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26 November 1984
Superseding
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MILITARY SPECIFICATION

INDICATOR, BEARING - DISTANCE - HEADING; ID - 663D/U

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers design requirements and all performance requirements for the procurement of one type, Bearing - Distance - Heading Indicator ID-663D/U with integral lighting, and servoed pointers and compass card.

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications and Standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

BB-N-411	Nitrogen, Technical
QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (Electrodeposited)

Military

MIL-P-116	Preservation, Method of

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (code 93), Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SPECIFICATIONS

MILITARY (Continued)

MIL-M-3171	Magnesium Alloy, Processes for Pretreatment and Prevention of corrosion on
MIL-E-5400	Electronic Equipment, Aerospace General Specification for
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-C-5824	Course Indicator ID-250A/ARN
MIL-S-7742	Screw Threads, Standard, Optimum Selection Series, General Specification for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-C-14806	Coating, Reflection Reducing, for Instrument Cover Glasses and Lighting Wedges
MIL-T 18303	Test Procedures; Preproduction, Acceptance and Life for Aircraft Electronic Equipment, Format for
MIL-S-20708	Synchros, General Specification for
MIL-P-23408	Plating: Tin-Cadmium (Electrodeposited)
MIL-L-25467	Lighting, Integral, Red, Aircraft Instrument, General Specification for
MIL-L-27160	Lighting, Instrument, Integral, White, General Specification for
MIL-G-81704	Glass, Aircraft Instrument, Lighting Wedge and Cover

SPECIFICATIONS

STANDARDS

FEDERAL

FED-STD-595	Colors

MILITARY

MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-781	Reliability Tests, Exponential Distribution
MIL-STD-785	Reliability Program for System and Equipment Development and Production
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-889	Dissimilar Metals
MIL-STD-2074	Failure Classification for Reliability Testing
MS24241	Connector-Receptacle, Electrical, Hermetic, Jam nut, Front mounting

STANDARDS

MILITARY (Continued)

MS33558	Numerals and Letters, Aircraft Instrument Dial, Standard Form of
MS33638	Cases, Instrument, Flange-Mounted, Aircraft
MS33737	Nuts, Self-Locking, Clip-In-Type, Instrument Mounting

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications

American Society of Testing and Materials

ASTM-STD-B633-78	Zinc on Iron and steel, Electrodeposited coatings of

(Copies of American Society of Testing and Materials standards should be obtained from:

American Society of Testing and Materials
1916 Race Street
Philadelphia, PA 19103)

3. REQUIREMENTS

3.1 Qualification - Indicators furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4. and 6.).

3.2 Selection of government documents. Except as provided in 3.2.1 and 3.2.2, specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.2.1 Standard parts. With the exception of 3.2.2, MS and AN standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.2.2 Commercial parts. Commercial parts having suitable properties shall be used when, on the date of invitations for bids, there are no suitable standard parts. In any case, commercial parts such as screws, bolts, nuts, cotter pins, having suitable properties, may be used provided:

(a) They can be replaced by the standard parts (MS or AN) without alteration.

(b) The corresponding standard part numbers are referenced in the parts list, and if practicable, on the contractor's drawings.

3.3 Materials. Materials shall conform to applicable specifications and shall be as specified herein. Materials for which there are no applicable specifications, or which are not specifically described herein, shall be of the best quality, of the lightest practicable weight and suitable for the purpose intended.

3.3.1 Critical materials. Noncritical materials shall be used where practicable. Where the use of a critical material is essential to meet specification requirements, the material used shall be the least critical of those which are adequate for the purpose.

3.3.2 Nonmagnetic materials. Nonmagnetic materials shall be used for all parts of the indicator except where magnetic materials are essential.

3.3.3 Metals. Metals shall be of the corrosion resistant type, or shall be suitably protected as specified herein to resist corrosion due to fuels, salt spray, or atmospheric conditions to which the indicator may be subjected when in storage or during normal service life.

3.3.3.1 Dissimilar metals. Dissimilar metals as defined in MIL-STD-889 shall not be used in intimate contact with each other, unless protection against electrolytic corrosion is provided.

3.3.3.2 Magnesium alloy parts. Magnesium alloy parts shall be treated in accordance with MIL-M-3171. When abrasion resistance is a factor, an anodic treatment approved by the procuring activity shall be used.

3.3.3.3 Aluminum alloy parts. Unless otherwise specified, aluminum alloy parts shall be covered with an anodic film conforming to MIL-A-8625. Small holes, pipe threads, and case inserts need not be anodized. Aluminum alloys which do not anodize satisfactorily shall be coated with a chemical film in accordance with MIL-C-5541.

3.3.3.4 Iron and steel parts. Iron and steel parts which are in hermetically sealed cases shall be cadmium plated in accordance with QQ-P-416. Parts which are not in sealed cases shall be chromium, nickel, or zinc plated in accordance with QQ-C-320, QQ-N-290, or ASTM-STD-B633-78, respectively. Parts in a confined space in the presence of organic material shall be tin-cadmium plated in accordance with MIL-P-23408. The class and type of plating shall meet the requirements of 3.3.4.

3.3.4 Protective treatment. When materials are used in the construction of the indicator that are subject to atmospheric or environmental conditions likely to cause corrosion in normal service life, they shall be protected against corrosion in a manner that will in no way prevent compliance with the performance requirements of this specification. Finishes and protective coatings which will crack, chip, or scale during normal service life or are affected by extremes of atmospheric or environmental conditions, shall not be used.

3.3.5 Fumes and vapors. Materials used in the construction of the indicator shall not produce corrosive, deleterious, toxic fumes or vapors under the conditions specified herein.

3.4 Design and construction. The indicator shall convert 26/11.8 volt type synchro signals furnished by associated equipment of 6.1 into numerical indications of distance and pointer-dial indications of heading and bearing. The indicator shall display distances from 000 up to 1999 nautical miles. The compass card and the two bearing pointers shall display heading and bearing information throughout 360 degrees of rotation. The distance presentation shall be positioned by synchro receivers. Bearing pointers and compass card shall be positioned by a self-contained servo-mechanism and amplifier controlled by the error signal of a synchro control transformer. The servo components shall be inter-changeable. The indicator shall be so constructed that no parts will work loose in service and will withstand the normal shocks, vibrations, and such other conditions as are incident to service, shipping, storage, and installation without a failure.

3.4.1 Maintenance. The design shall be such as to facilitate as much as possible disassembly, repair or overhaul, service maintenance, and reassembly using those tools and items of maintenance equipment which are normally available as commercial standards.

3.4.2 Case. The case shall conform to MS33638 for the 3-inch size. The dimension "L" shall not exceed 7.5 inches. The case and mounting flange shall be made of nonferrous material, uniform in texture, having a smooth surface, and shall be hermetically sealed. The case shall be finished with a lusterless black material, Color No. 37038 of FED-STD-595. The finishing material shall be of a durable type to withstand usage encountered in service.

3.4.2.1 Hermetic sealing. The case shall provide a hermetically sealed enclosure for all of the mechanism. The case shall be so constructed that it may be opened, the mechanism removed, replaced, and the case resealed at least three times. This shall be possible without the use of any special tool, jig or fixture, unless such device is specifically approved by the procuring activity. The sealing of the case shall not be dependent upon any material which will be adversely affected by any environment to which the indicator may be subjected in normal use in military aircraft.

3.4.2.2 Filling medium. The filling medium shall be a mixture of 90 percent nitrogen and 10 percent helium or a filling medium approved by the procuring activity. The nitrogen used shall be in accordance with BB-N-411, Type I, class 1, Grade C. The filling medium shall not contain more than 0.006 milligram of water vapor per liter (dew point -65°C) at the filling pressure. The absolute pressure of the filling medium in the case shall be 1 $\pm$ 0.1 atmosphere.

3.4.3 Weight. The weight of the completely assembled indicator shall not exceed 3.5 pounds.

3.4.4 Screw threads. Screw threads shall be in accordance with Requirement 12, Application of Fastener Hardware, of MIL-STD-454 and MIL-S-7742.

3.5 Electrical requirements.

* 3.5.1 Electrical power requirements. The indicator shall meet all applicable requirements and shall give specified performance from the following power sources with characteristics as defined in MIL-STD-704, where applicable, having limits as specified herein. The power required shall not exceed the specified amounts.

