

3.5.4.4.4.1.2 Switching - The switching mechanism shall generate control signals to the beam switching relays in the mixer and the receiver output switching relays in the control unit such that the 180 degree sector displayed on the CRT shall be maintained within 22.5 degrees of the setting selected by the reception direction switch.

*3.5.4.4.5 Power Indicator and Sweep Assembly - A power indicator shall be provided to show transmitter true power output level. The true power output shall be indicated continuously in all active modes. Calibration shall be in arbitrary units corresponding to 1000 watts full scale (low power) or 10,000 watts full scale (high power) as determined by the transmitter power command voltages.

3.5.4.4.6 Video Filters and Switching Assembly - The brightening pulse shall be passed through an envelope filter to improve the signal-to-noise ratio of this information. The time constant of the filter shall be selected to provide optimum presentation on the CRT. This time constant shall be switched to match the pulse length selected on the front panel. The filter shall possess a relatively long time constant to a positive going excursion and a very short time constant to a negative going excursion. The time constant to a positive excursion shall be approximately 35 milliseconds for the long pulse and approximately 3.5 milliseconds for the short pulse. The time constant to a negative excursion shall not exceed 1 millisecond in long pulse operation and 400 microseconds in short pulse.

3.5.4.4.6.1 The 22.5 degree blanking gates shall electrically follow the video filters, and shall be contained on the same circuit board as the video filters. These gates shall inhibit all signals when a logic level greater than +7.4 vdc is present at their control points, and shall pass signals when a logic level less than +0.6 vdc is present at their control points. The ON to OFF ratio of these gates shall exceed 40 dB.

3.5.4.4.7 Range Handwheel Assembly - The range handwheel assembly shall operate in conjunction with a range cursor system to generate a range cursor signal manually adjustable in range. A two-speed servo system operated by the range handwheel will provide the servo signal to position the range indicator on the indicator unit and on a remote range and bearing indicator. A range signal when processed by the range and bearing circuitry shall accurately position the cursor at the corresponding range on the cathode ray display. Range setting information will also be supplied to properly position the delayed trigger.

3.5.4.4.8 Audio Amplifier, Water Entry and Fail Safe Circuits Assembly - The audio amplifier shall be capable of at least 0.5 watt into a 250 ohm load. The output shall be transformer coupled with an ungrounded output winding. The frequency response between 200 and 3000 Hertz shall be within 3 dB. Gain shall be at least 50 dB. An audio gain control shall be provided. The audio gain control to be located on the front panel of the control unit. Audio gain control shall provide capability

or adjusting the output level over a range of 40 dB. The dynamic range of the amplifier shall be at least 50 dB. Distortion shall be less than 10 percent at 500 milliwatts output. Hum and noise shall be at least 50 dB below maximum signal output. The water entry circuit shall receive information from the depth sensing element and shall close a set of relay contacts that control a remote indicator light on the pilot's panel. Another set of contacts shall be provided to interlock the transmitter pulse so that transmission at high power will not occur until the projector is submerged between 5 and 15 feet of depth. The fail safe circuit shall inhibit the height signal in the event of a current change of at least +90 percent or -45 percent of the nominal 10 mA flowing for the depth and payout potentiometer excitation.

3.5.4.4.9 Depth-Height System - The depth-height circuitry shall provide DC excitation voltages stable within 1 percent, to the depth sensing and cable payout elements:

(1) Depth information to the depth meter, the intermediate speed control circuit, the recorder, and the water entry circuits.

(2) A difference voltage representing aircraft height.

(3) A 400 Hertz AC signal whose amplitude is equal to 60 millivolts per foot of height input signal, as received from the depth and cable payout devices, to within 2.5 percent of full cable length and whose phase is within 10 degrees of a reference phase supplied by the automatic hover equipment.

3.5.4.4.10 Dome Controls and Dome Seated Indicator - In addition to controls for operation of the Reeling Machine, Cable, Hydraulic, an indicator light shall be provided to indicate when the Transducer, Sonar is seated.

3.5.4.4.11 Temperature Circuit Assembly - Temperature circuits shall be employed to function in conjunction with the temperature probe located on the hydrophone. The temperature circuits shall provide a DC output for a temperature meter on the Control, Detecting-Ranging Set and a DC output pulse to the Recorder.

3.5.4.4.12 Voice Communication Circuit Assembly - The voice communication circuitry shall include all functions necessary to provide:

(1) Switching from CW to voice communications and from transmit to receive in voice communication mode.

(2) Filtering to provide a nominal 3 kHz upper sideband width using the same filters for both transmit and receive.

(3) An 8.0875 kHz carrier and local oscillator using the same circuit for both.

(4) A balanced modulator which will also demodulate the received signal.

(5) Automatic speech compression circuit for use in the transmit mode.

(6) A listen gain control circuit which will also control hydrophone preamplifier gain through the TVG circuit.

3.5.4.4.13 Cable Angle Lockout Circuit and Intermediate Speed Control Assembly

3.5.4.4.13.1 Cable Angle Lockout Circuit - The cable angle lockout circuit shall energize a relay when the reeling machine Raise/Lower switch located on the control unit is released from the raise position. The relay energize time shall be less than 100 ms after release of reeling machine raise switch. The relay shall remain energized for 6 +2 seconds after release of the Raise/Lower switch. The relay contact rating shall be 2.0 amps maximum for a resistive load at 28 VDC.

3.5.4.4.13.2 Intermediate Speed Control Circuit - The intermediate speed raise circuit shall energize the intermediate speed solenoid valve on the Reeling Machine, Cable, Hydraulic by sensing the depth voltage from the Projector, Sonar when the Raise/Lower switch is energized in the raise position. The circuit will energize the valve for depth signals greater than 40 +10 feet. This circuit shall be operative in the STANDBY and ON power modes. Provision for an external lockout switch to allow optional high speed raise shall be provided.

3.5.4.5 Controls - All controls necessary for normal operation shall be located on the front panel of the Control Detecting-Ranging Set or the Indicator, Azimuth and Range, except for the Recorder. The controls required for operation of the Recorder shall be located on a separate panel of the Recorder itself.

3.5.4.5.1 Front Panel Controls (Operational) - The control unit shall have the following operational controls on the front panel:

(1) Sound Velocity/Temperature

(2) Power

(3) Frequency

(4) Dome Controls

A. Raise/Lower

B. Seat

(5) Panel Dim

(6) Knots Threshold

(7) Range Kiloyards

(8) Range Handcrank

(9) Listen Gain

(10) Video Gain

(11) Audio Gain

(12) Operation Selector

(13) Listen Sector

(14) Reception Direction

(15) Doppler UP/BOTH/DOWN

(16) MTI ON/OFF

3.5.4.5.1.1 Sound Vel/Temp - A control, the readout of which is graduated in units of temperature from 30 degrees F to 100 degrees F, shall be provided to permit the operator to set the slope of the sweep ramp to correct for the existing water temperature, using a mean salinity of 34 parts per thousand. This control (2nd deck) shall also furnish sound velocity correction to the Recorder. Control panel calibration marks shall be provided at 25 degrees, 54 degrees, and 100 degrees fahrenheit.

3.5.4.5.1.2 Power - The power switch shall control the primary power to the system. It shall have three positions: OFF, STANDBY, and ON. The OFF position shall disconnect all power inputs from the AN/AQS-13A equipment except the cable guillotine, AC drift sensing and depth-height system for the automatic hover system. The STANDBY position shall provide power to those circuits specified in 3.3.13.

3.5.4.5.1.3 Frequency - The frequency selector switch shall be a three position switch to simultaneously switch the transmitter and receiver frequencies to any one of the three available operating frequencies. The positions shall be labeled 1, 2, and 3 for 9.25, 10.0 and 10.75 kHz, respectively.

3.5.4.5.1.4 Dome Controls - The following shall be provided:

(1) Dome Control Raise/Lower

(2) Dome Control Seat

3.5.4.5.1.4.1 Dome Control Raise/Lower - Shall provide control to the reeling machine. It shall be a three position toggle-type switch with spring return to center OFF position.

3.5.4.5.1.4.2 Dome Control Seat Switch - The dome control seat switch shall be a pushbutton that will energize the reeling machine which will reel in the cable from the trail position to the seated position. A dome seat indicator lamp shall indicate when the transducer is seated.

3.5.4.5.1.5 Panel Lite Dim - Shall provide a continuous control of panel illumination intensity.

3.5.4.5.1.6 Knots Threshold - The knots threshold control shall be a potentiometer to control the signal level required to open the MTI gate.

3.5.4.5.1.7 Range Kiloyards Switch - Shall be provided to select the five operating ranges of the equipment. They shall be 1 kiloyard, 3 kiloyards, 8 kiloyards, 12 kiloyards, and 20 kiloyards.

3.5.4.5.1.8 Range Handcrank - Shall simultaneously control a synchro generator to position the range indicators, a five turn potentiometer for the delayed trigger circuitry, and a five turn potentiometer to position the range setting of the cursor on the sonar display cathode ray tube.

3.5.4.5.1.9 Listen Gain - A manual control of the I.F. gain shall be provided when the operation selector switch is in the LISTEN position. This control shall also vary the preamplifier and the UQC receiver gain during voice communication mode.

3.5.4.5.1.10 Video Gain - Shall be a four gang potentiometer which shall simultaneously vary the video gain of the four receivers, to provide an adjustment of the brightness of the target presentation on the CRT.

3.5.4.5.1.11 Audio Gain Control - Shall provide control over the audio output signal level.

*3.5.4.5.1.12 Operation Selector Switch - Shall be a five position, nine pole switch to provide the following operational conditions:

(1) Test shall provide means of operating the system in the echo-range long pulse mode, and operating the transmitter at reduced power into the projector.

(2) Communicate position shall provide handkey control of the transmitter, at reduced power for telegraphic signaling. The receiver shall provide audio response for received signals when the handkey is in the UP position. This position is also used for voice communication.

(3) Listen position shall provide passive reception and display of signals from the transducer.

(4) Echo-Range Short Pulse shall provide normal echo-ranging mode with 3.5 millisecond transmit pulse and shall switch the video envelope filters to the short time constant.

(5) Echo-Range Long Pulse shall provide normal echo-ranging mode with a 35 millisecond transmit pulse and shall switch the video envelope filter to the long time constant.

3.5.4.5.1.13 Listen Sector - It shall be a two position switch. In position ALL, it shall permit simultaneous presentation of the audio signals from all four sectors to the audio amplifier and from four channels to the voice communication circuitry. In position ONE, only the audio signal and the voice communication signal associated with the second displayed sector (counting in a clockwise direction) shall be contained in the audio output. Automatic reversal of the display shall also be disabled in the ONE position.

3.5.4.5.1.14 Reception Direction - Shall be a special 8 position, 45 degree detent, 360 degree rotation switch which, operating in conjunction with the servo mechanism switch, shall produce the relay switching codes for controlling the beam switching, and receiver output switching to permit the operator to select for viewing and/or listening any 180 degree section in 45 degree steps. Reversal of the displayed area shall be disabled in all positions of the reception direction switch except north. The display will alternately reverse when the reception direction switch is in the north position and the listen sector switch is in the ALL position.

3.5.4.5.1.15 Doppler UP/BOTH/DOWN - The doppler switch shall be used to determine if the moving target doppler is up or down. The doppler switch shall be spring loaded to remain in the center or BOTH position.

3.5.4.5.1.16 MTI ON/OFF - The MTI switch shall be a two-position toggle switch. The OFF position shall allow operation of AN/AQS-13A without MTI. The ON position shall place the AN/AQS-13A in the MTI mode.

