

MIL-I-18856B(AS)**27 OCTOBER 1969****SUPERSEDING****MIL-I-18856A(Wep)****20 October 1960****MILITARY SPECIFICATION****INDICATOR, ANGLE OF ATTACK, 28V. D. C.****MS28062 and MS 28067****This specification has been approved by the Naval
Air Systems Command, Department of the Navy.****1. SCOPE**

1.1 Scope - This specification covers design and all performance requirements for the 1-7/8 inch dial, MS28067, and 2-3/4 inch dial, MS28062, 28v d. c. angle of attack indicators. Configuration of each indicator shall be governed by the dash number for the Military Standard Drawing.

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.

SPECIFICATIONSMilitary

MIL-D-1000/1	Drawings, Engineering and Associated Data
MIL-C-5015	Connectors, Electric, AN Type
MIL-C-14806	Coating, Reflection Reducing, For Instrument Cover Glasses and Lighting Wedges
MIL-I-18079	Installation of Angle of Attack and Sideslip Systems
MIL-T-18303	Test Procedures, Production and Acceptance for Aircraft Electronic Equipment, Format for
MIL-T-19229	Transmitter, Angle of Attack or Sideslip, Local
MIL-P-21563	Paint System, Fluorescent, for Aircraft Application

FSC 6610

MIL-I-18856B(AS)**SPECIFICATIONS**Military (Continued)

MIL-L-25467	Lighting, Integral, Aircraft Instrument, General Specification for (Red)
MIL-C-26482	Connector, Electric, Circular, Miniature, Quick Disconnect
MIL-L-27160	Lighting, Instrument, Integral, White, General Specification for
MIL-I-81400	Instruments, Aircraft, General Specification for

STANDARDSMilitary

MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-461	Electromagnetic Interference Characteristics Requirements
MIL-STD-470	Maintainability Program Requirements (for Systems and Equipments)
MIL-STD-471	Maintainability Demonstration
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-781	Reliability Tests, Exponential Distribution
MIL-STD-785	Requirements for Reliability Program
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of
MIL-STD-810	Environmental Test Methods
MS24367	Lamp, Incandescent-Miniature Integral Lighting
MS24515	Lamp, Subminiature

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STANDARDSMilitary (Continued)

MS28062	Indicator, Angle of Attack, 2-3/4 Dial, 28 Volt D. C.
MS28067	Indicator, Angle of Attack, 1-7/8 Dial, 28 Volt D.C.
MS28105	Window, Dial - Aircraft Instrument Cover, Glass
MS33585	Pointer, Dial, Standard Design of Aircraft Instrument

Federal

FED-STD-595	Colors
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2.2 Availability of Documents - When requesting any of the applicable documents, refer to both title and number. Copies of this specification and applicable documents may be obtained upon application to the Commanding Officer, Naval Publications and Forms Center, Code 1051, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

3. REQUIREMENTS

3.1 Qualification - This specification makes provision for qualification testing.

3.2 General Design Requirements - Selection and use of parts and materials and general requirements for design and construction shall be in accordance with the requirements of MIL-I-81400.

3.3 Selection of Government Documents - Specifications and standards for necessary commodities and services not specified herein and in MIL-I-81400 shall be selected in accordance with MIL-STD-143.

3.4 Weight - The weight of each indicator shall not exceed that specified for each dash number.

3.5 Performance shall meet the Test Methods of Section 4.

3.5.1 Reliability - The supplier shall establish a reliability assurance program for the indicator in accordance with MIL-STD-785.

3.5.1.1 Operational Stability - The indicator shall operate with satisfactory performance, continuously or intermittently for a period of at least 1,500 hours without the necessity for readjustment or relubrication.

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3.5.2 Operating Life - The indicator shall have a minimum operating life of 6,000 hours with reasonable servicing and replacement of parts. Parts requiring scheduled replacement shall be specified by the supplier.

3.5.3 Reliability in Mean Time Between Failure (MTBF) - The indicator shall have 1,500 hours of mean (operating) time between failures when tested and accepted as outlined under the Reliability Assurance Test requirements.

3.6 Dial and Pointer -

3.6.1 Visibility of Dial - The pointer, numerals, at least 1/16th inch 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 20° with a perpendicular to the dial and whose small diameter is the aperture of the case.

3.6.2 Dial Marking - The dial shall be marked as shown in Figure 1 or Figure 2, as applicable.

3.6.3 Pointer - The pointer of the indicator shall conform to Figure 1 or Figure 2, as applicable.

3.7 Cover Glass - The dimensions of the cover glass shall be in accordance with MS28105 unless the glass is part of the integral lighting.

3.7.1 Cover Glass and Wedges - The indicator cover glass and any other transparent element between the glass and the dial, such as a lighting wedge, shall be provided with a reflection reducing coating that meets the requirements of MIL-C-14806.

3.7.2 Cover Glass Mounting - The distance from the inner surface of the cover glass to the surface of the dial on which the marking is applied shall not exceed 0.125 inch.