(1) AC Power (Single Phase)

26 Volt (Constant Frequency)	
Operating Voltage Limits	24 to 28 Volts
Operating Frequency Limits	380 to 420 HZ
Power	45 VA

(2) DC Power 28 Volt System

Operating Voltage Limits	25 to 29 Volts
Power	12 Watts

(3) AC or DC Power 5 Volts

Operating Voltage Limits	4.9 to 5.1 Volts
Power Red or White Lighting	4.0 Watts Each

3.5.2 Undervoltage protection. The indicator shall not be damaged by voltages below the minimum specified and shall automatically resume normal operation when the voltage is within the specified limits.

3.5.3 Electronic parts. Electronic parts and the application thereof shall be in accordance with MIL-E-5400.

* 3.5.4 Illumination of display. The indicator shall be provided with 5-volt integral lighting in accordance with MIL-L-25467 and MIL-L-27160.

* 3.5.5 Lamps. The lamps shall be located within the case and shall conform to MIL-L-25467 and MIL-L-21760.

* 3.5.6 Electric connector. The electric connector used shall be a hermetically sealed MS24241M21-30N or an approved equivalent.

* 3.5.7 Electrical connections. The connections shall be made to the connector mounted on the indicator for the following external circuits.

A. Lead "Y" of compass card synchro
B. Lead "X" of compass card synchro
C. Lead "Z" of compass card synchro
D. Lead "C" of compass card synchro/servo and internal ground connection for 28 Vdc and 5 V lighting
E. Lead "Z" and "C" of single bar bearing pointer sychro/servo
F. Lead "Y" of single bar bearing pointer sychro
H. Lead "X" of single bar bearing pointer sychro
J. 26 Vac "H" single bar bearing pointer servo
K. 26 Vac "H" compass card servo

L. Lead "H" of all distance synchro receivers
M. Lead "X" of double bar bearing pointer synchro
N. Lead "Y" of double bar bearing pointer synchro
P. Lead "Y" of hundreds synchro receiver
R. Lead "X" of hundreds synchro receiver
S. Lead "X" of tens synchro receiver
T. Lead "Y" of tens synchro receiver
U. Lead "Y" of units synchro receiver
V. Lead "X" of units synchro receiver
W. Lead "Z" and "C" of all distance synchro receivers
X. +28 V dc servo amplifier power
Y. +28 V dc warning flag and thousands flag excitation
Z. "OFF" warning flag control (-)
a. 26 Vac "H" double bar pointer servo
b. Lead "Z" and "C" of double bar pointer sychro/servo
c. Thousands flag control (-)
d. 5V lighting (RED)
f. 5V lighting (WHITE)
g. Compass card CT test point (Optional)
h. Single Bar CT test point (Optional)
i. Double Bar CT test point (Optional)

3.5.8 Note: Synchro leads "H" (hot), "C" (cold) (26 V ac, 400 Hz), "X", "Y", "Z" are designated as defined in MIL-C-5824 for Course Indicator ID-250A/ARN.

* 3.5.9 Synchro impedance. Each of the three distance indications (units, tens, hundreds) shall be positioned by torque receiver synchros having a minimum impedance of 100 ohms for the rotor (Zro), 45 ohms for the stator (Zso), 10 ohms for stator (Zss) and nominal 26/11.8 volts 400 Hz. Each of the two bearing pointers and the compass card shall be positioned by a servo system having a synchro control transformer with a minimum input impedance of 500 ohms and nominal stator voltage of 11.8 volts max, 400 Hz.

3.5.9.1 Mechanical drive. Connections between the synchros and their corresponding dials or pointers shall be at a ratio of 1 to 1 and as direct as possible.

3.5.9.2 Voltage. The synchros shall operate from a voltage source of 26 volts, 400 $\pm$ 20 Hertz.

3.5.9.3 Synchro Zero. Zero (North) indication of the compass card and of the distance indicators shall correspond to synchro zero of the synchros as defined in MIL-C-5824. Synchro zero of the bearing pointer synchros shall correspond to a bearing indication of 180° (S) when 0° (N) of the compass card is positioned under the lubber line.

3.5.10 Interchangeability. Requirement 7, Interchangeability, of MIL-STD-454 applies.

3.5.11 Fungus resistance. Fungus resistance shall be in accordance with Requirement 4, Fungus-Inert Materials, of MIL-STD-454.

3.5.12 Soldering. Soldering shall be in accordance with Requirement 5, Soldering Requirements for Electronic Equipment, of MIL-STD-454.

3.5.13 Workmanship. Workmanship shall be in accordance with Requirement 9, Workmanship on Electronic Equipment, of MIL-STD-454.

3.6 Dial and pointers and distance counters.

3.6.1 Dial. The dial shall be securely mounted in such a manner that it will not loosen or slip when the indicator is vibrated. If screws are used, they shall be so located that they will not interfere with the proper location of any dial marking.

3.6.1.1 Visibility of dial. The pointers, numerals, at least 1/16" of the shortest graduations, and all other specified markings on the dial shall be visible from any point within the frustum of a cone whose side makes an angle of 30° with a perpendicular to the dial and whose small diameter is the aperture of the case.

3.6.1.2 Dial/counter markings shall be marked as shown in Figure 1. Unless otherwise specified, all visible portions shall be lusterless black Color No. 37038 of FED-STD-595 and all markings shall be lusterless white Color No. 37875 of FED-STD-595. The colors shall not change as a result of service use or subjecting the indicator to the inspections specified herein. The form of the numerals and letters shall be in accordance with MS33558. Numerals shall distinctly indicate the graduation to which each applies. If practicable, each numeral shall be placed so that the center of area of the numerals is on the radial line joining the appropriate graduation and the center of the dial. Any confusion resulting in doubt as to the graduation to which the numeral applies shall be cause for rejection. When several numerals are used in one group, the space between the numerals shall not be less than 1/64 inch.

3.6.1.3 Pointers. The pointers of the indicator shall be firmly attached to the mechanism but also shall be readily adjustable. The shaded portion of the pointers shall be finished lusterless white, Color No. 37875 of FED-STD-595. The unshaded portion shall be finished lusterless black, Color No. 37038 of FED-STD-595. The pointers shall be suitable for integral lighting and shall conform to Figure 1.

3.6.1.4 Graduations. The units distance counter shall be graduated in half-mile divisions as read against a stationary index. Compass and bearing divisions shall be every 2-1/2 degrees and heading information shall be indicated by means of stationary lubber indices as shown in Figure 1.

3.6.1.5 Compass card. The compass card shall be a stepped dial elevated toward the cover glass enough to establish the surface of the bearing pointer in the same plane as the surface of the compass card. The space between the pointed end of the double bar pointer and the inner ends of the azimuth card large graduations shall be held to the absolute minimum required for clearance.

3.6.1.6 Numerals. Numbers (0-9) on each distance indication shall be spaced 36 degrees apart and shall be 7/32" high. Numerals on the compass card shall be as shown in Figure 1.

3.6.1.7 Rotation of counters. All distance indications shall rotate so that the numerals in the window travel to the right for increasing values of distance.

3.6.1.8 Flag alarm. A flag alarm shall be provided and marked with the word "OFF." The flag shall partially obscure the numerals of the distance indicator and shall indicate "OFF" when the flag alarm circuit is not energized.

* 3.6.1.9 Cover glass. The cover glass shall be flat and free from discolorations, scratches, and striae which interfere with normal reading of the indicator and shall comply with MIL-G-81704 Type I. The space from the distance indication counters to the innermost glass surface shall not exceed 0.28 inch. The lighting wedge/cover glass system thickness shall not exceed 0.25 inch.

* 3.6.1.10 Anti-reflection coating. All reflecting glass surfaces of the cover glass and lighting wedge shall be covered with a reflection reducing coating that meets the requirements of MIL-C-14806 in addition to withstanding the environmental requirements specified herein.

* 3.6.1.11 Lighting. The indicator shall be provided with integral lighting in accordance with MIL-L-25467 and MIL-L-27160. The current required for either lighting circuit in the indicator shall not exceed 1 ampere AC or DC. The lighting shall be subject to approval of the procuring activity.

* 3.6.1.11.1 Prime standard. The internal lighting shall be comparable to and shall balance in brightness with a prime standard indicator. The prime standard shall be either a BDHI conforming to the requirements of this specification or a lighted model. The prime standard shall be equipped with red and white lighting and shall be used as a reference for acceptance of all production indicators.

* 3.6.1.11.2 Visual comparison. The general overall lighting level of the indicator shall fall within the limits of the prime standard when energized at the voltage levels specified.