3.5.4.5.2 Non-Operational Controls - The following screwdriver controls shall be located in the control unit:

Identification	Location	Function
R1005	Test panel - front panel	Sweep time calibration
R504	Power Indicator and Sweep Plug-In	Negative sweep zero
R501	Power Indicator and Sweep Plug-In	Delayed trigger calibration
R529	Power Indicator and Sweep Plug-In	Sweep balance
R519	Power Indicator and Sweep Plug-In	Positive sweep amplitude
R807	Depth-Height	Reference supply voltage adjust
R875	Audio-Water Entry Plug-In	Height calibration
R1011	Temperature plug-in	Recorder calibration adjust
R1040	Temperature plug-in	Frequency adjust
R1053	Temperature plug-in	Balance adjust
R1064	Temperature plug-in	Meter calibration adjust
R1069	Temperature plug-in	Gain control

3.5.4.6 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
J1051	MS3102R-28-12P	Power input
J1052	MS3102R-28-15P	Signal inputs
J1053	MS3102R-28-15S	Signal outputs to indicator
J1054	MS3102R-24-28P	Filament input and miscellaneous outputs to indicator

Reference Designation	Receptacle Type	Function
J1055	MS3102R-20-29S	Miscellaneous and control circuits to mixer
J1056	MS3102R-14S-6S	Audio output and handkey
J1057	MS3102R-20-29SW	Miscellaneous control circuits to mixer
J1058	MS3102R-20-29P	Miscellaneous and control circuits to reeling machine
J1060	MS3122E-20-41S	Recorder signals
J1064	MS3122E-16-26S	MTI inputs and outputs

3.5.4.7 Test Jacks - The control unit shall contain the following test jacks:

Reference Designation	Location	Function
J1011	Front Panel Test Panel	Audio output
J1002	Front Panel Test Panel	Ground
J1003	Front Panel Test Panel	Main trigger
J1004	Front Panel Test Panel	Composite timing waveform
J1005	Front Panel Test Panel	Positive sweep
J201	Timing Plug-in Module	+16 volt supply
J202	Timing Plug-in Module	-3 volt supply
J203	Timing Plug-in Module	Ground
J204	Timing Plug-in Module	Main sweep multivibrator
J205	Timing Plug-in Module	Delayed trigger
J206	Timing Plug-in Module	Delayed trigger multivibrator
J207	Timing Plug-in Module	Direction multivibrator
J208	Timing Plug-in Module	+85 volt supply

Reference Designation	Location	Function
J251	Timing Plug-in Module	Main trigger
J252	Timing Plug-in Module	Transmit-receiver multivibrator
J253	Timing Plug-in Module	Delay multivibrator
J254	Timing Plug-in Module	Transmit multivibrator
J801	Depth Height Amp	Reference supply negative
J802	Depth Height Amp	Reference supply positive
J803	Depth Height Amp	Fail safe output
J804	Depth Height Amp	Ground
J805	Depth Height Amp	Height signal input
J806	Depth Height Amp	Depth
J807	Depth Height Amp	Height output
J851	Audio, Water Entry and Fail Safe Plug-in	Audio input
J852	Audio, Water Entry and Fail Safe Plug-in	Audio output
J853	Audio Amp-Water Entry and Fail Safe	Height input
J854	Audio Amp-Water Entry and Fail Safe	AC out
J855	Audio Amp-Water Entry and Fail Safe	AC out
J1006	Front Panel Test Panel	Negative sweep
J1007	Front Panel Test Panel	Transmit pulse used for sync to target simulator
J1020	Temperature Board	Temperature sweep test point

Reference Designation	Location	Function
J1021	Temperature Board	Amplitude and null
J1022	Temperature Board	Temperature output pulse
J1023	Temperature Board	4 kHz test
J2556	Channel 1	Video Out
J2557	Channel 2	Video Out
J2558	Channel 3	Video Out
J2559	Channel 4	Video Out

3.5.4.8 Ventilation - A blower shall be provided to exhaust warm air from the control unit.

3.5.5 Indicator, Azimuth and Range IP-780/AQS-13 - The Indicator, Azimuth and Range unit shall meet the applicable requirements of Specification MIL-C-6781 (per 3.2.5) for type II control panels, and MIL-P-7788 for plastic plate lighting.

3.5.5.1 Function - The indicator unit shall contain the sonar display cathode ray tube with its associated excitation power supplies, controls and deflection amplifiers. It also shall contain the cursor range and bearing indicator.

3.5.5.2 Form Factor - The maximum dimensions of the indicator unit shall be 20.5 inches in height, 9.4 inches in width and 32.3 inches in depth exclusive of the mounting base. It shall be mounted on a damped vibration isolator Mounting Base MT-2202/AQS-10, which also mounts the Control, Detecting-Ranging Set C-6413B/AQS-13.

*3.5.5.3 Weight - The weight of the indicator unit shall not exceed 52.0 pounds. The weight ratio between the Indicator Azimuth and Range and the Control, Detecting-Ranging Set shall not exceed 1.2:1.

*3.5.5.4 Contents of Unit - The indicator unit shall contain the following assemblies, subassemblies:

(1) Cathode Ray Tube Display

(2) Cursor Range and Bearing Indicator

(3) Bearing Handwheel Assembly

(4) Deflection Amplifiers

(5) High Voltage Power Supplies

(6) Brightening Carrier Oscillator, Modulator, and Control

(7) Cursor Circle Generator

(8) BITE Indicator and Cursor Control Panel

(9) Variable Cursor Intensity Assembly

(10) Timing and Control Assembly (for BITE)

(11) MDS (minimum detectable signal) Assembly (for BITE)

(12) Line Driver Assembly (for BITE)

(13) CRT Overlay (for BITE)

3.5.5.4.1 Cathode Ray Tube Display - The cathode ray tube display system shall employ a five gun, 7 inch cathode ray tube with a long persistence screen. Each of four guns will display a 45 degree sector with signals from one receiver in such a manner that four receivers and four guns will display four adjacent 45 degree sectors to form a 180 degree sector display. The fifth gun shall be employed to display a cursor consisting of a circle of approximately 1/4 inch diameter whose position on the display tube can be controlled in azimuth by the bearing handcrank, its azimuth position indicated by the bearing indicator and its range position controlled by the range handwheel and indicated by the range indicator in such a manner that when the cursor circle is placed around the target on the display, the range and bearing indicator will indicate the range and bearing of the target. Automatic switching will provide a complete 360 degree coverage in two successive sweeps. A circular polarized filter shall be mounted over the face of the CRT to reduce reflected light.

3.5.5.4.2 Range and Bearing Indicator Assembly - This unit shall be mounted on the front panel of the indicator unit. It shall contain the following subassemblies and functions:

(1) Synchro Repeater Indicator to indicate the position of the cursor sine-cosine potentiometer and synchro generator, in the bearing handwheel assembly, in degrees.

(2) A Two-Speed Servo System to position a five digit counter to repeat and indicate the position of the range handwheel assembly. The readout shall be in yards.

(3) A Manual Control and indicator to permit manual insertion of magnetic variation in order that the bearing stabilization system will provide true bearings.

3.5.5.4.3 The Bearing Handwheel Assembly - The assembly shall consist of the bearing handwheel, a gear train, a synchro generator and a sine-cosine potentiometer. The sine-cosine potentiometer circuitry shall modify the range signal received from the range handwheel assembly in such a manner that the resulting signal will position the range and bearing cursor on the cathode ray tube. The synchro generator shall transmit the sine-cosine potentiometer position in such a manner that the bearing indicator will indicate the azimuth position of the range and bearing cursor.

3.5.5.4.4 Deflection Amplifiers - A deflection amplifier shall be provided for each set of plates of the five guns of the cathode ray tube. The deflection amplifier shall be DC coupled with push-pull output. It shall have differential inputs such that a signal to either input shall produce a push-pull output. The gain from either input to push-pull output shall be the same. The gain of the amplifiers shall be adjustable and sufficient to obtain a deflection of 3 inches on the cathode ray tube for an input of 10 volts to a deflection amplifier input. A centering control shall be provided to center the oscilloscope beam in the center of the display.

3.5.5.4.5 High Voltage Power Supply - This unit shall provide a regulated source of +3000 volts and -3000 volts ±150 volts to operate the cathode ray display tube. It shall contain the circuitry and controls for individual adjustment of intensity and focus for the five guns.

3.5.5.4.6 Brightening Carrier Oscillator and Modulators - A video coupling circuit to couple DC video and blanking signals from ground level to the -3000 volt operating level of the cathode ray tube grids shall be provided. It shall consist of the following:

(1) Oscillator and Amplifier

(2) Modulators

(3) Coupling Transformer

(4) Demodulator

3.5.5.4.6.1 Oscillator - An oscillator and amplifier shall be provided to supply a 60 volts peak-to-peak signal of 110 to 120 kHz to the grids of the four modulators. The oscillator shall be capable of being turned off by the blanking signal.

3.5.5.4.6.2 Modulators - There shall be four modulators, one for each sector. Each modulator shall receive the carrier frequency from the carrier oscillator amplifier, and a video signal from one receiver channel. A common cathode voltage control for all modulators shall determine the "threshold" output level of the modulator and serve as a simultaneous or common control of intensity for all four sectors.

3.5.5.4.6.3 Coupling - A coupling transformer insulated for high voltage shall couple the RF signal from the modulator plate circuit to the demodulator and grid circuit of the cathode ray tube.

3.5.5.4.6.4 Demodulator - The demodulator shall be a full wave voltage doubler and together with the modulator system shall be capable of providing a DC threshold level variable from a minimum not greater than 5 volts to a maximum of at least 15 volts. Signal inputs to the modulator shall be capable of producing demodulated signals of at least 20 volts above any threshold level.

3.5.5.4.7 Cursor - A cursor circle generator shall generate a signal which when applied to one input each of the cursor vertical and cursor horizontal deflection amplifiers shall display a circle on the cathode ray tube whose diameter is adjustable from 0 to at least 0.25 inch. A front panel intensity control shall be provided.

*3.5.5.4.8 BITE Indicator and Control Panel - A panel with operating controls for BITE, cursor intensity and a meter and light indicator shall be provided.

(1) BITE control shall consist of a coaxial rotary switch. The outer control shaft shall provide seven positions corresponding to 1) OFF, 2) STAVE, 3) RANGE AND BEARING, 4) MDS, 5) MDS (SEA), 6) LISTEN, and 7) AGC. The inner control shaft shall provide four positions providing selection to one of the four video channels. Whenever the sonar system is placed in the BITE mode and the OPERATION SELECTOR switch is not in TEST, the transmitter shall be inhibited.

(2) Cursor intensity control shall vary intensity of the CRT cursor.

(3) The meter shall incorporate a scale calibrated in dB and a green colored band to indicate acceptable system limits.

(4) An indicating light shall indicate IN-TEST whenever the BITE mode is employed.

3.5.5.4.9 Variable Cursor Intensity Assembly - A means to provide variable cursor intensity shall be employed. It shall permit the cursor to be used in various ambient light conditions. It shall be controlled by the sonar operator from a front panel control.

*3.5.5.4.10 Timing and Control Assembly - A means to provide preprogrammed BITE timing and control signals shall be employed. Timing shall be provided by 160,524 Hz crystal controlled clock oscillator divided to provide a 10,033 Hz sample signal. IN-TEST light and BITE control signals shall be provided.

*3.5.5.4.11 MDS Assembly - The MDS assembly shall provide a sample and hold circuit, filters for monitoring four video channels and meter scale circuitry to provide a low, medium and high range scale for the test level meter.

*3.5.5.4.12 Line Driver Assembly - The line driver shall provide a composite BITE signal consisting of an AC signal superimposed upon a DC level. Amplitude of the composite signal shall be selected by the test position of the BITE control switch.

*3.5.5.4.13 CRT Overlay - An overlay for the PPI cathode ray tube shall be provided as an integral part of the CRT bezel assembly. The overlay shall contain tolerance bands to facilitate performance verification of the STAVE, RANGE and BEARING tests.

*3.5.5.4.13.1 Starting at zero degrees (north), tolerance bands shall be centered at odd integer multiples of 11.25 degrees throughout 360 degrees. Each tolerance band shall consist of a left and right hand bracket separated by 11.25 degrees.

*3.5.5.4.13.2 The radial center of each tolerance band shall be located at a distance corresponding to 2.5 KYD's on the 3.0 KYD range scale. Each bracket shall have a radial height corresponding to 150 YD's on the 3.0 KYD range scale.

*3.5.5.5 Controls - The indicator unit shall contain the following operational controls:

Identification	Location	Function
BEARING	Front Panel	Controls azimuth position of cursor and bearing indicator.
VARIATION	Front Panel on Range and Bearing Indicator	Provides manual correction of magnetic variation.
INTENSITY	Front Panel behind hinged cover	Provides simultaneous adjustment of intensity of four sector guns.

Identification	Location	Function
FOCUS	Front Panel behind hinged cover	Provides simultaneous adjustment of focus of all five guns.
BITE	Front Panel	Selects BITE test functions of 1) STAVE, 2) RANGE & BEARING, 3) MDS, 4) MDS (SEA), 5) LISTEN, 6) AGC, and permits selective monitoring of video channels.
CURSOR INTENSITY	Front Panel	Provides adjustment of cursor intensity.

3.5.5.5.1 The azimuth and range indicator shall contain the following screwdriver adjustments.

Identification	Location	Function
R1209	H.V. Power Supply	Intensity control CRT gun No. 1
R1217	H.V. Power Supply	Intensity control CRT gun No. 2
R1226	H.V. Power Supply	Intensity control CRT gun No. 3
R1236	H.V. Power Supply	Intensity control CRT gun No. 4
R1240	H.V. Power Supply	Intensity control CRT gun No. 5
R1203	H.V. Power Supply	Focus control CRT gun No. 1
R1211	H.V. Power Supply	Focus control CRT gun No. 2
R1220	H.V. Power Supply	Focus control CRT gun No. 3
R1228	H.V. Power Supply	Focus control CRT gun No. 4

Identification	Location	Function
R1237	H.V. Power Supply	Focus control CRT gun No. 5
R1301	Cursor Plug-in Module	Positive range cursor calibration
R1302	Cursor Plug-in Module	Negative range cursor calibration
R1305	Cursor Plug-in Module	Cursor circle diameter adjustment

3.5.5.5.2 The following screwdriver adjustments shall be provided on each of the five deflection plug-in amplifiers:

Identification	Location	Function
R1108	Deflection amplifier plug-in	Vertical gain adjustment
R1111	Deflection amplifier plug-in	Horizontal gain adjustment
R1113	Deflection amplifier plug-in	Vertical centering adjustment
R1114	Deflection amplifier plug-in	Horizontal centering adjustment

3.5.5.6 Electrical Connections - Connection to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
J1451	MS3102A-24-28P	Power input
J1452	MS3102A-28-21S	Output to remote indicators
J1453	MS3102A-28-15P	Signal inputs (bearing, video, sweeps, etc.)
J1454	MS3102A-24-28S	Filament outputs, panel light input, servo signals

*3.5.5.7 Test Jacks - The azimuth and range indicator shall contain the following test jacks located on the top of their respective modules:

Reference Symbol	Function
J1101	-Up input
J1102	-Down input
J1103	-Right input
J1104	-Left input
J1105	+Down output
J1106	+Up output
J1107	+Right output
J1108	+Left output
J1151	Divided clock signal
J1152	Burst
J1153	Clock oscillator output
J3601	Buffer #1 output, S&H input
J3602	S&H output; TC input
J3603	TC output; Meter input
J3604	Gnd
J3501	BITE AC and DC Summing Point
J3502	BITE signal
J3503	Ground

*3.5.5.8 Ventilation - A blower shall be provided to exhaust warm air from the indicator unit.