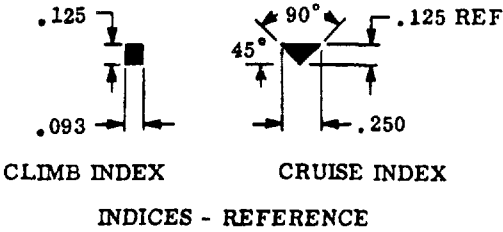
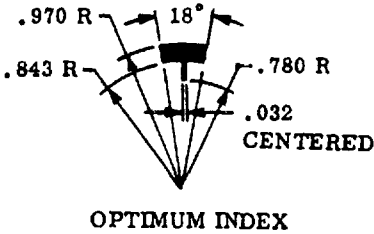
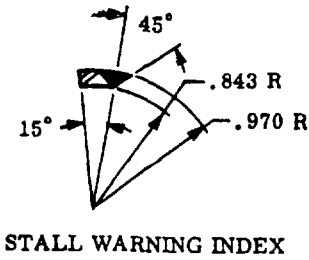
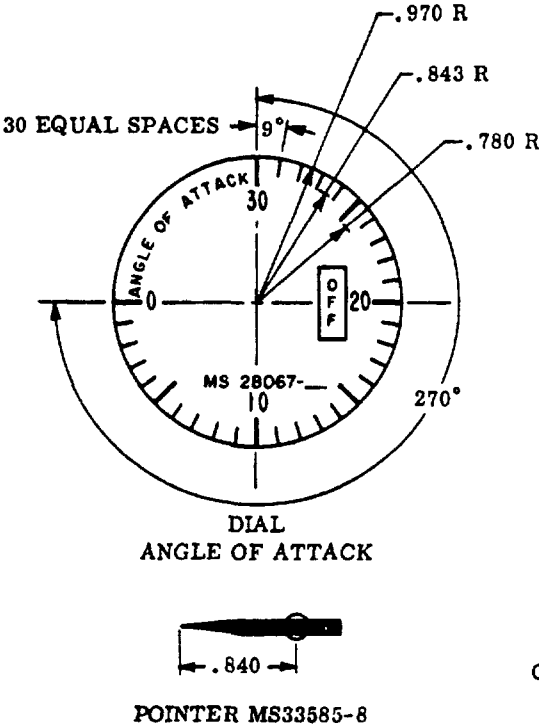
3.8 Electrical Requirements - Fuses or circuit breakers not permitted.

3.8.1 Primary Input Power Requirements - The indicator shall give specified performance from power sources with characteristics as defined in MIL-STD-704 having limits as specified herein. The power required shall not exceed the specified amounts.

(a) D.C. power 28v Category "B" 10 watt max for servo.

3.8.1.1 Integrally Lighted Indicator - The integrally lighted indicator, operating on 5 ± 0.1 volts a.c. or d.c., 3 watts max. for each color, using lamps MS24367-715AS15 or MS24515-718AS15, shall illuminate all markings within the indicator case as specified in MIL-L-25467 and MIL-L-27160 for the red and/or white integral lighting utilized.