3.7 Service conditions. The indicator shall operate satisfactorily under any of the environmental service conditions or conditions specified herein.

3.7.1 Reliability. The contractor shall conduct a reliability program using MIL-STD-785 as a guide. On a reorder from a supplier who has previously produced the equipment, the program previously used may be continued unless otherwise indicated in the contract or order.

3.7.2 Reliability in mean-time-between-failures. The indicator shall have 1,000 hours of mean (operating) time between failures.

3.7.3 Operating life. The operating life of the indicator shall exceed 5,000 hours with reasonable servicing and replacement of parts as specified by the contractor.

3.7.4 Interference control. The generation of radio interference by the indicator and the vulnerability of the indicator to radio interference shall comply with the requirements of MIL-STD-461 and MIL-STD-462.

* 3.8 Nameplate. A nameplate shall be securely attached to the exterior of the case and shall be marked in accordance with the requirements of MIL-STD-130 except that the NSN shall be omitted. The serial number shall be permanently attached to the rear exterior of the case.

3.8.1 Manufacturer's part number. The manufacturer's part number on the nameplate shall be identical with the manufacturer's engineering production drawing number including applicable dash numbers if the drawing is tabulated and covers more than one part.

3.9 Mounting hardware. The mounting flange shall be capable of retaining clip-in lock nuts conforming to MS33737-11.

3.10 Data requirements. No data are required by this specification (other than reports accompanying samples submitted for testing) or by applicable documents, unless specified in the contract or order. (See paragraph 6.2.)

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. Inspection of the indicators shall be classified as follows:

a. Qualification inspection: Qualification inspection consists of examination and tests performed on sample indicators submitted for approval as a qualified product.

b. Quality conformance inspection: Quality conformance inspection consists of examinations and tests performed on indicators manufactured and submitted for acceptance under contract.

4.3 Qualification inspection. The qualification inspection of the indicators shall consist of all of the examinations and tests of this specification performed in the order specified under the paragraph headed Inspection methods.

4.3.1 Qualification inspection sample. Qualification inspection samples shall consist of three indicators manufactured in accordance with this specification. The indicators submitted for qualfication inspection shall have been previously subjected only to the individual inspections. The samples shall be forwarded at the contractor's expense, to the laboratory designated in the Letter of Authorization.

* 4.3.1.1 Qualification inspection sample identification. The qualification inspection samples shall be plainly identified by durable tags, securely attached, and marked with the following information:

Sample for Qualification Inspection
INDICATOR, BEARING - DISTANCE - HEADING ID-663D/U
Submitted by (manufacturer's name, date)
for Qualification Inspection in accordance
with Specification MIL-I-22075 under
authorization (reference letter authorizing tests).
Manufacturer's Part Number _____

4.4 Quality conformance inspection. The Quality conformance inspection shall consist of the Individual inspection, the Sampling plans, and the Reliability assurance tests of this specification. The contractor shall furnish all samples and shall be responsibile for accomplishing all the inspections. Sampling plan B inspections shall be conducted at a Government laboratory designated by the procuring activity. Quality conformance inspection, except for Sampling plan B, shall be under the supervision of the Government quality control representative. The contractor shall furnish test reports showing quantitative results for all tests required by this specification, signed by an authorized representative of the contractor or laboratory as applicable. Acceptance or approval of material during the course of manufacture shall in no case be construed as a guarantee of the acceptance of the finished product.

* 4.4.1 Individual inspection. Each indicator submitted for acceptance shall be subjected to the Individual inspection. This inspection shall determine compliance with the requirements of material, workmanship, operational adequacy, and reliability. As a minimum, each indicator accepted shall have passed the following inspection:

Examination of product
Illumination of display
Position error
Dielectric strength
Accuracy tests
Friction error
Damping
Indicator speed
Flag alarm
Case Leakage
Synchro impedance

4.4.2 Sampling plans. The Sampling plans shall consist of Sampling plan A and Sampling plan B inspections. The inspection samples selected for sampling tests shall first have passed the Individual inspection. The inspection samples which have been subjected to Sampling plan A inspection shall not be delivered on contract until they have been refurbished and resubmitted and passed all the Individual inspections. Inspection samples which have been subjected to the Sampling plan B inspection shall not be delivered on contract.

4.4.2.1 Sampling plan A sample selection. Sampling plan A samples shall be selected at random in accordance with the following schedule:

Quantity Offered for Acceptance	Quantity to be Selected for Inspection
First 15	1 (zero when sampling plan B is invoked)
Next 50	1
Next 75	1
Next 100	1
Each additional 200 or fraction thereof	1

* 4.4.2.1.1 Sampling plan A inspection. Each sample selected for Sampling plan A inspection shall be subjected to the following tests in the order listed:

Magnetic effect
High altitude - low temperature
High temperature operation
Power consumption
Fogging
Vibration error
Lighting (Sampling Plan A)

4.4.2.2 Sampling plan B instruction. Two indicators shall be selected at random from the first 15 produced on contract and submitted within 10 days after manufacture. These samples shall be forwarded, at the contractor's expense, to a Government laboratory designated by the procuring activity. Each sample shall be plainly identified by a durable tag, securely attached and marked with the following information:

INDICATOR, BEARING - DISTANCE - HEADING ID-663D/U
Submitted by (Manufacturer's name, date)
for production Acceptance Sampling Plan B inspection of MIL-I-22075, in accordance with Contract/Order No. _____
Manufacturer's part number _____

* 4.4.2.2.1 Sampling plan B inspection. Each sample for Sampling plan B inspection shall be subjected to the following tests in the order listed:

Sampling plan A
Low temperature exposure
High temperature exposure
Vibration failure
Impact shock
Radio noise interference
Salt fog
Lighting contrast
Temperature shock
Test for helium

* 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 Reliability Assurance Production Acceptance Phase shall be conducted. Classification of failures shall be in accordance with MIL-STD-781 and MIL-STD-2074.

* 4.4.3.1 Qualification phase. Prior to the acceptance of equipment 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 F shall be used. The Accept-Reject Criteria for Test Plan III shall be used.

* 4.4.3.2 Reliability assurance production acceptance phase. Reliability assurance production acceptance phase testing shall be conducted through a burn-in. Each equipment produced shall pass a minimum of 100 hours Burn-In Test. Any failure occurring during the last 25 hours which requires component changes or major recalibration, shall be subjected to additional 25 hours of burn-in after completion of repairs. (The 100 hours shall be completed plus an additional 25 hours, a total of 125 hours). Units accumulating 200 hours or more shall be overhauled (bearings replaced and other wear parts replaced as necessary) and resubmitted to the minimum 100 hours Burn-In Test. The equipments shall be subjected to and shall meet the requirements of the individual tests after completion of the Burn-In Test. During the burn-in period, the equipments shall be subjected to the following environmental conditions:

Temperature	-54°C to +55°C (-65°F to 131°F)
Temperature cycling	Temperature cycling shall be time to stabilize at low temperature followed by time to stabilize at the high temperature, plus 2 hours.
Vibration	2.2G +10-0% peak acceleration value at any nonresonant frequency between 20 and 60 cps measured at the mounting points on the equipment. The duration of vibration shall be at least 10 minutes during each hour of operating time.
Equipment On-Off Cycling .	Equipment off during cooling cycle and on during heating cycle. Only the on time shall be used for the minimum 100 hours.
Input Voltage	Nominal specified voltage +5 -2%

* 4.4.3.2.1 Thermal survey. A thermal survey shall be made of the equipment to be tested, under the temperature cycling and duty cycle of the test level required, prior to initiation of testing for the identification of the component of greatest thermal inertia and the establishment of the time temperature relationships between it and the chamber air. These relationships shall be used for determining equipment thermal stabilization during the test. The lowest test level temperature stabilization takes place when the rate of change of the point of maximum thermal inertia at the upper temperature limit is less than 2°C/hour. The techniques and results of the thermal survey shall be described, plotted, submitted to and approved by the procuring activity prior to the initiation of testing. Temperatures of the heating-cooling air shall be recorded continuously during both survey and testing. The equipment thermal survey need be made only once for each identical equipment type representative of the manufacturer's normal production under the current production.

* 4.4.3.2.2 Test chambers. Test chambers shall be capable of maintaining the ambient and forced air temperatures at the specified test level temperatures + 2°C during the test. The rate of temperature change of the thermal medium in both the heating and cooling cycles shall average not less than 5°C/minute. Chamber and forced air temperatures shall be monitored continuously. Thermostats shall be installed to interrupt the programming motor used in automatic control of environmental cycling until maximum and minimum air temperature requirements are satisfied. The time to stabilize at both temperatures shall be determined for use during the test.