3.5.6 Transmitter, Sonar T-982A/AQS-13 - The Transmitter, Sonar unit shall meet the following requirements:

*3.5.6.1 Function - The Transmitter, Sonar shall provide the electrical power to drive the Transducer, Sonar. Two output power levels, three operating frequencies, and two pulse widths shall be capable of selection from the Control, Detecting-Ranging Set front panel. The power level as well as the repetition rate shall be determined by the range selector. The transmitter shall also be handkey-controlled to emit CW pulses, of at least 10 percent of the full power output, for communications purposes. It shall also be capable of operation from an external signal source for voice communication purposes. The transmitter shall be capable of ASPECT transmissions controlled by the RO-358 Recorder. A true power monitor circuit (BITE) shall be provided to measure transmitter true power output for determining possible faults in the transmitter, projector, or cable.

3.5.6.2 Form Factor - The maximum dimensions of the transmitter shall be 8.2 inches in height, 16.7 inches in width and 26.5 inches in depth exclusive of the mounting base. It shall be mounted on a damped vibration isolator Mounting Base, MT-3335/AQS-13.

*3.5.6.3 Weight - The weight of the transmitter shall not exceed 78.3 pounds.

*3.5.6.4 Contents of Unit - The transmitter shall contain the following assemblies or circuits:

(1) Power Amplifier Circuits

(2) Power Supply

(3) Power Level Control and Logic Circuit

(4) Oscillator and Frequency Control

(5) Keying Circuits

(6) Overload Protection

(7) High Voltage Discharge Assembly

(8) True Power Monitor Circuit

(9) Squelch Assembly

3.5.6.4.1 Power Amplifier - The power amplifier shall be capable of operation as follows:

3.5.6.4.1.1 Output Characteristics - Two pulse lengths, of 3.5 milliseconds ±15 percent and 35 milliseconds ±15 percent, selectable by the Operation Selector Switch shall be provided at the output. The output shall also be capable of being handkey-controlled for communications purposes.

It shall be able to deliver CW pulses at a rate up to 50 characters a minute at 10 percent of full power output. It shall be capable of delivering pulse bursts of 2 to 7 milliseconds at full power for use with the recorder on ASPECT. It shall also be capable of single sideband operation in the voice communication mode.

3.5.6.4.1.2 Pulse Envelope - The output pulse shall have a rise time no greater than one millisecond and a fall time no greater than one millisecond. The total drop from leading edge to trailing edge of the pulse shall be no greater than 3 dB.

3.5.6.4.1.3 Power Output - The instantaneous RMS power output as measured at the mid-point of the pulse in time shall be greater than 5 KW into a resistive load of 25 ohms, at a line voltage of 115 volts rms. Short circuit protection shall be provided.

3.5.6.4.1.4 Pulse Rate - The output shall be capable of full power, at long or short pulse, on the 3K yard or longer range scales. It shall be capable of 10 percent of full power output, on long or short pulse, on the 1K yard scale.

3.5.6.4.1.5 Receive Mode - A device shall be operated, from the transmit-receive circuits in the control unit, to prevent spurious pulses or noise from entering the final amplifier assembly during the receive mode.

3.5.6.4.1.6 Indicators - An indicator device shall be employed to monitor the operation of the output amplifier. It shall indicate if any of the output transistors need replacement before there is any danger of a multiple failure.

3.5.6.4.2 Power Supply - The power supply shall provide all necessary voltages to the power amplifier, drivers, and oscillator. Capacitors shall be employed as energy storage devices in order to prevent severe overloading of the input power line during the transmit pulse. A device shall be employed to discharge these capacitors if the dust cover is removed. A suitable means shall be employed to normally charge and discharge these capacitors.

3.5.6.4.3 Power Level Control and Logic Circuit - A means to provide different levels of power shall be employed. The low power level shall be automatically selected on the 1K yard range scale, the communicate mode, and the test mode of operation. An interlock shall be provided to permit high power transmission only when the power supply has been switched from low to high voltage. The power supply shall be automatically returned to low voltage.

3.5.6.4.4 Frequency Control - Three frequencies shall be generated within the transmitter. They shall be 9.25, 10.0 and 10.75 kHz. Frequency stability shall be within ±25 Hertz. Selection of the operating frequency shall be made from a single switch located on the control unit.

3.5.6.4.5 Keying - The output of the transmitter shall be controlled by a pulse of the desired width from the keying circuits of the control unit. This pulse shall be injected at a low level stage of the transmitter to key the transmitter on and off.

3.5.6.4.6 Overload Protection - An overload protection circuit shall be employed to protect the transmitter against an overload condition in high power due to the load. This circuit shall be capable of self-test by the Sonar Operator at the transmitter front panel. It shall sense the overload condition and automatically disable the keying pulse. The circuit shall reset automatically.

3.5.6.4.7 High Voltage Discharge Assembly - A circuit shall be provided that discharges the transmitter capacitor bank within 60 seconds whenever transmitter power switch is turned off.

*3.5.6.4.8 True Power Monitor Circuit - A means of continuously monitoring the true power output of the transmitter shall be provided. This circuit shall have an output of 5 volts at full low or full high power (500 watts or 5 kilowatts). Both voltage and current sensing shall be employed to obtain a true power indication. The true power monitor circuit shall include an active divider, filters, and a sample and hold. The divider shall provide high-low power logic to the voltage and current sensing elements. The filters shall eliminate harmonic frequencies relative to the fundamental transmit frequencies. The sample and hold circuit shall provide continuous monitoring of the transmitter pulse.

*3.5.6.4.9 Squelch Assembly - A means shall be provided to squelch extraneous transmitter output resulting from oscillator leakage during the receive mode of operation.

3.5.6.5 Controls - The following controls or adjustments are provided on the transmitter:

3.5.6.5.1 Screwdriver Adjustments - These adjustments are on the overload protection assembly and the oscillator assembly.

Control	
R3351	Adjusts maximum power output
R3352	Adjusts low power output
R3328	Adjusts pulse amplitude
R3320	Adjusts protection level

3.5.6.5.2 Interlock - Interlock switch S3303 is provided to interrupt input power when the dust cover is removed. It shall provide interlock by-pass when manually actuated for test purposes.

3.5.6.5.3 Front Panel Switches - Three switches shall be mounted on the front panel. Once these switches have been set there is no further need for attention. They are primarily for installation checkout and test.

Switch Identification	Function
ON/OFF, 2 position	Controls primary power to unit. Would normally be left in ON position.
TEST-MAX. POWER, 2 position	In TEST position inserts resistance in series with load to test for short circuit. Normally in MAX. POWER position.
TEST-RESET, 3 positions	In the up, TEST, position, simulates an overload to test the overload circuit. In down, RESET, position, reapplies power if circuit should not reset automatically. Spring loaded to return to center position.

3.5.6.6 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
J3301	MS3102R-18-12P An integral part of an RF filter	Three phase input power for amplifiers
J3302	MS3102A-22-34S	Power output
J3303	MS3102A-20-29P	Controls circuits and blower power.

*3.5.6.7 Test Jacks - The transmitter shall contain the following test jacks:

Reference Designation	Location	Function
J3801	TPM and Osc Assy	Current Signal
J3802	TPM and Osc Assy	Voltage Signal
J3803	TPM and Osc Assy	Ground
J3804	TPM and Osc Assy	Sample Gate
J3805	TPM and Osc Assy	TPM Output

3.5.6.8 Ventilation - Blowers shall be provided to exhaust warm air from the transmitter.

3.5.7 Recorder RO-358/AQS-13A - The Recorder shall meet the following requirements:

3.5.7.1 Function - The recorder shall provide the following modes of operation:

3.5.7.1.1 Range Mode - In the range mode, the AN/AQS-13A Detecting-Ranging Set shall operate in normal echo ranging mode. Programmed command signals shall be provided to initiate the transmit cycle. Detected echo video pulses shall be impressed on the stylus to provide a permanent recording on the chart paper. The chart drive mechanism shall advance the chart 0.010 inch for each sweep of the stylus, providing visual integration of a continuous range recording. The selected range scale, transmit pulse width and sound velocity correction shall be controlled by the operating controls located on the Control, Detecting-Ranging Set. In the range mode a means shall be provided to indicate on the chart paper the range scale in use at the time the recording was made.

3.5.7.1.2 Bathythermograph Mode - The chart paper shall be calibrated in depth in feet, on its vertical axis and a dual temperature scale in degrees Fahrenheit on the horizontal axis. A means shall be provided to sense the chart position and compare this to the depth signal voltage received from the AN/AQS-13A Detecting-Ranging Set in a comparator circuit. The error signal shall drive the chart motor and thereby position the chart paper with respect to the depth of the Transducer, Sonar. The stylus will be driven at a constant speed of nominally three sweeps per second. A means shall be provided to indicate on the chart paper the BT scale in use.

*3.5.7.1.3 ASPECT Mode - The ASPECT mode shall employ the burst method of transmission. Provision shall be made to automatically switch the equipment into a modified expand sweep mode. In this mode the cursor controlled trigger determines the symmetrical transmit/receive cycle time when the cursor is placed at the target range.

*3.5.7.1.3.1 Transmit Cycle - During the transmit cycle the transmitter transmits a nominal 2.24, 4.48, or 6.72 millisecond pulse nominally every 368 milliseconds, as selected by the operator. The stylus motors are driven from variable frequency oscillators at a speed such that the stylus makes one sweep in nominally 368 milliseconds (i.e., one sweep for each transmitted pulse) when the range rate is zero. For other range rates one of the oscillators is shifted in frequency by the range rate control which changes the stylus speed to compensate for range rate and produces a vertical pattern on the chart paper in the receive mode.

3.5.7.1.3.2 Receive Cycle - During the receive cycle the sonar echoes from the Detecting-Ranging Set, Sonar AN/AQS-13A are amplified by the write amplifier and impressed on the stylus to print the classification pattern on the chart paper.

3.5.7.1.4 Self Test Mode - A self test mode, employing the ASPECT output signals, shall be provided. The ASPECT signals shall be automatically switched to the echo input of the recorder and all front panel controls shall remain fully operative when the mode selector switch is placed in the TEST position. ASPECT transmit signals shall be recorded on the chart paper for visual analysis of the associated electronic and mechanical functions.

*3.5.7.1.5 MAD Mode - In the MAD mode, input signals from the ASQ-81 shall control bi-directional movement of the recording stylus. Internally generated write pulses shall be impressed on the stylus to provide a permanent recording on the chart. The chart drive mechanism shall advance the chart at a nominal rate of 3.2 inches per minute providing a continuous recording of the MAD signal amplitude as a function of time.

*3.5.7.2 Form Factor - The recorder shall have a maximum width of 8.9 inches, a maximum height of 14.8 inches and maximum depth of 12.2 inches. The recorder shall have a door that opens sideways to provide access to the recorder magazine and a door that opens down to provide access to the recorder magazine 2A4.

*3.5.7.3 Weight - The weight of the recorder shall not exceed 29.0 pounds.

*3.5.7.4 Contents of Unit - The recorder shall contain the following removable subassemblies:

(1) Recorder magazine (2A4)

(2) Seven electronic plug-in printed wiring modules (2A5, 2A6, 2A7, 2A8, 2A9, 2A11, 2A12).

(3) One electronic plug-in power supply module (2A10)

3.5.7.4.1 Recorder Magazine - The recorder magazine shall contain the following features:

3.5.7.4.1.1 Chart Drive - The chart drive mechanism shall consist of a digital servomotor and enclosed gear train. Positioning of the chart paper shall be accomplished by transmitting torque through a sprocket drive roller.

*3.5.7.4.1.2 Spool Indexing - The chart paper shall be wrapped around two spools located at opposite ends of the magazine. One shall serve as a supply spool and the other as a take-up spool. The spools shall accommodate a 24-foot roll of 0.004 inch thick chart paper. A colored sprocket tooth and a white indexing dot, on the gear train, shall be provided for initial indexing of the chart paper.

3.5.7.4.1.3 Chart Paper - The recorder shall be designed to operate with chart paper which shall be a front grounded electrosensitive dry paper, 5.57 inches wide, having blue scales printed thereon. Driving holes shall be accurately positioned with respect to the scales to maintain system accuracy and to serve as a positive means of positioning the chart. The driving holes shall be utilized to synchronize the chart position potentiometer when operating in the BT mode.