* 4.4.3.3 Test details. Test details such as the length of the temperature profile, duty cycle, the performance characteristics to be measured, special failure criteria, preventive maintenance to be allowed during 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 and the Reliability Assurance Production Acceptance Phase of the Reliability Assurance tests.

* 4.4.3.3.1 Duty cycle. The duty cycle shall consist of cycling the bearing pointers, compass card, and distance presentation at a rate of 20 degrees per second. The direction of rotation shall be reversed every two minutes. When the compass card is rotating in the CCW direction the 1000's flag shall be out of view. When the compass card is rotating in the CW direction the 1000's flag shall be in view. The indicator lighting shall be energized. When the indicator is "off," the flag alarm shall appear.

4.4.3.3.2 Performance characteristics to be measured. The accuracy tests, indicator speed, and flag alarm tests, paragraphs 4.6.5, and 4.6.8, and 4.6.9, shall be conducted at least once each week. The indicator shall be observed daily, on regular working days, for any obvious failure.

4.4.3.3.3 Failure criteria. Whenever performance characteristics fail to meet any one of the requirements for the accuracy test (4.6.5), indicator speed test (4.6.8), and the flag alarm test (4.6.9), at least one failure has occurred. Should a failure occur during the reliability test, 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), and

(4) Include a test under the individual inspection (4.4.1) to check all equipments for this requirement until reasonable assurance is obtained that the defect has been satisfactorily corrected.

4.4.3.3.4 Preventative maintenance. During the period of the tests, no preventive maintenance measures may be performed on the indicator.

* 4.4.3.3.5 Disposition of equipment. Indicators that have been subjected to the reliability qualification tests shall not be delivered on the contract until they have been refurbished, resubmitted, and passed the individual inspection of 4.4.1.

4.5 Inspection conditions.

4.5.1 Standard conditions. Unless otherwise specified, all inspection required by this specification shall be made under the following conditions:

Temperature	Room ambient 25° ± 5°C
Pressure	Normal atmospheric
Humidity	Room ambient
Input Power	26 ± 0.5 V ac 400 ± 5 Hz 27.5 ± 0.5 V dc 5 ± 0.1 V ac or dc

4.5.2 Test readings. Unless otherwise specified, before a test reading is taken the indicator shall be vibrated using a vibrator set at 30 cps, 60 cps, or 120 cps with a maximum amplitude of 0.002 inch.

4.5.3 Attitude. Unless otherwise specified, the indicator shall be tested in its normal operating position.

* 4.5.4 Integral lighting. The indicator lighting system shall be energized during all tests except salt fog or as otherwise specified herein and shall operate satisfactorily when energized. The lighting shall operate satisfactorily before, during, and after completion of each test unless otherwise specified herein.

* 4.5.5 Warm-up. A 10 minute warm-up period will be permitted prior to testing under low temperature conditions.

4.5.6 Tolerances. Tolerances indicated for room temperature tests shall also apply to environmental tests.

4.6 Inspection methods.

4.6.1 Examination of product. Each indicator shall be examined to determine conformance with specification requirements for dimensions, weight, color, markings, nameplate, and workmanship.

* 4.6.1.1 Accuracy test during environmental tests. The accuracy test required in 4.6.11, 4.6.12, 4.6.19, 4.6.20 shall be performed as follows:

Compass card at 0, 90, 180, and 270 degrees in both CW and CCW directions.

Pointer #1 and 2 at 180, 270, 0, and 90 degrees in both CW and CCW directions.

Distance presentation at 0-3-7 numbers for unit, tens, hundreds.

* 4.6.2 Illumination of display. The indicator shall be tested for comparison with the prime standard in accordance with Specifications MIL-L-25467 and MIL-L-27160.

* 4.6.2.1 Prime standard. Using parts which are identical to the parts to be used in production indicators, an indicator shall be constructed which meets all display requirements of MIL-L-25467 and MIL-L-27160. The indicator model and recorded lighting data shall be submitted to the procuring activity for approval, and if approved, the indicator model shall be certified as a prime standard.

* 4.6.2.2 Prime standard life. A minimum of 12 average areas covering all representative areas of the face of the prime standard shall be measured for brightness and color prior to submission, and at least every 50 hours of operation thereafter. A change of $\pm$20% brightness or $\pm$5% color change in any area using the initial data as a reference voids the prime standard certification.

* 4.6.2.3 Production (visual comparison). With 2.50 $\pm$ .01 volts simultaneously applied to the indicator under test, and to the prime standard, like areas of the warning flag, moving background, numerals, indicia, markings, etc., shall be compared. Overall uniformity, similarity, and brightness of the test indicator to that of the prime standard shall be observed. Like comparison of the test indicator to the prime standard shall allow for acceptance. If the brightness is dissimilar in any individual area, 2.40 and 2.60 volts shall be applied consecutively to the prime standard. The brightness of the production indicator at 2.50 $\pm$ 0.1 volts shall fall within the brightness of the prime standard when set at 2.40 and 2.60 volts. A color comparison test shall be made with the prime standard and production indicator energized with 5.0 $\pm$ 0.1 volts. The indicators shall be identical in color. If any questionable areas still exist, they shall be measured with a photometer in accordance with the requirements of MIL-L-25467 and MIL-L-27160. If the production indicator fails this test, it shall be rejected and returned for rework.

4.6.3. Position error. With the indicator connected as described in 4.6.5.1, 4.6.5.2, 4.6.5.3, and 4.6.5.4 and with the indicator in the normal upright position, the indications for heading, bearing and distance shall be noted. With the indicator held in any other position, the indications shall not differ from their original setting by more than the following:

Distance	0.1 unit
Compass Card	1 degree
Bearing Pointers	1 degree

4.6.4 Dielectric strength. A potential of 200 volts (root mean square) alternating current at 60 Hertz shall be applied between isolated pins and the case for a period of 5 seconds. There shall be no breakdown of insulation or any other permanent damage to the indicator as a result of this test. Calculated leakage resistance shall exceed 20 megohms.

* 4.6.4.1 Insulation Resistance. With a potential of 500 volts direct current applied for 5 seconds between isolated circuits and between circuits and the case, the resistance shall be greater than 50 megohms.

4.6.5 Accuracy tests.

4.6.5.1 Compass card. With the indicator connected as shown in Figure 2, and SW #1 and SW #2 in the "B" position, the compass card transmitter B1, shall be rotated in a clockwise direction, from zero through 360 degrees in increments of 30 degrees. This test shall be repeated for rotations of the transmitting synchro in a counterclockwise direction. The compass card indication shall be monitored continuously and shall not differ from the synchro transmitter setting by more than one degree at any point during this test.

4.6.5.2 Single bar bearing pointer. With the bearing pointer transmitter B3, zeroed per MIL-C-5824, the single bar bearing pointer shall be at the 180 degree index position of the indicator. The single bar bearing pointer shall be rotated from zero through 360 degrees, in both a clockwise and counterclockwise direction, in increments of 30 degrees. During this test SW #1 shall be at "B" position and SW #2 shall be at "A" position of Figure 2. The pointer shall be monitored continuously and shall not differ from the transmitter synchro setting by more than one degree at any point during this test.

4.6.5.3 Double bar bearing pointer. With the bearing pointer transmitter B3, zeroed as in 4.6.5.2, the double bar bearing pointer shall be rotated from null through 360 degrees, in both a clockwise and counterclockwise direction, in increments of 30 degrees. During this test SW #1 shall be at "A" position and SW #2 shall be at "B" position of Figure 2. The pointer shall not differ from the transmitter synchro setting by more than one degree at any test point.

4.6.5.4 Distance presentation. Each test transmitter synchro (B4, B5, B6) shall be rotated, starting at null, through 360 degrees, in increments of 36 degrees. The appropriate distance digit of the indicator shall align itself ± 3.6 degrees to the apex of the distance index for each increment of rotation, when compared to the applicable test transmitter synchro setting.

4.6.5.5 System compatibility, tacan search mode.

4.6.5.5.1 Bearing input variation. Tacan search mode operation shall be simulated by changing the bearing input synchro B2, at a rate of 70 ± 10 degrees per second. The mean magnetic heading displayed by the compass card shall not change by more than 1-1/2 degrees from that observed when the bearing was fixed. The compass card shall not oscillate during the search mode by more than 2 degrees double amplitude. The heading synchro B1 input shall be held stationary. During this test SW #1 shall be at "A" position while SW #2 is at "B" position. The test shall be repeated with SW #1 at "B" position and SW #2 at "A" position.

4.6.5.5.2 Heading input variation. The heading input synchro B1 shall be varied at a rate of 20 ± 2 degrees per second in a clockwise direction and then in a counterclockwise direction. The bearing input synchro B2 shall be held stationary. The mean difference between the clockwise and the counterclockwise reading of each pointer shall not exceed 4 degrees in the dynamic test with the pointer connected to synchro B2. To test the single bar pointer (pointer #1), SW #1 shall be at "A" position and SW #2 shall be at "B" position. To test the double bar pointer (pointer #2), SW #1 shall be at "B" position and SW #2 shall be at "A" position. The mean difference between the clockwise and counterclockwise readings of each pointer shall not exceed 7 degrees in the dynamic test with both pointers connected in parallel to synchro B2. For this test, SW #1 and SW #2 shall be at "A" position.

* 4.6.6 Friction error. The friction testing of synchro receivers for bearing pointers and distance display may be combined with the accuracy testing of 4.6.5 by gradually and smoothly making test transmitter settings without overshoots. The difference in indicator readings before and after vibration (see 4.5.2) can be termed the synchro friction error for purposes of this specification. The friction limit for the bearing pointers shall be one degree of arc. The friction level of the distance display shall not exceed 3.6 degree of arc.

4.6.7 Damping. The indicator shall be connected as shown in Figure 2 with no electrical power applied to the rotor of the test synchro transmitter.

4.6.7.1 Pointer damping. The rotor of the B3 test synchro transmitter shall be displaced 175 degrees from the indicator's pointer position. Electrical power shall be applied and the indicator's pointer shall move to the new position, coming to a complete stop at 175 ± 1 degrees, from the previously indicated position, within 3 seconds. This test shall be repeated for the other pointer.

4.6.7.2 Compass card damping. The rotor of the B1 test synchro transmitter shall be displaced 30 degrees from the position indicated by the compass card. Electrical power shall be applied and the compass card shall move to the new position, coming to a complete stop at 30 ± 1 degrees, from the previously indicated position, within 2 seconds.

4.6.7.3 Distance indicator damping. The rotor of each B4, B5, and B6 test synchro transmitter shall be displaced 144 degrees from the indicated position for each respective distance dial of the indicator. Electrical power shall be applied and each distance dial shall move to the new position, coming to a complete stop at 144 ± 3.6 degrees, from their previously indicated positions, within 3 seconds.

* 4.6.8 Bearing and heading speed. With the indicator connected, as shown in Figure 2, the test transmitter synchro rotors shall be displaced first in the clockwise direction and then in a counterclockwise direction at the rates indicated below. The indicator shall change these input signals into the appropriate display. The display signals shall not lead or lag the input signals by more than 2 degrees when transferred into an electrical measurement of the CT rotor output. The procedure used for measuring the 2 degree lead or lag shall be approved by the procuring activity.

	Transmitter	Rate	Switch Position
Compass Card	B1	30 degrees/sec	SW #1B, SW #2B
Bearing Pointers,			
Single Bar	B3	90 degrees/sec	SW #1B, SW #2A
Double	B3	90 degrees/sec	SW #1A, SW #2B

* 4.6.8.1 Distance speed. Each distance indicator dial shall follow an input signal changing at a rate shown below, first in a clockwise direction and then a counterclockwise direction without damage and with no tendency for the dials to spin. No cumulative error shall be produced and each indicator dial shall read correctly after the speed is reduced to 12 degrees per second. The maximum allowable lag transferred from an electrical measurement shall not exceed 7 degrees using a measuring system compatible with Figure 3.

	Transmitter	Rate
Distance Presentation	B4, B5, B6	180 degrees/sec

4.6.9 Flag alarm. With the indicator connected as shown in Figure 2 and with the switch open, the flag alarm shall partially obscure (see Figure 1) the numerals on the distance indication and indicate "OFF." When the flag alarm switch is closed the flag shall disappear revealing the numerals. The flag alarm operating current shall not exceed 5.0 milliamperes.

4.6.9.1 Thousand mile digit. With the indicator connected as shown in Figure 2 and with the switch open, the thousand mile digit shall not be in view. When the thousand mile digit switch is closed the digit "1" shall center in the window.

4.6.10 Magnetic effect. The indicator shall be properly connected and power applied. The indicator shall be revolved about a short bar magnet compass with the nearest part of the indicator 5-1/2 inches from the bar magnet. The compass shall have its compensating magnets removed and shall be set up in a uniform magnetic field whose horizontal intensity is between 0.17 and 0.19 oersted. The indicator shall be revolved in a horizontal plane which is perpendicular to the axis of the bar magnet. The indicator shall be held in positions 0, 45, 90, 135, 180, 225, 270, 315 degrees. At each of these positions the indicator shall be rotated 360 degrees about its horizontal axis. The deflection of the compass at any of the specified positions shall not exceed three degrees. This test shall be repeated with no power applied. The same tolerance shall apply.

* 4.6.11 High altitude-low temperature. The indicator shall be subjected to a pressure equivalent to 50,000 feet at a temperature of -54° ± 2°C for a period of four hours. While at this pressure and temperature the indicator shall be subjected to and shall meet the requirements of the following tests:

Accuracy tests
Indicator speed
Flag alarm

At low temperature the distance dial speed test (para 4.6.8.1) shall be performed at 12 degrees/sec instead of 180 degrees/sec. At the conclusion of this test and after the equipment has returned to standard conditions it shall be subjected to and shall meet the requirements of the individual tests.

* 4.6.12 High temperature operation. (This test may be combined with the High temperature exposure test at the discretion of the testing agency.) The indicator shall be properly connected except that no power shall be applied. The indicator shall then be subjected to an ambient temperature of 71° ± 2°C for a period of 4 hours. During the last 5 minutes of the 4-hour period, power shall be applied to the indicator. At the end of the 4-hour period and with the temperature maintained at 71° ± 2°C, the indicator shall be subjected to and shall meet the requirements specified in the following tests:

Accuracy tests
Indicator speed
Flag alarm

At the conclusion of this test and after the equipment has returned to standard conditions it shall be subjected to and shall meet the requirements of the individual tests.

* 4.6.13 Power consumption. The indicator shall be connected as shown in Figure 2 and the ac and dc power measured while the instrument is operating. The ac power shall not exceed 45VA and the dc power shall not exceed 12 watts. The lighting power shall not exceed 4.0 watts (red or white).

4.6.13.1 Electrical power extremes. The indicator shall be subjected to the tests shown below, at the extreme voltage and frequency limits, in accordance with the electrical power requirements of paragraph 3.5.1:

Accuracy tests
Indicator speed
Flag alarm

4.6.14 Case leakage. Each indicator shall be tested for case leakage with either a mass spectrometer or by an equally sensitive leak test. The gas or mixture of gases in the case, adjusted to a pressure differential of one atmosphere, shall not have a leakage rate from the case exceeding one micron cubic foot per hour (10^{-5} cubic centimeters per second).

* 4.6.15 Vibration error. With the indicator connected and energized as shown in Figure 2 (switch positions as described in paragraph 4.6.8), it shall be mounted on the vibration stand so that a line joining the centers of the two lower mounting holes is in a horizontal plane and the plane of the mounting lugs in a vertical position. The indicator shall be operated by the synchro test transmitters. The indicator shall be subjected to a sinusoidal vibration of 0.01 inches double amplitude displacement from 5 to 70 Hertz and $\pm$ 2G from 70 Hertz to 2000 Hertz. A resonance survey shall be performed along each of the three mutually perpendicular axes not exceeding the above amplitudes. A resonance dwell shall be performed at each resonance identified above for a period of 10 minutes. The indicator shall be vibrated at the amplitudes shown above, for one hour in each of three mutually perpendicular planes with the frequency being varied uniformly from 5 Hz to 2000 Hz and returned during a period of approximately 15 minutes. Upon completion of the vibration, the indicator shall be subjected to and shall meet the requirements of the individual tests. The following requirements shall also be met during all of the vibration test.

4.6.15.1 Pointer vibration. The maximum amplitude of the pointers' vibration shall not exceed 1/64 inch.

4.6.15.2 Pointer accuracy. The bearing reading shall not differ at any time by more than 1/2 degree from the reading obtained when the indicator is at rest.