3.5.7.4.1.3.1 Lateral Scale - The recorder shall be designed to operate with chart paper whose lateral scale shall be divided into 50 increments composed of 10 major divisions which are subdivided into 5 minor divisions each. The range scale shall extend from 0 to 100% and the dual temperature scale shall extend from 25 to 75 and 45 to 95. The temperature scale corresponding to one minor division per degree Fahrenheit shall be identified on the lateral scale.

3.5.7.4.1.3.2 Longitudinal Scale - The recorder shall be designed to operate with chart paper whose longitudinal scale is divided into 46 increments composed of 9 major divisions, each of which are subdivided into 5 minor divisions. The last major division shall be subdivided into 6 minor divisions, of which the last minor division is 0.002 inches shorter than the other minor divisions. This scale shall be repeated every four inches of the chart paper and shall be identified as extending from 0 to 460 feet and marked at 100 foot intervals of depth. Each chart shall be numbered consecutively, beginning with 1 and ending with 60 or greater.

3.5.7.4.1.3.3 Range Scale Index - A range scale index shall be printed along the right margin to indicate the scale of the recorded data. A BT HI/LO scale index shall also be printed on the right hand margin.

3.5.7.4.1.3.4 Start and End Markings - The word START shall be printed in bold letters at the beginning of each roll of chart paper in red ink and the word END shall be similarly printed near the end of each roll.

3.5.7.4.1.4 Stylus Drive - The stylus drive mechanism shall be coupled to two digital servo motors by means of an enclosed gear train.

*3.5.7.4.1.5 Stylus Assembly - The stylus assembly shall consist of three styli mounted on a common carrier. They are spaced so that one enters the chart area when another leaves the chart. Each stylus shall interrupt the light source at time of chart entry.

*3.5.7.4.1.6 Photo Cell and Light Source - A photo cell and light source shall be provided to initiate the timing sequence.

3.5.7.4.2 Electronic Assembly - The electronic assembly shall contain the following functional circuits:

3.5.7.4.2.1 Range Circuit - See MIL-D-81622A(AS) Addendum 1.

3.5.7.4.2.2 Bathythermograph Circuit - The graphical temperature output accuracy shall be within ±3% of full scale of the Detecting-Ranging Set, Sonar AN/AQS-13A input temperature pulse signal to the recorder. Temperature resolution shall be ±0.5 degree or better.

3.5.7.4.2.2.1 Depth Circuit - The graphical depth output shall be within ±3% of full scale of the Detecting-Ranging Set, Sonar AN/AQS-13A depth input signal to the recorder. Depth range shall be 0 to 450 feet and depth resolution shall be ±4 feet or better.

*3.5.7.4.2.3 ASPECT Circuit - Using the burst method of transmission the transmit key pulse length shall be 2.24, 4.48, or 6.72 milliseconds ±5% as determined by the front panel control. The pulse repetition rate shall have a nominal period of 368 milliseconds. Range rates of ±30 knots shall be accommodated.

*3.5.7.4.2.4 Chart Velocity - The chart paper shall advance at a constant rate of 3.2 ±0.2 inches per minute when the Recorder MODE selector switch is placed in the MAD position.

*3.5.7.4.2.5 Centering - When the Recorder MODE selector switch is placed in the MAD position and the MAD input is grounded, one of the three styli shall move across the chart paper with a speed equal to the 1 KYD range scale speed. When a new stylus appears at the left, it shall accelerate to the center of the chart corresponding to 50% on the range scale. Positional accuracy shall be within ±3% of full scale.

*3.5.7.4.2.5.1 Reference - A pushbutton switch shall be provided to advance a new stylus onto the chart paper while re-referencing the MAD servo loop.

*3.5.7.4.2.6 Positional Accuracy - During the MAD mode of operation the styli shall have a scale factor of 0.4 volt per minor scale division with zero volt corresponding to 50% on the range scale. Full scale shall be from -10.0 volts to +10.0 volts. Positional accuracy shall be within 0.6 volt.

*3.5.7.4.2.7 Slew Rate - The styli shall be capable of stepping rates from zero to 250 minor divisions per second.

*3.5.7.4.2.8 SAD - Whenever the SAD input exceeds -3.7 volts +0.4 volts the SAD indicator lamp shall light and the MAD tracing shall be intensity modulated for a nominal period of 1 second. The stylus shall be momentarily displaced -0.7 +0.3 volt at the start of the 1 second interval and +0.7 volt at the end of the 1 second interval. The SAD lamp shall remain on until it is extinguished by depressing the SAD light switch.

*3.5.7.4.3 Power Supply - The power supply module shall provide six regulated output voltages: 4.75 Vdc, 150 mA max; 5 Vdc, 2.0 A max; 14 Vdc, 2.5 A; +28 Vdc, 5A; +28 Vdc, 350 mA; -28 Vdc, 350 mA. The input voltage requirement of the power supply shall be 115/200 Vac rms, 3 phase, 400 Hertz.

*3.5.7.5 Controls - The recorder shall have the following operational controls on the front panel:

Identification	Location	Function
MODE	Front Panel	Select operating mode
LTG DIM	Front Panel	Panel light dimmer
CHART MOVE	Front Panel	Chart slewing up or down
RANGE RATE	Front Panel	Range rate
PULSE	Front Panel	Pulse length
CONTRAST	Front Panel	Contrast control
PATT SHIFT	Front Panel	Pattern shift
SAD	Front Panel	Indicate SAD pulse and extinguish light
REFERENCE	Front Panel	Reference MAD servo

*3.5.7.6 Non-Operational Controls - The following screwdriver controls shall be located in the recorder:

Identification	Location	Function
R1	2A2 Control Panel	Range rate control
R1	2A4 Magazine	BT chart position
A1	2A4 Magazine	Optical trigger
R38	2A6 Plug-in Assy	Write amplifier offset
R11	2A7 Plug-in Assy	BT time base frequency
R14	2A7 Plug-in Assy	Range time base frequency
R42	2A7 Plug-in Assy	Maximum slew rate
R28	2A8 Plug-in Assy	ASPECT time base frequency

*3.5.7.7 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
2J1	MS3122E-20-41P	Input and output
2J2	M81511/21ED01P1	MAD input output

*3.5.7.8 Test Jacks - The recorder unit shall contain the following test jacks:

Reference Designation	Location	Function
J1	Plug-in Board 2A5	Composite B1 Stylus Drive Signal
J2	Plug-in Board 2A5	Composite B2 Stylus Drive Signal
J3	Plug-in Board 2A5	Composite Chart Solenoid Drive Signal

Reference Designation	Location	Function
J1	Plug-in Board 2A6	Composite Chart Drive Signal
J2	Plug-in Board 2A6	Write Amplifier Output
J1	Plug-in Board 2A7	Signal Ground
J2	Plug-in Board 2A7	BT/Range Oscillator
J3	Plug-in Board 2A7	External Oscillator Input
J1	Plug-in Board 2A8	Range Rate Oscillator
J2	Plug-in Board 2A8	Optical Trigger
J1	Plug-in Board 2A9	Zero Mark
J2	Plug-in Board 2A9	Signal Ground
J3	Plug-in Board 2A9	+5 Counter Output
J4	Plug-in Board 2A9	Stylus Motor Select
J1	Plug-in Board 2A11	SAD Pulse
J2	Plug-in Board 2A11	Reset Pulse
J3	Plug-in Board 2A11	MAD Control
J4	Plug-in Board 2A11	Write Command
J1	Plug-in Board 2A12	VCO Input
J2	Plug-in Board 2A12	DAC Output
J3	Plug-in Board 2A12	VCO Output
J4	Plug-in Board 2A12	MAD Input
J5	Plug-in Board 2A12	5.00 V Ref.

3.5.8 Processor, Frequency FR-184/AQS-13A - The Processor, Frequency unit shall meet the following requirements:

3.5.8.1 Function - The Processor, Frequency shall gate the video signal in the Amplifier, Intermediate Frequency to allow display of video signals on the CRT of the Indicator, Azimuth and Range containing doppler signals greater than a variable preselected threshold setting during reverberation limited operation. The frequency processor shall establish the transmit frequency as the zero doppler reference frequency. At the end of the second ping after transmit turn-on or transmit frequency change, the zero doppler reference frequency shall be within 7 Hz of the transmit frequency. At the end of the third ping the zero doppler reference frequency shall be within 2 Hz of the transmit frequency. Throughout the ping interval or listening period (for a maximum period of 25 seconds), the zero doppler reference frequency shall not change more than ±2 Hz.

3.5.8.2 Form Factor - The maximum dimensions of the frequency processor shall be 18.1 inches in length, 5.1 inches in width and 7.7 inches in height.

3.5.8.3 Weight - The weight of the frequency processor shall not exceed 16.5 pounds.

3.5.8.4 Contents of Unit - The frequency processor shall contain the following non-repairable subassemblies:

		Quantity
(1)	90 kHz VCXO	4
(2)	Mixer	4
(3)	Phase line	4
(4)	Phase Comparator	4
(5)	Filter	4
(6)	Sample and Hold	4
(7)	Threshold Comparator	4
(8)	Threshold Reference	1
(9)	Timing Circuit	1
(10)	Power Supply	1

3.5.8.4.1 90 kHz VCXO - The 90 kHz VCXO shall provide a frequency output that is a function of the DC input voltage. For an input voltage of +10 Vdc the frequency shall be 90,075 kHz minimum. For an input voltage of -10 Vdc the frequency shall be 89,925 kHz maximum. The output voltage shall be nominally 5.0 volts peak-to-peak when loaded with 3900 ohms ±5%.

3.5.8.4.2 Mixer - The mixer shall heterodyne the 100 kHz I.F. signal with the signal from the 90 kHz VCXO signal derived from a 2000 ohm source. The output shall contain the difference frequency centered about 10 kHz with a level of 0.36 to 5.0 Vrms. The 100 kHz and 90 kHz frequency components shall be suppressed by 60 dB or more.

3.5.8.4.3 Phase Line - The DC input and output resistance shall be 4700 ohms ±5%. The phase line shall be a linear phase measuring device with the zero phase crossover at 10,050 ±20 Hz. The phase shift of the output referenced to the input shall be leading at the rate of 0.355 ±10% ±0.3 degree per 1.0 Hz below 10 kHz and shall be lagging at the rate of 0.335 ±10% ±0.3 degree per 1.0 Hz above 10 kHz.

3.5.8.4.4 Phase Comparator - The phase comparator shall detect the phase difference between the 10 kHz signal at the input of the phase line and 10 kHz signal at the output of the phase line. The phase comparator shall operate over an input signal amplitude range of 1.0 volt peak-to-peak to 17.0 volts peak-to-peak to provide a rectangular wave unloaded output of 14.1 volts peak-to-peak minimum. The phase symmetry of the output shall be an indication of the phase difference at the inputs. For a zero phase difference at the input, the output phase non-symmetry shall be 8.0 ±4 degrees.

3.5.8.4.5 Filter - The filter will derive its input from the output of the phase comparator. The output of the filter shall be a DC voltage proportional to the phase symmetry of the input rectangular waveform. The DC output shall be nominally 70 mV from 0° to 85° per degree of non-symmetry. The DC output for a symmetrical rectangular waveform (square wave) shall be 0.00 ±12.0 mV.

3.5.8.4.6 Sample and Hold Circuit - The sample and hold circuit samples the DC voltage upon command from the timing circuit at the output of the filter assembly and changes the frequency output of the 90 kHz VCXO. The sample and hold circuit shall be switched to the sample mode by application of 4.7 Vdc or more at its control point. When the circuit is in the sample mode, the output of the phase comparator shall be nulled by action of a closed servo loop consisting of the VCXO, phase line, phase comparator, and sample and hold circuit. The hold mode shall be initiated by application of +0.6 volt maximum at the circuit control point. The circuit offset voltage in the sample mode, referenced to the input, shall not exceed ±7.0 millivolts. In the hold mode the circuit shall be capable of holding the last voltage present at its output within ±6.3% ±150 millivolts for 10 minutes or more.

3.5.8.4.7 Threshold Comparator - The threshold comparator determines when the output of the filter is greater in amplitude than the reference voltage established by the knots threshold control. The accuracy of this comparison shall be ±1.85% ±2.66 mV (±0.39 knots). This condition shall be indicated by a logic output level of less than +0.6 Vdc; the opposite condition shall be indicated by a logic level of greater than +7 Vdc. Three logic controls shall be provided at the input to the threshold comparator.

3.5.8.4.8 Threshold Reference - The threshold reference circuit shall supply two outputs that vary from 0.0 to +6.0 Vdc and 0.0 to -6.0 Vdc to the threshold comparators. The two outputs shall track each other in amplitude and are adjustable. The range of calibration of each output shall be 0 to 30 knots, the accuracy of the volts to knots conversion factor shall be ±2.1% and the offset error with the potentiometer set to zero shall be ±0.012 Vdc. Each output shall be capable of driving four threshold comparators or an equivalent 500 ohm load.

3.5.8.4.9 Timing Circuit - The timing circuit provides the four sample and hold circuits with a sample command. The timing circuit shall provide an output pulse width of 10 milliseconds or greater and a minimum amplitude of 6.8 volts. The sample command occurs 6.0 ±3.0 milliseconds after the transmit initiate pulse, which is the trigger for the timing circuit. The timing circuit shall not respond to a pulse width less than 3 milliseconds in duration.

3.5.8.4.10 Power Supply - The power supply shall be a non-repairable, miniature dual output assembly. Each output shall be 15 ±5% Vdc at the maximum rated current of 1.0 ampere and fully isolated from any other circuit ground. The power supply shall have over voltage, over current, and over load protection. The input requirement of the supply shall be 115/200 Vrms, 400 Hz, 3-phase.

3.5.8.4.11 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
1J1	MS3112E18-32P	Input and output

3.5.8.4.12 Test Jacks - The Processor, Frequency shall contain the following test jacks:

Reference Symbol	Location	Function
TP1	Rear Panel	-15 VDC
TP2	Rear Panel	Common
TP3	Rear Panel	+15 VDC

Reference Symbol	Location	Function
TP1	Mixer Assy (A1)	Signal in
TP2	Mixer Assy (A1)	Signal out
TP1	Filter Assy (A4)	Signal in
TP2	Filter Assy (A4)	Doppler DC out
TP1	Threshold Comparator (A6)	MTI gate
TP1	Timing Assy (A21)	Timing in
TP2	Timing Assy (A21)	Delayed timing
TP1	Sample & Hold Assy (A5)	Timing in
TP2	Sample & Hold Assy (A5)	DC shift
TP1	90 kHz VCXO Assy (A2)	DC in
TP2	90 kHz VCXO Assy (A2)	Shifted 90 kHz out
TP1	Threshold Ref Assy (A14)	DC doppler in
TP2	Threshold Ref Assy (A14)	DC doppler out

3.5.9 Power Supply, PP-4196/AQS-13 - The Power Supply unit shall meet the following requirements:

3.5.9.1 Function - The power supply shall furnish regulated and unregulated DC voltages for the system. It shall also furnish an AC regulated voltage to the cursor circuits. Its input shall be 115V, 3-phase, 400 Hertz.

3.5.9.2 Form Factor - The maximum dimensions of the power supply shall be 10.1 inches in height, 10.7 inches in width and 29.2 inches in depth exclusive of the mounting base. It shall be mounted on a damped vibration isolator Mounting Base MT-2203/AQS-10.

3.5.9.3 Weight - The weight of the power supply shall not exceed 32.0 pounds.

3.5.9.4 Contents of Unit - The power supply shall contain the following assemblies and circuits:

(1) Unregulated DC supplies

(2) Regulated DC supplies

(3) Unregulated AC supplies

(4) Regulated AC supplies

(5) Control circuits

(6) Blower

(7) Metering circuits

(8) Test points

3.5.9.4.1 Unregulated DC Supplies - Two unregulated DC supply voltages shall be provided primarily for relay operation. These voltages shall be supplied in the Standby and ON mode of operation.

3.5.9.4.1.1 +85 Supply - An unregulated dc supply with a nominal voltage of +85 and a current capacity of 300 mA shall be provided.

3.5.9.4.1.2 +28 Supply - An unregulated dc supply with a nominal voltage of +28 and a current capacity of 4 amperes shall be provided.

3.5.9.4.2 Regulated DC Supplies - Twelve regulated DC supply voltages shall be supplied for operation of the system electronic circuits. Active feedback type regulators shall be used for all of these supplies except the +180 and the +47 volt supplies.

3.5.9.4.2.1 Voltage and Current Rating - The following voltages shall be supplied with the specified tolerances and maximum load currents shown:

Supply Voltage	Tolerance	Maximum Load Current
+500	±7.5V	85 mA
+200	±3.0V	150 mA
-200	±3.0V	100 mA
+180	±7V	58 mA
+107	+8 -2V	30 mA
+85	±2V	400 mA
+47	±4V	800 mA
+30	±1V	820 mA
-30	±1V	300 mA
+16	±1.0V	370 mA
+6	±0.5V	70 mA
-3	±0.25V	80 mA

3.5.9.4.2.2 Ripple - The RMS value of ripple voltage shall not exceed 30 mV rms on any of these supplies when they are connected to the actual system load except the +47 volt shall not exceed 500 mV rms.

3.5.9.4.3 AC Supply - An unregulated twenty-six volts RMS shall be supplied at 400 Hertz, 1 amp, for use in the equipment servo system.

3.5.9.4.4 Regulated AC - A regulated 400 Hertz voltage shall be provided by the use of zener diodes. The nominal peak to peak voltage shall be within ±10 percent of 40.8. However, this value shall not vary more than ±1.5 percent under the service conditions. The final regulating zener diodes are in the Indicator, Azimuth and Range.

3.5.9.4.5 Control Circuits - The following control circuits shall be provided.

3.5.9.4.5.1 Time Delay - A 60 second time delay shall be provided. This shall delay the application of the regulated voltages so that the vacuum tube filaments will have time to reach operating temperature. The delay shall begin when the power switch on the Control, Detecting-Ranging Set is turned from OFF to STANDBY.

3.5.9.4.5.2 Power Relay - A relay shall be provided to control the 115V, 400 Hertz power to the system. It shall be actuated by the power switch on the Control, Detecting-Ranging Set between OFF and STANDBY.

3.5.9.4.5.3 B+ Relay - A relay shall be provided to turn the regulated supplies on and off when the power switch on the Control, Detecting-Ranging Set is moved between STANDBY and ON.

3.5.9.4.6 Blower - A blower shall be provided to furnish adequate cooling for the power supply.

3.5.9.4.7 Metering Circuits - A front panel meter shall be provided to monitor the supply voltages. A front panel control shall select the voltage to be indicated on the meter. Suitable multipliers shall be used so that all voltages will register in the green, except unregulated +85, unregulated +28, and the +47 which shall read a minimum of 1/2 scale on the meter.

3.5.9.5 Controls - The following controls shall be provided:

3.5.9.5.1 Screwdriver Adjustments -

Identification	Location	Function
1. R-13	Top of chassis	+500 ripple balance
2. R-17	Top of chassis	+500 voltage adjust
3. R-29	Top of chassis	+200 voltage adjust

Identification	Location	Function
4. R-48	Top of chassis	-200 voltage adjust
5. R-71	Top of regulator board	+85 voltage adjust
6. R-87	Top of regulator board	+30 voltage adjust
7. R-97	Top of regulator board	+16 voltage adjust
8. R-107	Top of regulator board	+6 voltage adjust
9. R-117	Top of regulator board	-3 voltage adjust
10. R-127	Top of regulator board	-30 voltage adjust

3.5.9.5.2 Front Panel Control - A front panel switch shall be provided to individually select power supply voltages. The voltages are then indicated on the front panel meter. This switch shall be for test purposes. It shall be a multiple position rotary type labeled VOLTAGE TEST.

3.5.9.6 Electrical Connectors - Connections to external circuit shall be provided as follows:

Reference Designation	Receptacle Type	Function
J1	MS3102R-18-21P An integral part of the RF filter	Three phase power input
J2	MS3102A-22-14S	Output to Intermediate Frequency Amplifier
J3	MS3102A-36-8S	Output to Detecting-Ranging Set Control and Azimuth and Range Indicator

*3.5.9.7 Test Points - A panel shall be provided inside the chassis with the following test points:

J20	+500 volts	J32	-3 volts
J21	+200 volts	J33	-30 volts
J22	+107 volts	J34	-200 volts
J23	+85 volts	J28	+85V Relay

J24	+47 volts Regulated	J29	+28V Relay
J25	+30 volts	J30	20 V AC
J26	+16 volts	J31	115 VAC
J27	+6 volts	J35	Ground

3.5.10 Reeling Machine, Cable, Hydraulic RL-237A/AQS-13 - The Reeling Machine, Cable, Hydraulic, shall meet the following requirements:

3.5.10.1 Function - The Reeling Machine, Cable, Hydraulic with the Cable Assembly and Reel attached shall raise and lower the Transducer, Sonar to and from the aircraft. It shall be possible to stop and operate the equipment with any desired amount of cable unreeled. The unit shall provide drift sensing information for the helicopter automatic hover system and the pilot's and sonar operator's drift meters. It shall also provide an electrical link between the reel and cable assembly and the sonar equipment. The reeling machine and the reel and cable assembly shall retrieve the entire length of cable and stow the transducer within the confines of the aircraft. The reeling machine shall be illuminated with two lights utilizing the +28 Vdc power source.

3.5.10.2 Form Factor - The maximum dimensions of the reeling machine shall be 48.6 inches in height, 17.9 inches in width and 69.2 inches in length. It shall be mounted only to the floor of the aircraft.

3.5.10.3 Weight - The weight of the reeling machine shall not exceed 111.7 pounds.

*3.5.10.4 Contents of Unit - The reeling machine shall contain the following assemblies:

(1) Hydraulic Control Manifold

(2) Hydraulic Motor

(3) Emergency Hoist DC Electric Motor

(4) Gear Reduction Unit

(5) Cable Payout Sensing Device

(6) Slip Ring Assembly

(7) Limit Switches

(8) Level Wind Mechanism

(9) Frame Assembly

(10) Drift Sensing Mechanism

(11) Cable Cutting Device

(12) Half Inch Drive Speed Wrench

(13) Intermediate Speed Valve

3.5.10.4.1 Hydraulic Control Manifold - The hydraulic control manifold shall control the routing of hydraulic fluid to the hydraulic motor upon command and shall regulate the flow of hydraulic fluid. It shall be actuated by 28 volt DC solenoids. A 28 volt main solenoid valve shall be placed in series with the hydraulic control manifold valve that shall operate simultaneously with the manifold valve to insure that the reeling machine can be stopped in the event the manifold valve malfunctions.

3.5.10.4.2 Hydraulic Motor - The hydraulic motor shall operate the reeling machine, to raise the transducer at a rate no less than an average 11.0 feet per second in high speed, and to allow the transducer to lower at a rate no less than an average 4.0 feet per second measured between the transducer seated position and maximum transducer depth. The lowering rate in air shall be between 5.0 and 10.0 feet per second. The hydraulic motor shall be capable of raising the transducer at slower speeds depending on the flow of hydraulic fluid routed to it from the hydraulic control manifold and specifically at a rate of 1.0 foot $\pm$0.5 foot per second for retrieving the transducer from the trail position to the seated position. The hydraulic motor shall have a sufficient hydraulic pressure head to prevent cavitation when subjected to cable overload conditions outlined in paragraph 3.5.10.4.4.

3.5.10.4.3 Emergency Motor - A DC motor shall be provided to raise the transducer in the event of hydraulic power failure. This motor shall be capable of raising the transducer and cable the full length at an average rate greater than 4.0 feet per second with an input of 27.5 volts. Input power requirements shall be in accordance with MIL-STD-704, category "B" for 27.5 volt DC power, except that operation below 24 volts shall not be required under any conditions. The current requirements shall not exceed 180 amperes starting and 80 amperes running.

3.5.10.4.4 Gear Reduction Unit - A gear reduction unit shall be provided to reduce the reel and cable assembly speed when raising or lowering the transducer in accordance with 3.5.10.4.2. The unit shall include a brake to prevent slippage of the reel and cable assembly during aircraft vibration and slight hydraulic fluid leakage of the manifold control valve, or in the event of hydraulic system failure. An overload protection feature shall allow the reel and cable assembly to rotate

when a 650 pound minimum load is applied to the cable at full reel. The gear reduction unit shall provide a receptacle for a standard 1/2 inch drive speed wrench for the purpose of maintenance hand cranking. The hand crank drive shall be coupled to the reduction unit through a manually operated mechanical clutch. An interlock switch shall be provided as an integral part of the clutch assembly that will render the hydraulic reeling system inoperative when it is placed in the hand crank position.

3.5.10.4.4.1 Reel and Cable Assembly Mounting - The gear reduction unit shall provide a means of mounting for the Cable Assembly and Reel, without removal of the cable from the reel. The mounting shall be 6 studs with nuts and 2 guide pins.

3.5.10.4.5 Cable Payout Sensing Device - A potentiometer shall be provided to work with the depth-height system to indicate the amount of cable unreeled. The potentiometer shall have linear segments corresponding to the wraps of cable on the reel. The linearity of each of these segments shall be ±0.2 percent. The angular rotation corresponding to the eleven segments shall be held to ±0.158 percent of the total angular rotation of the potentiometer.

3.5.10.4.6 Slip Ring Assembly - A slip ring assembly with a minimum of 34 separate rings shall be provided to connect the transducer cable through the reeling machine. The rings shall be of the following characteristics:

(1) Sixteen rings shall be of the low noise type generating no more than 50 microvolts of noise in a 3000 Hertz bandwidth between 8.5 and 11.5 kHz. They shall be insulated for 600 VDC test.

(2) Two rings shall be capable of handling 40 amperes of AC current for a 40 millisecond pulse. They shall be insulated to withstand 1000 volts RMS.

(3) The remaining rings shall be insulated for a 600 VDC test and capable of 2 amperes of current.