4.6.15.3 Distance accuracy. The distance indication shall be legible and accurate to within 0.1 of a unit.

* 4.6.16 Radio noise interference. The indicator shall be subjected to the tests and meet all the requirements of MIL-STD-461 for Class A1b equipment. For conducted susceptibility (CS01), a signal of 380 to 420 Hz shall not be injected onto the AC or DC power leads.

* 4.6.17 Lighting sampling plan A. The indicator shall be subjected to and shall meet the requirements of MIL-L-25467 and MIL-L-27160 sampling plan A tests.

4.6.18 Fogging. The indicator shall be energized and placed in 71° ± 2°C controlled ambient temperature for a minimum period of one hour. After this period, and while still at this temperature, an ice cube shall be rubbed on the cover glass for a period of from one to two minutes. The glass shall be wiped dry (do not use compressed air) and the indicator inspected for evidence of water or oil fog inside the cover glass. Evidence of fogging shall be cause for rejection. This test may be combined with the High Temperature Operation Test.

* 4.6.19 High temperature exposure. The indicator shall be subjected to a temperature of 71° ± 2° C for a period of 24 hours. The indicator shall be properly connected but no power shall be applied during the 24 hour soak period. At the end of the 24-hour soak period and while still at the elevated temperature, normal power shall be applied. After a 10-minute warm-up period the indicator shall be subjected to and shall meet the requirements of 4.6.5, 4.6.8, and 4.6.9. The indicator shall then be returned to standard conditions and allowed to stabilize for a period of 4 hours, after which it shall be subjected to and shall meet the requirements of the individual tests.

* 4.6.20 Low temperature exposure. The indicator shall be subjected to a temperature of -62° ± 2° C for 4 hours, then -54° ± 2° C for 24 hours. The indicator shall be properly connected but no power applied. During the last 10 minutes of the 24 hour period, normal power shall be applied. At the end of the 24 hour period and while at -54° ± 2° C, the indicator shall be subjected to and shall meet the requirements of 4.6.5, 4.6.8, and 4.6.9. At low temperature the distance dial speed test (para 4.6.8.1) shall be performed at 12 degrees/sec instead of 180 degrees/sec. The indicator shall then be returned to standard conditions and allowed to stabilize for a period of 4 hours after which it shall be subjected to and shall meet the requirements of the individual tests.

* 4.6.21 Salt fog. The indicator shall be tested in accordance with MIL-STD-810. After completion of the test procedure, the indicator shall be subjected to and shall meet the requirements of the individual tests.

* 4.6.22 Temperature shock. The indicator shall be tested in accordance with Temperature Shock Test of MIL-STD-810, using a high temperature of 71° ± 2° C and a low temperature of -57° ± 2°C. After completion of the test procedure, the indicator shall be subjected to and shall meet the requirements of the individual tests.

4.6.23 Impact Shock. The indicator shall be rigidly attached to the shock machine using the mounting holes. The indicator shall be connected and energized as shown in figure 2, switch positions as described in paragraph 4.6.8. The indicator shall be operated by the synchro test transmitters during the shock test. Three shocks in each direction shall be applied along the three mutually perpendicular axes of the indicator (total of 18 shocks). The shock pulse shall be one-half sinusoidal with peak value of 15 ± 2.5G and duration of 11 milliseconds. The indicator shall be subjected to and shall meet the

requirements of the individual tests. A crash safety test shall be performed to test the integrity of the mounting. The indicator or dummy load shall be attached by its normal mounting holes. The indicator or dummy load shall be subjected to two shocks in each direction along the three mutually perpendicular axes (total of 12 shocks). The shock pulse shall be one-half sinusoidal with peak value of 30 ± 5G and a duration of 11 milliseconds. There shall be no failure of the mounting attachment and the indicator or dummy load shall remain in place and not create a hazard. Bending and distortion shall be permitted.

4.6.24 Test for helium. The indicator case seal shall be broken as appropriate and the indicator subjected to the test for helium by means of a mass spectrometer helium detector. Failure to detect helium shall be cause for rejection. This test may be omitted if helium is detected during the case leakage test of paragraph 4.6.14.

* 4.6.25 Lighting contrast. The indicator shall be subjected to and shall meet all the requirements of the test specified in MIL-L-25467 and MIL-L-27160. This test shall be performed prior to final assembly.

4.6.26 Synchro impedance. This inspection is to verify the synchro impedance, Zso and Zss, of the distance measuring elements (DME) specified in paragraph 3.5.9. Since the rotors of these synchros are connected in parallel inside the indicator the Zso and Zss can not be measured directly as described in MIL-S-20708. Therefore the following test shall be used on the assembled indicator. Connect the indicator as shown in figure 4. Adjust the voltage supply and the decade box until 10.2 ± .2 volts are obtained across both the decade box and the indicator as shown in figure 4. The decade box setting shall be 15 ohms miminum. The value of this setting may be changed, with the approval of the acquiring activity, if the new value corresponds to an individual synchro impedance, satisfying paragraph 3.5.9. An equivalent test may be used after approval by the acquiring activity.

4.7 Rejection and retest. Indicators which have been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and action taken to correct the defects shall be furnished the Government inspector.

4.8 Test procedures. The procedures used for conducting all required tests shall be prepared by the contractor and submitted to the acquiring activity or authorized agent for review and approval. The right is reserved by the Government to modify the test 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 acquiring activity. However, the right is reserved by the acquiring activity to require modification of such procedures, including additional tests, when deemed necessary.

* 4.9 Life test. The contractor shall furnish all samples and shall be responsible for accomplishing this test. The test shall be for 1000 hours duration and shall be conducted on equipments that have passed the Reliability Assurance Production Acceptance Phase. The test shall be conducted under the conditions specified in 4.9.2. The Life Test sample shall be selected by the Government Inspector.

* 4.9.1 Quantity to be selected for life test. One per contract of 300 equipments or less. For contracts in excess of 300 equipments, quantity shall be specified by the contract.

* 4.9.2 Conditions for the life test. The indicator shall operate for a period of 1000 hours. The bearing pointers, compass card, and distance presentation shall be cycled at a rate of 20 degrees per second. The direction of rotation shall be reversed every 2 minutes. At the end of the 1000-hour period, the indicator shall be subjected to and shall meet the requirements of the individual tests.

* 4.9.2.1 Lamp life. The indicator shall be subjected to the Life Test specified in MIL-L-25467 and MIL-L-27160.

* 4.9.3 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. A daily visual observation shall be made for proper operation.

* 4.9.4 Performance check. At approximately 100-hour intervals, the indicator shall be subjected to and shall meet the requirements of the following tests:

Accuracy Tests (4.6.5)
Bearing and Heading Speed (4.6.8)
Flag Alarm (4.6.9)
Friction Error (4.6.6)

* 4.9.5 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. This record shall indicate the following:

(1) Part Type Number

(2) The circuit reference symbol number

(3) The part function

(4) Name of manufacturer

(5) Nature of the failure

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

* 4.9.5.1 Failure report. In the event of a failure, the Government inspector shall be notified immediately. A report shall be submitted to the acquiring 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.

5. PACKAGING

5.1 Preservation. The indicator shall be packaged in accordance with MIL-STD-794, Level A or C as specified in the contract or order (see 6.2). For Level A packaging, the method of preservation shall be in accordance with MIL-P-116, Method 1A-5, without preservative compound (using metal reusable containers).

5.2 Packing. The indicator shall be packed in accordance with MIL-STD-794, Level A, B, or C as specified in the contract or order (see 6.2).

5.3 Marking. The interior and exterior containers shall be marked as specified in MIL-STD-794.

5.3.1 Precautionary marking. The following precautionary markings shall appear conspicuously on two opposite sides of each interior package and shipping container wherever practicable.

FRAGILE
DELICATE INSTRUMENTS
HANDLE WITH CARE

6. NOTES

* 6.1 Intended use. The indicator covered by this specification is intended for use in naval aircraft to provide bearing, distance, and heading information. It shall be a direct replacement for the unlighted ID-663/U and the lighted ID-663A/U, ID-663B/U, and ID-663C/U indicators. Three ID-663D/U indicators connected in parallel shall be compatible with the following:

Equipment	Specification
AN/ARN-21 radio set	MIL-R-7060
Indicator coupler CU-395/ARN-21A	MIL-I-8693
MA-1 compass system	MIL-C-17858
MF-1 compass system	MIL-C-21013
AN/ARN-52 navigational set	MIL-N-22239

AN/AJB-3 computer set	MIL-C-23716
AN/ASN-41 computer set	MIL-C-81185
AN/ARN-118 TACAN	

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification

(b) The quantity and part number of the instrument desired.