3.5.10.4.7 Limit Switches - Limit switches shall be provided to stop the reeling machine when the transducer is fully raised. Suitable means shall be provided to automatically reduce the raise rate to 1.0 ±0.5 foot per second before the transducer reaches the trail position. Reduction of speed from maximum to slow shall occur uniformly and not abruptly.

3.5.10.4.8 Level Wind Mechanism - A level wind mechanism shall be provided to cause the cable to be fed onto the reel such that there is no overlapping of the cable except at the extremities of a layer and that the entire 500 foot length of cable when loaded on the reel shall form a hollow right circular cylindrical bundle whose outer diameter does not exceed the outer diameter of the reel. Provisions shall be made for an in-flight, manual, automatically lockable, adjustment of the level wind mechanism alignment by virtue of access to a standard 1/2 inch speed handle output. The output shall be capable of moving the sheave on the level wind mechanism in either direction. The movement shall be continuous and capable of stopping at any position along the lead screw.

3.5.10.4.9 Frame Assembly - The reeling machine structure shall withstand a downward force at the forward sheave of 1000 pounds without permanent deflection. The 1000 pounds force shall be measured anywhere within a 24 degree cone whose axis is normal to the horizontal mounting of the reeling machine. No magnesium parts shall be used.

3.5.10.4.10 Drift Sensing Mechanism - Provisions shall be made to provide cable angle (drift) information to the automatic hover system and to the indicators in the pilots instrument panel and the sonar operator's console. The mechanism shall be capable of supplying drift information in both lateral and longitudinal planes simultaneously.

3.5.10.4.10.1 Drift Signal - The drift signal shall provide cable angle information along the X and Y horizontal axis of the helicopter. The total measured angle shall be at least ±12 degrees from the helicopter Z axis in all directions. The cable sensing assembly shall be capable of sensing changes in cable angle of 0.1 degree or greater except for a total allowable cable angle sensor threshold of 0.33 degree about the cable angle sensor zero (null) position. The electrical output of the cable sensing assembly shall be provided by a 400 Hertz linear transformer. Its output shall be 0.33 volt rms per degree for a 115 Vrms excitation and shall be accurate within ±0.5 degree. This output shall be in phase ±6 degrees with the reference voltage. D.C. signals for (3) 100 -0- 100 microampere indicators shall also be provided. The D.C. output shall be adjustable to provide a nominal signal of 8.33 mV per degree across a load of 333 ohms.

3.5.10.4.11 Cable Cutting Device - A guillotine type of emergency cable detachment mechanism shall be provided. It shall allow the pilot to immediately detach the cable and transducer regardless of the length of lowered cable. The guillotine explosive charge shall be ignited by application of 18 volts DC, or greater.

3.5.10.4.12 One-Half Inch Drive Speed Wrench - A one-half inch drive speed wrench shall be provided to manually operate the reeling machine or to adjust the level wind mechanism. A pocket shall be provided for stowage of the speed wrench when not in use on top of the Housing, Reeling Machine.

3.5.10.4.13 Intermediate Speed Valve - A solenoid operated flow limiting valve shall be provided on the hydraulic system supply line to limit the hydraulic fluid flow rate during the valve de-energized state to a maximum of 2.8 ±0.3 gpm resulting in an average transducer retrieval speed of approximately 5 feet per second. The valve will be operated by the intermediate speed raise circuit (3.5.4.4.13.2) and shall have a manual speed select switch located on the aircraft sonar operator's console.

3.5.10.4.14 Cable Cycle Counter - A counter shall be provided to indicate lower raise cycles. The counter shall indicate a cycle when the reeling machine obtains a raise command which has been preceded by a lower command.

3.5.10.5 Controls - The reeling machine shall contain the following controls.

3.5.10.5.1 Operational Controls:

Identification	Location	Function
Payout mech clutch	Rear of Reeling Machine	Engages payout clutch
Payout mech adjust	Rear of Reeling Machine	Calibrates the payout mech. to cable position
Handcrank engage/ disengage	Side of Reeling Machine	Engages a clutch that will allow handcrank operation or hydraulic power operation

3.5.10.5.2 Slow Speed Switch - A mechanical position sensing device shall be provided in the gear reduction unit to actuate the hydraulic slow speed valve, automatically, before the transducer reaches the trail position. The transition to slow speed shall not be abrupt.

3.5.10.5.3 18 Inch Limit Switch - A mechanical position sensing device shall be provided in the gear reduction unit to automatically deeenergize the main solenoid and the raise solenoid when the transducer has reached a point 18 ±6 inches from the bottom of the aircraft.

3.5.10.5.4 Seated Switch - There shall be a switch provided on the drift sensing assembly that will stop the reeling machine motor when the transducer has reached the stowed position.

3.5.10.5.5 Level Wind Adjustment - A self-locking 1/2 inch speed handle output adjustment shall be provided for the level wind mechanism to allow for the positioning and direction of travel of the level wind sheave into alignment with the point of departure of the sonar cable from the reel.

3.5.10.5.6 Screwdriver Adjustment -

Identification	Location	Function
Trail Pos. Adj.	Rear of Reeling Machine	Adjust distance that the trail position stops from seat position

3.5.10.6 Test Points - A panel shall be provided on the side of the reeling machine with the following test points:

J5002 & J5023	These test points shall be used for bypassing the clutch switch S5004 when payout mech. clutch is disengaged.

3.5.10.7 Electrical Connections - The connectors to the external equipment described herein in addition shall meet the 200 hour salt spray requirement of paragraph 3.3.10.2.

Reference Designation	Receptacle Type	Function
J5655	MS3127F-20-16P	Power input-drift sensing and current control
J5656	MS3127F-12-8P	Power input-guillotine
J5657	Special Feedthru with 28-21PS-Insert (Bendix Part No. 3154336)	Slip ring outlet
J5658	MS3127F-8-4P	Power input-reel lamps
J5659	MS3127F-14-12P	Power input-reeling machine control circuitry
J5661	MS3127F-20-8P	Power input - DC motor
J5662	MS3122F-8-2P	Power input-intermediate speed valve

Reference Designation	Receptacle Type	Function
P5019A	Special Plug with 21S Insert (Bendix Part No. 10-410997-21S)	To connect slip ring assembly to reel and cable assembly
P5015	MS3126F-8-2S	To connect reeling machine to lower limit switches

3.5.10.8 Hydraulic Connections -

Fitting Type	Function
3059349-1A6	Inlet for reeling machine pressure.
3059349-1A8	Outlet for reeling machine return.

3.5.11 Cable Assembly and Reel RC-466A/AQS-13 - The Cable Assembly and Reel shall meet the following requirements:

3.5.11.1 Function - The Cable Assembly and Reel shall be capable of stowing 500 feet of sonar cable with the cable tensioned to 150 +25 pounds. It shall mount on Reeling Machine, Cable, Hydraulic. It shall provide an electrical link between the Transducer, Sonar and the Reeling Machine, Cable, Hydraulic.

3.5.11.2 Form Factor - The maximum dimensions of the reel and cable assembly shall be 25.1 inches in diameter and 8.5 inches in width except for P7001 which extends beyond the periphery when cable is completely reeled in.

3.5.11.3 Weight - The weight of the reel and cable assembly shall not exceed 141 pounds.

3.5.11.4 Contents of Unit - The reel and cable assembly shall contain the following subassemblies:

(1) Sonar Cable

(2) Reel Assembly

(3) Lower Limit Switch Assembly

3.5.11.4.1 Sonar Cable - The Sonar Cable shall meet the requirements specified in MIL-C-81452.

3.5.11.4.2 Reel Assembly - The Reel Assembly shall have a grooved liner to assure proper cable wrapping. It shall be of sufficient strength to support 500 feet of sonar cable tensioned to 150 ±25 pounds.

3.5.11.4.3 Lower Limit Switch Assembly - A limit switch shall be provided to stop the reeling machine when all but a minimum of three wraps of the cable are payed out. A backup limit switch shall be provided to stop the reeling machine when all but a minimum of three wraps of the cable are payed out, in the event of failure of the first switch.

3.5.12 Housing, Transducer CW-1007/AQS-13A - The Housing, Transducer shall meet the following requirements:

3.5.12.1 Function - The Housing, Transducer shall provide a covering over the transducer and shall contain a wiper assembly for the purpose of removing water from the Sonar Cable during the transducer retrieval cycle. It shall have quick connect features and be fastened to the top of the funnel. A minimum of 90% of the water on the cable will be removed and discharged directly to the outside of the helicopter.

3.5.12.1.1 Drift Sensor - The transducer housing assembly shall not affect the drift sensor voltage output more than ten (10) percent.

3.5.12.2 Form Factor - The maximum dimensions of the transducer housing shall not exceed 21.0 inches in diameter, and 38.0 inches in height in extended position.

3.5.12.3 Weight - The weight of the transducer housing shall not exceed 19.0 pounds.

3.5.12.4 Contents of the Unit - The transducer housing shall contain the following assemblies:

(1) Housing assembly

(2) Bellows

(3) Wiper assembly

3.5.12.4.1 Housing Assembly - The housing assembly shall cover the transducer in the seated position. It shall prevent the water, carried up by the cable, from entering the aircraft.

3.5.12.4.2 Bellows - A nylon reinforced neoprene bellows shall connect the wiper assembly to the housing.

3.5.12.4.3 Wiper Assembly - The wiper assembly shall contain two neoprene wipers for the purpose of removing water from the cable. Two replaceable springs shall be used to attach the wiper assembly to the reeling machine.

3.5.12.4.4 Life - The transducer housing shall withstand a minimum of 1000 seating and unseating operations of the transducer.

3.5.13 Housing, Reeling Machine CW-757A/AQS-13 - The Housing, Reeling Machine, shall meet the following requirements:

3.5.13.1 Function - The Housing, Reeling Machine shall provide a covering over the Reeling Machine, Cable, Hydraulic to prevent water from entering the inside of the helicopter.

3.5.13.2 Form Factor- The maximum dimensions of the reeling machine housing shall be 52.0 inches in height, 28.5 inches in width and 52.5 inches in length.

3.5.13.3 Weight - The weight of the reeling machine housing shall not exceed 24.0 pounds.

3.5.13.4 Contents of the Unit - The reeling machine housing shall contain the following assemblies:

(1) Cover

(2) Flaps, Access

(3) Frame, Support

(4) Panel, Window

(5) Pocket, Handcrank

3.5.13.4.1 Cover - The cover shall be fabricated of a synthetic fabric impregnated with a suitable plastic to prevent deterioration by hydraulic and engine oils, aircraft fuel, and salt water. It shall be fitted over the support frame and attached at the base. A gasket shall be provided between the support frame base and the floor of the helicopter to affect a watertight seal to the floor. A flap or other suitable device shall be provided near the bottom of the cover to insure that salt water run-off is confined within the support frame.

3.5.13.4.2 Flaps, Access - There shall be four access flaps in the cover. They shall be located and of sufficient size to provide access to (1) drift sensing mechanism, (2) funnel neck and cable reel, (3) hand crank receptacle, (4) gear reduction unit and hydraulic control manifold, (5) level wind adjustment, and (6) to allow for the removal or installation of the entire transducer from inside the aircraft. The access flaps shall be fitted with heavy duty zippers to facilitate opening.

3.5.13.4.3 Frame, Support - The support frame shall support the reeling machine cover in its proper shape, shall be constructed of aluminum and be readily dismountable. It shall be constructed to allow for the simple removal or installation of the transducer from inside the helicopter. The support frame shall have as its base a six inch high "kick-panel" which shall be mounted to the floor of the helicopter and to which the cover shall be attached. A gasket shall be installed to provide a watertight seal between the helicopter floor and the support frame base.

3.5.13.4.4 Panel, Window - There shall be one window panel in the cover. It shall be for viewing of the suspended cable and transducer and the drift sensing mechanism and seating block. It shall be fabricated of flexible transparent material.

3.5.13.4.5 Pocket, Handcrank - A pocket shall be provided for storage of the reeling machine 1/2 inch drive speed wrench.

3.5.14 Circuit Breaker SA-1263/AQS-13 - The circuit breaker shall meet the following requirements:

3.5.14.1 Function - The circuit breaker is a protective switch for the purpose of actuating the emergency DC motor. The circuit breaker shall deenergize the emergency motor if excessive current is drawn by the motor.

3.5.14.2 Form Factor - The maximum dimensions of the circuit breaker shall be 2.0 inches in height, 5.4 inches in width and 6.5 inches in depth.

3.5.14.3 Weight - The weight of the circuit breaker shall not exceed 1.3 pounds.

3.5.14.4 Contents of the Unit - The circuit breaker shall contain the following subassemblies:

(1) Circuit Breaker

(2) Cover and Plate Assembly

3.5.14.4.1 Circuit Breaker - A circuit breaker shall be provided that will suitably protect the emergency DC motor from an overload condition. It shall break the operating circuit internally while its actuating toggle remains in its energized position. The circuit breaker shall automatically reset when the actuating toggle is returned to the deenergized position.

3.5.14.4.2 Cover and Plate Assembly - The circuit breaker, connector, supporting bracketry, etc., shall be contained in a watertight cover and plate assembly.

3.5.14.5 Controls - There shall be a push-pull control that will energize the circuit breaker and be spring loaded to return automatically when released. The circuit breaker handle shall be sealed in the "off" position with a breakable fine wire seal.