(c) Levels of packaging (see 5.1) and packing (see 5.2) desired.

(d) The laboratory that shall conduct tests (see 4.4, 4.4.2.2).

(e) Items of data required by contract or order (see 3.10).

(f) The activity responsible for test procedure approval (see 4.8).

(g) Quantity to be selected for life test (see 4.9.1)

6.3 Definitions.

* 6.3.1 Hermetic seal. Hermetic sealing is the process by which an item is totally enclosed by a suitable metal structure or case and sealed airtight by fusion of metallic or ceramic materials. This includes the fusion of metals by welding, brazing, or soldering; the fusion of ceramic materials under heat or pressure; and the fusion of ceramic materials into a metallic support. Elastomeric or resinous materials or combinations of these materials may be used as a cover-glass seal provided that the specific leak-rate requirements are met under all tests and environmental conditions listed herein. Elastomeric or resinous materials may be used in other areas provided prior approval is obtained from the procuring activity.

6.3.2 Good as new. "Good as new" shall mean indicators operated less than 10 percent of specified MTBF operation.

6.3.3 Refurbished. "Refurbished" shall mean that the indicator has been completely overhauled with all component parts meeting current parts standards; and the indicator shall have been subjected to, and met, all the requirements of a new indicator.

* 6.4 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for the opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this

requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command (AIR-54951), Department of the Navy, Washington, D.C., and information pertaining to qualification of products may be obtained from that activity.

6.5 The outside margins of this specification have been marked with an asterish (*) to indicate where changes (deletions, additions, etc.) from the previous issue have been made. 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 contents as written irrespective of the marginal notations and relationship to the last previous issue.

6.6 Precedence of documents. When the requirements of the contract, this specification, or applicable subsidiary specification conflict, the following precedence shall apply:

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

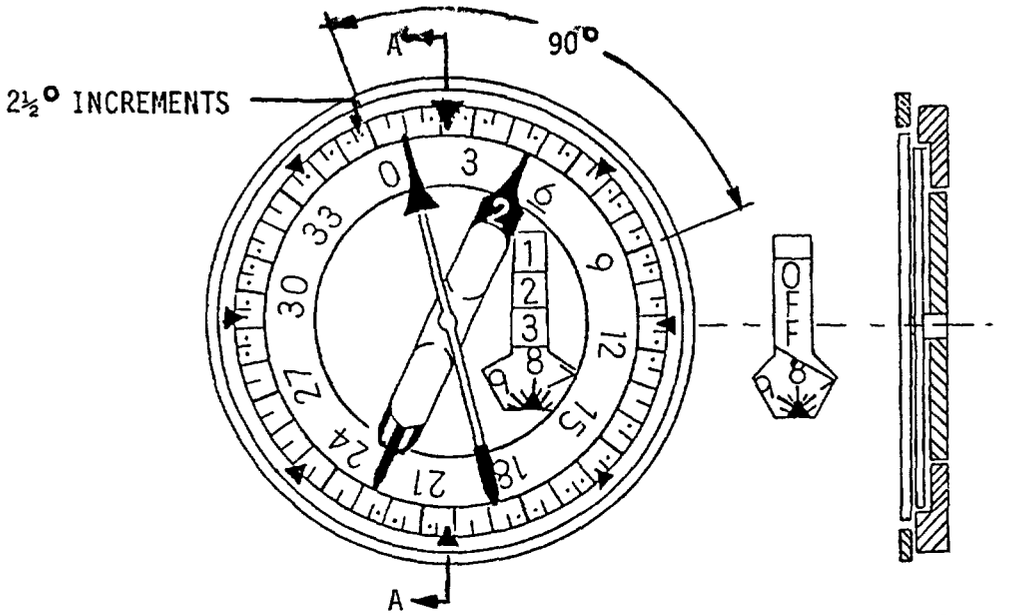
(2) This specification. This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by the procuring activity.

(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.

Custodian: Navy -AS

Preparing Activity: Navy - AS

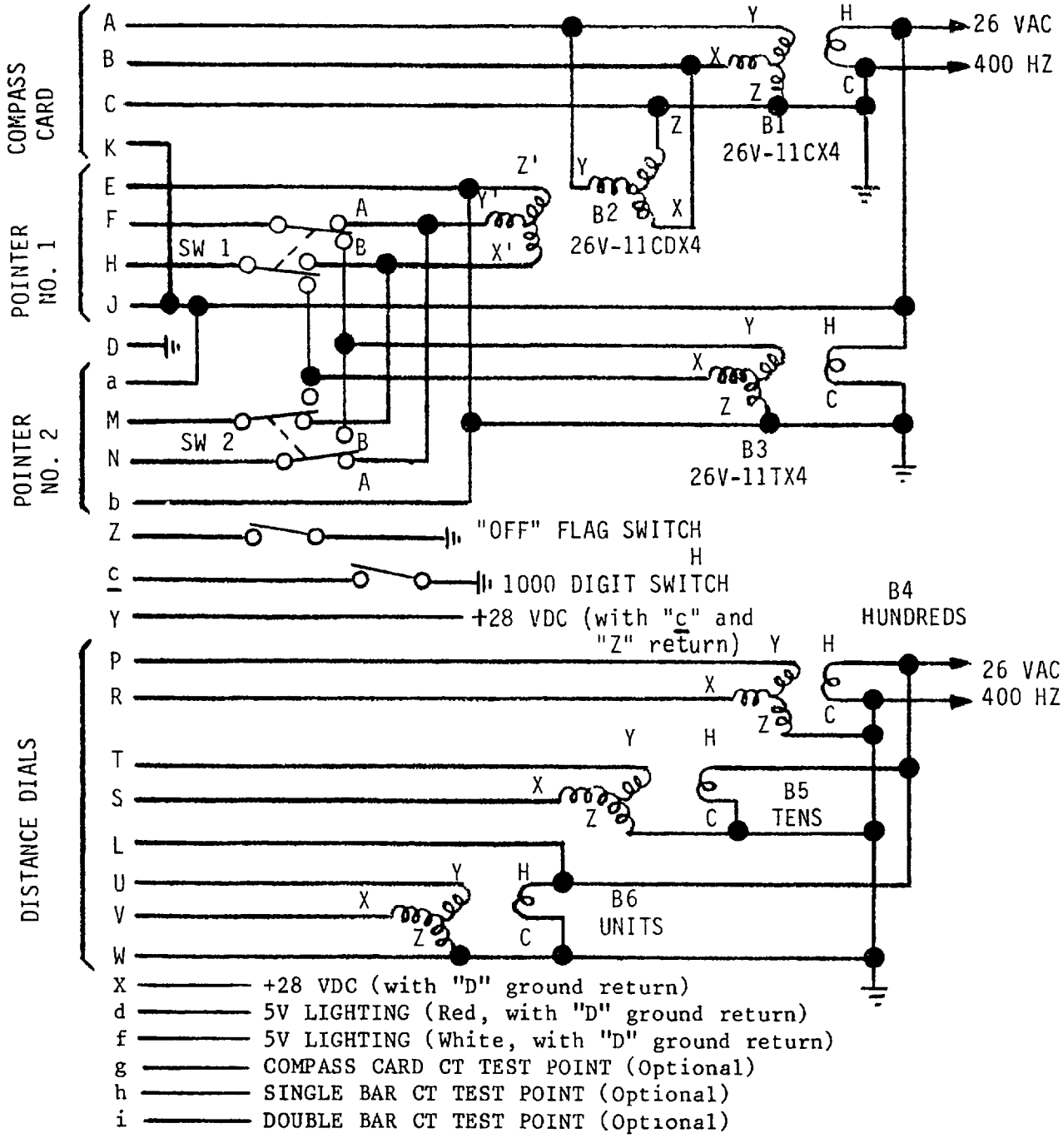
Project No. 6605-N337



SHADED PORTION OF THE POINTERS SHALL BE FINISHED IN LUSTERLESS WHITE

Marking	Height or Length +0.010	Width of Line or Graduation +0.003	Finish
Compass card			Lusterless White Color No. 37875
Numerals	0.219	0.027	
Numbered Graduations	0.174	0.025	
Major Graduations	0.174	0.020	
Minor Graduations	0.104	0.015	
Dot Graduations	0.025 DIA		
Index at Zero	0.219	0.187	
Other Indices	0.172	0.094	
Distance Indication Counter			
Numerals	0.219	0.027	
Unit Graduations	0.120	0.020	
Half-unit Graduations	0.080	0.015	
Background of "OFF" Flag	--	--	
Letters "OFF"	0.125	0.020	Lusterless Black Color No. 37038
Background of Dial	--	--	

Figure 1. Dial



SYNCHROS B3, B4, B5 AND B6 ARE ELECTRICALLY EQUAL TO TYPE 26V-11TX4 OF SPEC. MIL-S-20708.