3.5.14.6 Electrical Connections - Two studs shall be provided for external DC power connections.

3.5.15 Indicator, Bearing and Range ID-786/AQS-10 - The Indicator, Bearing and Range shall meet the following requirements:

3.5.15.1 Function - The Indicator, Bearing and Range unit shall repeat the information appearing as range and bearing on the Indicator, Azimuth and Range unit. The range shall be indicated digitally in the center of the meter and the bearing by a pointer and 360 degree scale around the edge of the indicator.

3.5.15.2 Form Factor and Mounting - The maximum dimensions of the range and bearing indicator shall not exceed 3.28 inches in height, 3.28 inches in width and 5.91 inches in depth. It shall be housed in a meter type case and shall be rigid mounted to the instrument panel of the aircraft. The body of the indicator behind the mounting flange shall not exceed a diameter of 3.18 inches.

3.5.15.3 Weight - Weight of the bearing and range indicator shall not exceed 1.7 pounds.

3.5.15.4 Contents - The bearing and range indicator shall contain the following assemblies, subassemblies and circuits:

3.5.15.4.1 Repeater - The bearing synchro repeater shall consist of a synchro torque receiver to drive a pointer which shall repeat the cursor bearing from the bearing and range indicator within ± 1 degree.

3.5.15.4.2 Range Indicator - The range indicator shall be a 5 digit counter type readout capable of reading to an accuracy of ± 10 yards.

3.5.15.4.3 Servo - The range indicator servo amplifier and gear train mechanism shall consist of a two speed servo system including a transistorized amplifier capable of driving the range readout counter motor to an accuracy of ± 10 yards.

3.5.15.4.4 Instrument Lighting - The bearing and range indicator shall conform to the applicable requirements of MIL-P-7788 for plastic plate lighting.

3.5.15.5 Electrical Connections - Connections to external circuits shall be provided as follows:

Reference Designation	Receptacle Type	Function
J4201	PT1H-16-26P (Bendix Part No. 1034709)	Input and Output

3.5.16 Visor, Cathode Ray Tube MX-3275/AQS-10 - The Visor, Cathode Ray Tube shall meet the following requirements:

3.5.16.1 Function - The visor shall reduce the amount of ambient extraneous light falling on the cathode ray tube face.

3.5.16.2 Form Factor - The maximum dimensions of the visor shall be 8.2 inches in diameter and 12.5 inches in depth.

3.5.16.3 Weight - The weight of the visor shall not exceed 0.8 pound.

3.5.16.4 Contents of Unit - The visor shall be a bonded assembly consisting of the light shield and flexible eye piece.

3.5.17 Mounting Base MT-2201/AQS-10 - The Mounting Base shall meet the following requirements:

3.5.17.1 Function - The Mounting Base shall provide a base upon which the Amplifier, Intermediate Frequency is mounted for vibration isolation. The base shall consist of a supporting assembly which provides a mounting structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172 except for dimensions and except that the rack shall be electrically insulated from the mounts.

3.5.17.2 Form Factor - The maximum dimensions of the mounting base shall be 2.9 inches in height, 16.7 inches in width, and 30.6 inches in depth.

3.5.17.3 Weight - The weight of the mounting base shall not exceed 3.2 pounds.

3.5.17.4 Contents of Unit - The mounting base shall contain the following:

3.5.17.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassemblies.

3.5.17.4.2 Vibration Mount - The vibration and shock mounts shall be fastened to the base assembly and installed on the airframe.

3.5.18 Mounting Base MT-2202/AQS-10 - The Mounting Base shall meet the following requirements:

3.5.18.1 Function - The Mounting Base shall provide a base upon which the Control, Detecting-Ranging Set and the Indicator, Azimuth and Range are mounted for vibration isolation. The base consists of a supporting assembly which provides a mounting structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172, except for dimensions and except that the rack shall be electrically insulated from the mount.

3.5.18.2 Form Factor - The maximum dimensions of the mounting base shall be 2.5 inches in height, 19.0 inches in width, and 32.9 inches in depth.

3.5.18.3 Weight - The weight of the mounting base shall not exceed 5.9 pounds.

3.5.18.4 Contents of Unit - The mounting base shall contain the following:

3.5.18.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassemblies.

3.5.18.4.2 Vibration Mount - The vibration and shock mounts shall be fastened to the base assembly and installed on the airframe.

3.5.19 Mounting Base MT-2203/AQS-10 - The Mounting Base shall meet the following requirements:

3.5.19.1 Function - The Mounting Base shall provide a base upon which the Power Supply is mounted for vibration isolation. The base consists of a supporting assembly which provides a mounting structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172, except for dimensions and except that the rack shall be electrically insulated from the mounts.

3.5.19.2 Form Factor - The maximum dimensions of the mounting base shall be 2.6 inches in height, 11.5 inches in width, and 30.6 inches in depth.

3.5.19.3 Weight - The weight of the mounting base shall not exceed 2.7 pounds.

3.5.19.4 Contents of Unit - The mounting base shall contain the following:

3.5.19.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassemblies.

3.5.19.4.2 Vibration Mounts - The vibration and shock mounts shall be fastened to the base assembly and installed on the airframe.

3.5.20 Mounting Base MT-2397/AQS-10 - The Mounting base shall meet the following requirements:

3.5.20.1 Function - The Mounting Base shall provide a base upon which the Converter, Frequency, Electronic is placed for vibration isolation. The base consists of a supporting assembly which provides a mounting structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172, except for dimensions and except that the rack shall be electrically insulated from the mounts.

3.5.20.2 Form Factor - The maximum dimensions of the mounting base shall be 2.9 inches in height, 16.8 inches in width, and 23.0 inches in depth.

3.5.20.3 Weight - The weight of the mounting base shall not exceed 2.9 pounds.

3.5.20.4 Contents of Unit - The mounting base shall contain the following:

3.5.20.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassemblies.

3.5.20.4.2 Vibration Mounts - The vibration and shock mounts shall be fastened to the base assembly and installed on the airframe.

3.5.21 Mounting Base MT-3335/AQS-13 - The Mounting Base shall meet the following requirements:

3.5.21.1 Function - The Mounting Base shall provide a base upon which the Transmitter, Sonar is placed for vibration isolation. The base consists of a supporting assembly which provides a mounting structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172, except for dimensions and except that the rack shall be electrically insulated from the mounts.

3.5.21.2 Form Factor - The maximum dimensions of the mounting base shall be 2.46 inches in height, 17.16 inches in width, and 28.00 inches in depth.

3.5.21.3 Weight - The weight of the mounting base shall not exceed 3.0 pounds.

3.5.21.4 Contents of Unit - The mounting base shall contain the following:

3.5.21.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassemblies.

3.5.21.4.2 Vibration Mounts - The vibration and shock mounts shall be fastened to the base assembly and installed on airframe adapter plates.

3.5.22 Mounting Base MT-3972/AQS-13A - The mounting base shall meet the following requirements:

3.5.22.1 Function - The Mounting Base shall provide a base upon which the Processor, Frequency is mounted for vibration and shock isolation. The base consists of a supporting assembly which provides a mounting structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172, except for dimensions and except that the rack shall be electrically insulated from the mount.

3.5.22.2 Form Factor - The maximum dimensions of the mounting base shall be 2.60 inches in height, 5.80 inches in width, and 19.31 inches in length.

3.5.22.3 Weight - The weight of the mounting base shall not exceed 2.4 pounds.

3.5.22.4 Contents of Unit - The mounting base shall contain the following:

3.5.22.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassembly.

3.5.22.4.2 Vibration Mount - The vibration and shock mounts shall be fastened to the base assembly and installed on the airframe.

3.5.23 Mounting Base MT-4305/AQS-13A - The Mounting Base shall meet the following requirements:

3.5.23.1 Function - The Mounting Base shall provide a base upon which the Recorder is mounted for vibration and shock isolation. The base consists of a supporting assembly which provides a mounting

structure complete with integral vibration isolating elements. It shall include a fastener assembly which allows quick unit installation and removal. The mounting base shall meet the applicable requirements of MIL-C-172 except for dimensions and except that the rack shall be electrically insulated from the mount.

3.5.23.2 Form Factor - The maximum dimensions of the mounting base shall be 2.6 inches in height, 9.9 inches in width, and 12.9 inches in depth.

3.5.23.3 Weight - The weight of the mounting base shall not exceed 3.5 pounds.

3.5.23.4 Contents of Unit - The mounting base shall contain the following:

3.5.23.4.1 Base Assembly - The base assembly shall consist of a structural support and fastener subassemblies.

3.5.23.4.2 Vibration Mounts - The vibration and shock mounts shall be fastened to base assembly and installed on the airframe.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection - Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the contractor may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to assure the equipment and service conform to prescribed requirements.

4.1.1 Classification of Tests - Items covered by this specification shall be subjected to the following tests to determine compliance with all applicable requirements:

(1) Preproduction (First Article) Tests

(2) Initial Production Tests

(3) Acceptance Tests

(4) Life Tests

4.2 Preproduction Tests - Preproduction tests shall be made on an equipment representative of the production equipments to be supplied under the contract. Preproduction tests shall be accomplished under the responsibility of the contractor and shall be conducted in accordance with the approved test procedure of 4.6. The government inspector

and the procuring activity shall be advised when tests are to be conducted so that a representative may be designated to witness or supervise the tests when so desired. Contractors not having adequate facilities to conduct all required tests shall obtain the services of a commercial testing laboratory acceptable to the Government.

4.2.1 Preproduction Test Data - The contractor shall submit all data collected in conducting these tests to the procuring agency for review and approval. On first production contracts this data shall include a list of all electrical and electronic parts giving their specified voltage, current and temperatures. The ambient and surface temperature shall be obtained under the extreme high temperature operating condition.

4.2.2 Scope of Tests - Preproduction tests shall include all tests deemed necessary by the procuring activity to determine that the equipment meets all the requirements of this specification and the contract. Preproduction tests shall include environmental tests in accordance with the procedures of specification MIL-T-5422 and as modified by paragraphs 3.3.10 and interference tests in accordance with specification MIL-I-6181 and as modified by paragraph 3.3.6.

4.2.3 Preproduction Approval - Approval of the preproduction sample shall be by the procuring activity upon satisfactory completion of all tests. No production equipments shall be delivered prior to the approval of the preproduction model. Prefabrication of production equipment prior to the approval of the preproduction model is at the contractor's own risk. The approved preproduction model will be returned to the contractor for his use in the fabrication and testing of equipment to be submitted for acceptance. The preproduction model shall not be considered as one of the equipments under the contract.

4.2.4 Production Equipments - Equipments supplied under the contract shall be in all respects, including design, construction, workmanship, performance, and quality, be equivalent to the approved preproduction sample. Each equipment shall be capable of successfully passing the same tests imposed on the preproduction sample. Evidence of noncompliance with the above shall constitute cause for rejection and for equipment already accepted by the government, it shall be the obligation of the contractor to make necessary corrections as approved by the procuring activity.

4.3 Initial Production Tests - One of the first ten production equipments shall be selected and sent at the contractor's expense to a designated Government laboratory for tests. This equipment shall be selected by the procuring activity after the equipment has successfully passed all individual tests. The preproduction sample shall not be selected for this test.

4.3.1 Scope of Tests - This equipment may be subjected to any and all tests the procuring activity deems necessary to assure that the production equipment is equivalent to the previously approved pre-production sample in design, construction, workmanship, performance, and quality and that it meets all applicable requirements.

4.3.2 Accessory Material - In addition to the complete equipment submitted for Initial Production Tests the contractor shall also submit such accessory material and data necessary to test the equipment.

4.3.3 Initial Production Sample Approval - Approval of the initial production sample shall be by the procuring activity upon satisfactory completion of all tests. Any design, material or performance defect made evident during this test shall be corrected by the contractor to the satisfaction of the procuring activity. Failure of the initial production sample to pass any of the tests shall be cause for deliveries of equipment under the contract to cease until proper corrective action is approved and accomplished. Corrective action shall also be accomplished on equipment previously accepted when requested by the procuring activity.

4.3.4 Reconditioning of Initial Production Test Sample - On completion of the initial production test the equipment shall be reworked by the contractor by replacing all wear or damaged items. After reworking the contractor shall resubmit the equipment for acceptance.

4.4 Acceptance Tests - The contractor shall furnish all samples and shall be responsible for accomplishing the acceptance tests. All inspection and testing shall be under the supervision of the government inspector. Contractors not having facilities satisfactory to the procuring activity shall engage the services of a commercial testing laboratory acceptable to the procuring activity. The contractor shall furnish test reports showing quantitative results for all acceptance tests. Such reports shall be signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of the acceptance of the finished product. Acceptance tests shall consist of the following:

(1) Individual Tests

(2) Sampling Tests

(3) Reliability Assurance Tests

(4) Special Tests

4.4.1 Individual Tests - Each equipment submitted for acceptance shall be subjected to the individual tests. These tests shall be adequate to determine compliance with the requirements of material, workmanship, operational adequacy and reliability. As a minimum, each equipment accepted shall have passed the following tests:

(1) Examination of Product

(2) Operational Test

(3) Manufacturing Run-In Test

4.4.1.1 Examination of Product - Each equipment shall be examined carefully to determine that the material and workmanship requirements have been met.