Each synchro transmitter shall rotate clockwise (viewed from shaft end) for increasing reading of the compass dial, all pointers and all distance dials with electrical connections in accordance with MIL-C-5824. With the synchro transmitter at the high null (zero degrees) position, the compass card shall read zero degrees at the lubber line, the tail of each pointer shall be at the lubber line and all distance dials shall read zero miles.

Figure 2. Test Circuit Wiring Diagram,

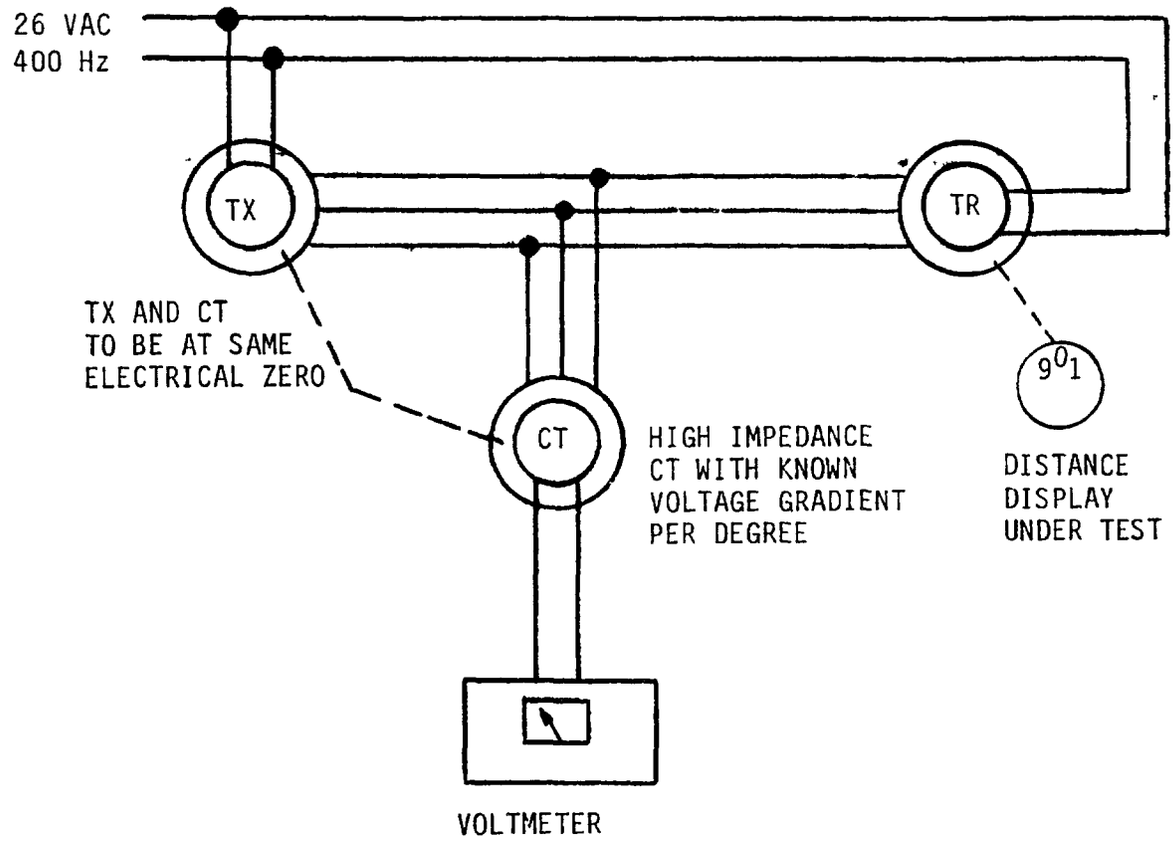
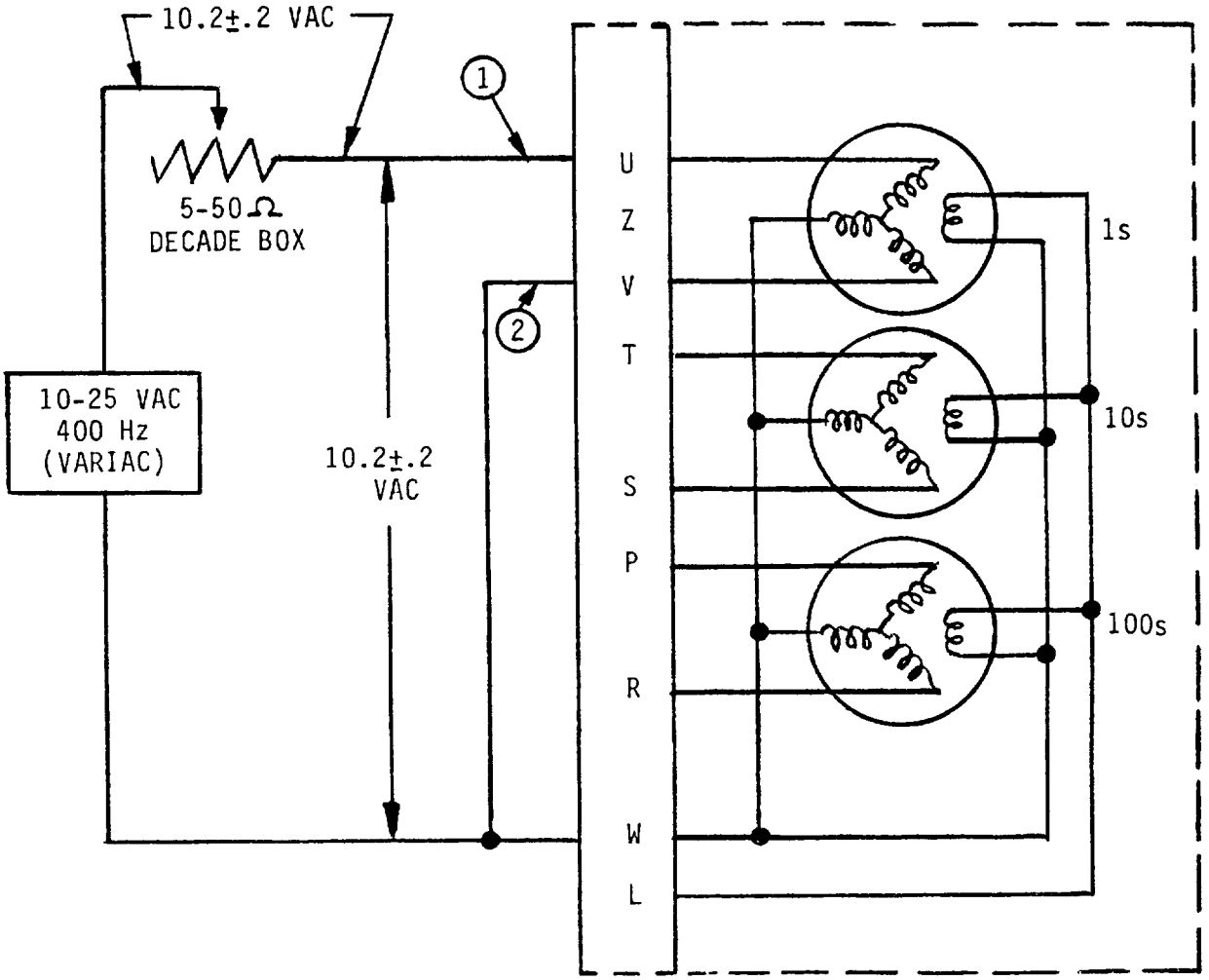


Figure 3. Distance Display Lag Test



Repeat inspection of paragraph 4.6.27 for the 10s and 100s synchros by connecting lines 1 and 2 to T,S and P,R respectively.

Figure 4. Distance Dial Synchro Impedance Test.

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