4.4.1.2 Operational Test - Each equipment shall be operated long enough to permit the equipment temperature to stabilize and to check sufficient characteristics and record adequate data to assure satisfactory equipment operation.

4.4.1.3 Manufacturing Run-In Test - Each equipment shall be operated under the conditions specified for a period of 12 hours without failure, except the Projector, Sonar and Hydrophone, Sonar which will be operated for a six-hour period and the Reeling Machine, Cable, Hydraulic and Cable Assembly and Reel shall be operated without failure for a total of 24 cycles of normal operation and 3 cycles of emergency operation. A failure shall be defined as anything which causes malfunctioning of the equipment. Only those adjustments will be permitted which can be made by using such controls and adjustments that are accessible to the operator during normal use of the equipment.

Temperature	Ambient room
Humidity	Ambient room
Vibration	Any selected frequency within the range of 17 to 30 Hertz (excluding resonant points) to an amplitude as specified in MIL-E-19400 (AER) for equipment with vibration isolators removed.

The equipment shall be vibrated (without vibration isolators) for a period of 10 minutes prior to the beginning of the specified period of operation. Where feasible, the equipment shall be operated during this vibration period for the purpose of detecting flaws and imperfect workmanship. Operation within the specified limits of satisfactory performance is not necessarily required during the vibration period. The direction of vibration should be vertical to the normal mounting plane for 5 minutes and lateral to that plane for 5 minutes. Where it is not feasible to vibrate the equipment in 2 directions, the vertical direction shall be used.

During the specified period of operation following the 10-minute vibration period, the equipment shall be mechanically cycled periodically through its various phases of operation. Should a failure occur, it should be repaired and the test started over, except that the 10-minute vibration period need not be repeated when it is certain the failure was not the result of the vibration. Should repetitive failures occur, corrective action shall be taken to eliminate this defect from future equipment. A record shall be kept of all failures. The burn-in period specified may be composed of 3-hour periods to conform with standard working hours.

4.4.2 Sampling Tests - Equipments selected for sampling tests shall first have passed the individual tests. Equipments shall be selected for sampling tests by the government inspector in accordance with the following: (Sampling tests shall not be conducted unless Reliability Assurance Tests of 4.4.3 are deleted by contractual action.)

Quantity of Equipments Offered for Acceptance	Quantity to be Selected for Sampling Tests
First 10	0*
Next 50	1
Next 75	1
Next 100	1 for each additional 200 or fraction thereof

*NOTE: If by contract action the Initial Production Test (4.3) is deleted, then a Sample Test shall be conducted on one equipment from the first 10 produced.

4.4.2.1 Scope of Tests - As a minimum, each equipment selected for sampling tests shall be subjected to the following tests:

(1) Complete operational test at ambient room conditions, making all necessary measurements to assure that all applicable specification requirements have been met.

(2) Operational test at certain environmental conditions. The conditions may vary for each equipment tested and should be based on results of the preproduction, initial production, individual, and special tests.

(3) Manufacturing run-in test specified in paragraph 4.4.1.3 except that the test duration shall be 120 hours with no restriction on the number of failures. However, each failure shall be analyzed as to cause and remedial action necessary to reduce the possibility of its recurrence in future equipment.

4.4.3 Reliability Assurance Tests - Reliability Assurance Tests shall be conducted using MIL-STD-781. Tests as required by both the Qualification Phase and the Sampling Phase shall be conducted.

4.4.3.1 Qualification Phase - Prior to the acceptance of equipments under the contract or order, a minimum of three (3) equipments shall be tested as outlined in MIL-STD-781, under the section entitled "Qualification Phase of Production Reliability Tests." The maximum number of equipments to be used shall be those listed in Table 5 of MIL-STD-781. For the Qualification Phase, Test Level E shall be used. The Accep-Reject Criteria for Test Plan IV shall be used.

4.4.3.2 Reliability Production Acceptance (Sampling) Phase Tests - The equipment, throughout production, shall be tested as outlined in MIL-STD-781 (as modified herein) under the section entitled "Production Acceptance (Sampling) Phase of Production Reliability Tests". Test level E shall be used.

4.4.3.2.1 All Equipment Test - Each equipment produced except those submitted for the Reliability Qualification Test, shall be tested for 25 hours. Prior to the 25 hour test on each equipment, a burn-in period may be used at the option of the contractor. If the burn-in period is to be used the details thereof must be included in the approved test procedures. To determine whether the MTBF is being met at any time during the contract the operating test hours and the failures thereon (not counting burn-in failures or burn-in operating time) shall be totaled and the results compared with the reject line of Test Plan II of MIL-STD-781. (Extend the line as necessary to accomodate the data.) These totals shall accumulate so that at any one time the experience from the beginning of the contract is included. At the conclusion of each month the test results shall be sent to the procuring activity and to the Naval Air Systems Command, Attention: Avionics Division. At any time that the current totals of test hours and test failures plotted on Test Plan II curves show a reject situation, the procuring activity shall be notified. The procuring activity reserves the right to stop the acceptance of equipment at any time that a reject situation exists pending a review of the contractor's efforts to improve the equipment, the equipment parts, the equipment workmanship, etc., so that the entire compilation will show other than a reject decision.

4.4.3.3 Test Details - The test details such as the length of the Test Cycle, the length of the heat portion of the cycle, the performance characteristics to be measured, special failure criteria, preventive maintenance to be allowed during the test, etc., shall be part of the test procedures to be submitted and approved by the procuring activity prior to the beginning of the Qualification Test Phase of the Reliability Assurance Tests.

4.4.4 Special Tests - Special tests shall be conducted on a quantity of equipments for the purpose of checking the effect of any design or material change on the performance of the equipment and to assure adequate quality control. The equipment selected for special tests may be selected from equipments previously subjected to the sampling or reliability assurance tests.

4.4.4.1 Special Tests Schedule - Selection of equipments for special tests shall be made as follows:

(1) On an early equipment after an engineering or material change.

(2) Whenever failure reports or other information indicate additional equipments should be tested. (This will be determined by the procuring activity.)

4.4.4.2 Scope of Tests - Special tests shall consist of such tests as are approved by the procuring activity. Test procedures previously approved for preproduction and sampling tests shall be used where applicable. When not applicable the contractor shall prepare a test procedure and submit it to the procuring activity for approval prior to conducting the tests.

4.4.5 Equipment Failure - Should a failure occur during either the sampling reliability assurance or special tests, the following action shall be taken:

(1) Determine the cause of failure.

(2) Determine if the failure is an isolated case or design defect.

(3) Submit to the procuring activity for approval, proposed corrective action intended to reduce the possibility of the same failure(s) occurring in future tests.

(4) Where practical, include a test in the individual test to check all equipment for this requirement until reasonable assurance is obtained that the defect has been satisfactorily corrected.

4.5 Life Test - The contractor shall furnish all samples and shall be responsible for accomplishing the life test. The life test shall be of 300 hours duration on all equipment, except the Reeling Machine, Cable, Hydraulic and Cable Assembly and Reel. These units shall be operated 1000 cycles, simulating 1000 dips in normal operation for the life test. The life test shall be conducted on equipments that have passed the individual test. The life test shall be performed under the conditions specified in paragraph 4.5.1. (Equipments which have successfully passed the Initial Production Test, Sampling Tests, Reliability Tests, or Special Tests may be selected for life tests.) When reliability tests are conducted, the life test may be omitted if, during the reliability tests, a quantity of equipments equal to, or more than, that listed below receive at least 300 hours each of test time.

Quantity of Equipments Offered for Acceptance	Quantity to be Selected for Life Test
First 25	1
Next 175	1
Next 300	1
	1 for each additional 500 or fraction thereof

4.5.1 Test Conditions - The life test shall be conducted under the following simulated service conditions.

Temperature	Normal room
Altitude	Normal ground (0-5000 ft.)
Humidity	Room Ambient
A.C. Voltage	108.5 to 117.5 volts (at lowest applicable frequency)
D.C. Voltage	27.0 ±2.0 volts

4.5.2 Test Periods - The test may be run continuously or intermittently. Any period of operation shall be of sufficient duration to permit the equipment temperature to stabilize. Periodically, the equipment shall be turned on and off several times and put through its various phases of operation.

4.5.3 Performance Check - At approximately 8-hour intervals during the tests a limited performance check shall be made. The performance check proposed by the contractor shall be subject to approval by the procuring activity.

4.5.4 Test Data - The contractor shall keep a daily record of the performance of the equipment, making particular note of any deficiencies or failures. In the event of part failures, the defective part shall be replaced and the operation resumed for the balance of the test period. A record shall be kept of all failures throughout the test, including all tube failures. This record shall indicate the following:

(1) Part type number

(2) The circuit reference symbol number

(3) The part function

(4) Name of the manufacturer

(5) Nature of the failure

(6) The number of hours which the part operated prior to failure

4.5.4.1 Failure Report - In the event of a failure, the government inspector shall be notified immediately. A report shall be submitted to the procuring activity upon completion of the test. In this report, the contractor shall propose suitable and adequate design or material corrections for all failures which occurred. The procuring activity will review such proposals and determine whether they are acceptable.

4.6 Test Procedures - The procedures used for conducting preproduction tests, acceptance tests and life tests shall be prepared by the contractor and submitted to the procuring activity for review and approval. The right is reserved by the procuring activity or the government inspector to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of this specification or the contract. Specification MIL-T-18303 shall be used as a guide for preparation of test procedures. When approved test procedures are available from previous contracts, such procedures will be provided and may be used when their use is approved by the procuring activity. However, the right is reserved by the procuring activity to require modification of such procedures, including additional tests, when deemed necessary.

4.7 Reconditioning of Tested Equipment - Equipment which has been subjected to acceptance and life tests shall be reconditioned by the contractor by replacing all wear or damaged items. After reworking, the contractor shall resubmit the equipment for acceptance.

4.8 Presubmission Testing - No item, part or complete equipment shall be submitted by the contractor until it has been previously tested and inspected by the contractor and found to comply, to the best of his knowledge and belief, with all applicable requirements.

4.9 Rejection and Retest - Equipment which has been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmittal, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the government inspector.

5. PREPARATION FOR DELIVERY

5.1 General - All major units and parts of the equipment shall be preserved, packaged, packed and marked for the level of shipment specified in the contract or order in accordance with specifications MIL-E-17555 and MIL-STD-794.

6. NOTES

6.1 Intended Use - The equipment covered by this specification is intended for installation and operation in an ASW helicopter and shall be utilized while airborne to detect, locate, track, and communicate with submerged objects in the vicinity of the immersed transducer.

6.2 Ordering Data - Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

(1) Title, number, and date of this specification.

(2) Selection of applicable levels of packaging and packing (see 5.1).

6.3 Precedence of Documents - When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply:

(1) Contract - The contract shall have precedence over any specification.

(2) This Specification - This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by the procuring activity.

(3) Referenced Specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

6.4 Performance Objectives - Minimum size and weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specified functions beyond the requirements of this specification are objectives which shall be considered in the production of this equipment. Where it appears a substantial reduction in size and weight or improvement in simplicity of design, performance, ease of maintenance or reliability will result from the use of materials, parts and processes other than those specified in Specification MIL-E-5400, it is desired their use be investigated. When investigation shows advantages can be realized, a request for approval shall be submitted to the procuring activity for consideration. Each request shall be accompanied by complete supporting information.

6.5 Non-Repairable Subassemblies - As a general rule non-repairable subassemblies should be encapsulated or hermetically sealed. The number of connections internal to the subassembly should be held to a minimum. Detail parts tolerances and ratings should be so selected that the life of the subassembly is greater than that of a similar repairable one. With few exceptions (such as high voltage power supplies), the non-repairable subassembly should evidence a Mean-Time-to-Failure greater than 5000 hours, and for many applications this figure must be nearer 50,000 hours.

6.6 The parentheses (*), when used in the type designation, will be deleted or replaced by either a number or letter furnished by the procuring activity upon application by the contractor for assignment of nomenclature in accordance with 3.3.8. The complete type number shall be used on nameplates, shipping records and instruction books, as applicable.

6.7 Asterisk - In specification revisions and superseding amendments an asterisk "*" preceding a paragraph number denotes paragraphs in which changes have been made from the previous issue. This has been done as a convenience only and the government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content as written, irrespective of the asterisk notations and relationship to the last previous issue.

*6.8 Associated Equipment -

(1) Hand Key

(2) Headset

(3) Drift Meters (2 axis) quantity 3 (100-0-100 microamperes)

(4) Voice Comm. Selector Switch

(5) Intermediate Speed Valve Selector Switch

(6) Guillotine Switch

(7) Funnel, Upper

(8) Funnel, Lower

Project No. 5845-N046

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the application of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION

MIL-D-81622A(AS) DETECTING-RANGING SET, SONAR AN/AQS-13A

ORGANIZATION

CITY AND STATE

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity - Optional)*

DATE

DD FORM 1426

REPLACES EDITION OF 1 OCT 54 WHICH MAY BE USED.

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Naval Air Systems Command
Washington, D.C. 20361

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