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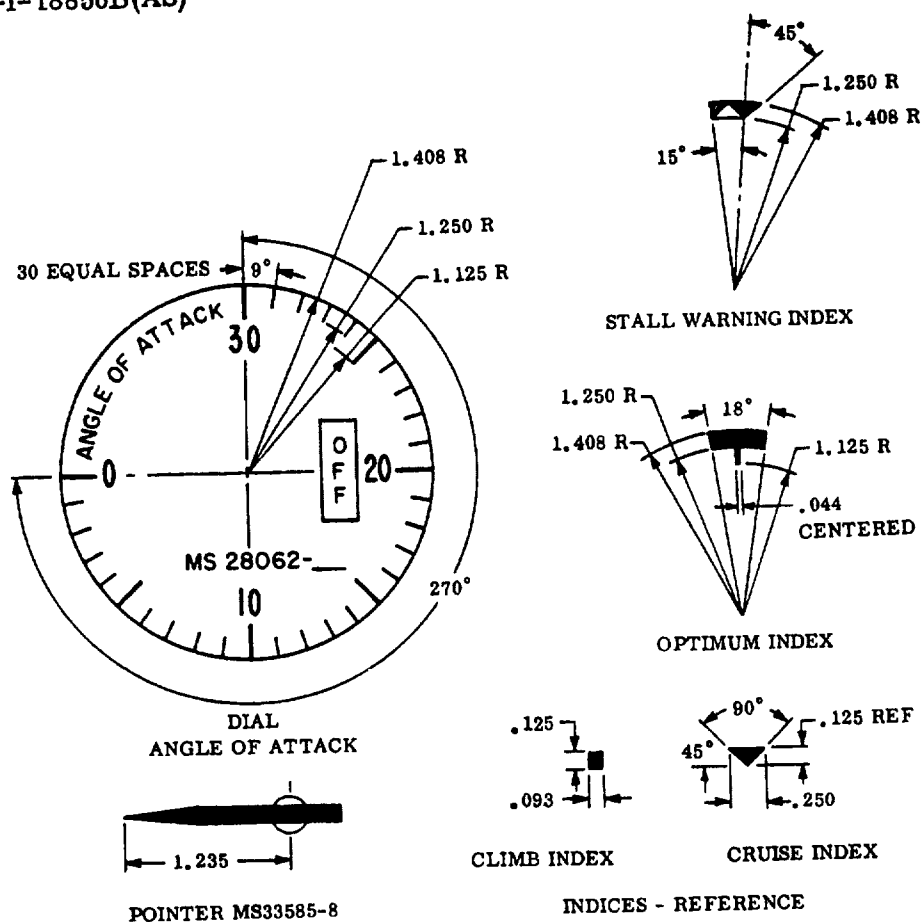
MARKING	HEIGHT OR LENGTH ±.010	WIDTH OF LINE OR GRADUATION ±.005	MATERIAL OR FINISH
MAJOR GRADUATIONS INTERMEDIATE GRADUATIONS NUMERALS LETTERS SHADED PORTION OF POINTER AND REFERENCE INDICES	--- --- .120 .090 ---	.029 .021 .023 .021 ---	LUSTERLESS WHITE NO. 37875 OF FED-STD-595
BACKGROUND OF POWER WARNING FLAG "OFF"	---	---	FLUORESCENT RED-ORANGE PER MIL-P-21563
BACKGROUND OF DIAL UNSHADED PORTION OF POINTER AND REFERENCE INDICES "OFF" MS28067 (ADD PROPER DASH NO.)	--- --- --- .047	--- --- --- .016	LUSTERLESS BLACK NO. 37038 OF FED-STD-595

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES: ±.010
ANGLES ±1°.

NUMERALS SHALL DISTINCTLY INDICATE THE GRADUATION TO WHICH EACH APPLIES.

Figure 1. Dial - Angle of Attack Indicator, 2-Inch Case Nominal Size, 1-7/8 Inch Dial.

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MARKING	HEIGHT OR LENGTH ±.010	WIDTH OF LINE OR GRADUATION ±.005	MATERIAL OR FINISH
MAJOR GRADUATIONS	---	.040	LUSTERLESS WHITE NO. 37875 OF FED-STD-595
INTERMEDIATE GRADUATIONS	---	.023	
NUMERALS	.187	.023	
LETTERS	.125	.021	
SHADED PORTION OF POINTER AND REFERENCE INDICES	---	---	FLUORESCENT RED-ORANGE PER MIL-P-21563
BACKGROUND OF POWER WARNING FLAG "OFF"	---	---	
BACKGROUND OF DIAL	---	---	LUSTERLESS BLACK NO. 37038 OF FED-STD-595
UNSHADED PORTION OF POINTER	---	---	
AND REFERENCE INDICES	---	---	
"OFF"	---	---	
MS28062 (ADD PROPER DASH NO.)	.047	.016	

DIMENSIONS IN INCHES. UNLESS OTHERWISE SPECIFIED TOLERANCES ±.010, ANGLES ±1°.

NUMERALS SHALL DISTINCTLY INDICATE THE GRADUATION TO WHICH EACH APPLIES.

Figure 2. Dial - Angle of Attack Indicator, 3-Inch Case Nominal Size, 2-3/4 Inch Dial.

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3.8.2 Electrical Connector - The electrical connector used shall conform to MIL-C-5015 or MIL-C-26482, as applicable. The type connector used shall be as shown in MS28062 or MS28067. The index key of the connector shall be located on the side nearest the top of the indicator.

3.9 Manufacturer's Part Number - Changes in manufacturer's numbers shall be governed by the drawing number requirements of MIL-D-1000/1.

3.10 Maintainability - The supplier's maintainability program shall be in accordance with MIL-STD-470. The maintenance concept for this indicator shall be repair at depot level only.

3.11 Detail Requirements -

3.11.1 Design and Construction - The indicator configured to MS28062 or MS28067 shall be used with angle of attack transmitters conforming to MIL-T-19229 and installed in a system conforming to MIL-I-18079 (Installation of Angle of Attack and Sideslip Systems). The indicator shall also incorporate electrical switches providing means for energizing two separate sets of lights. The first set will consist of three separate 28v d.c., 1.5 amp maximum lamps to indicate low, medium, and high ranges of angle of attack. The transition from high to low range shall be electrically continuous so that at no time will all lights be extinguished and such that only one light shall be energized at a time. The second set shall be capable of operating four sets of 28v d.c., 50 ma maximum lamps to indicate to the pilots low, low-medium, medium, high-medium, and high ranges of angle of attack. The three lamps separately will indicate low, medium, and high ranges of angle of attack. Low-medium range will be indicated by simultaneously energizing the lamps which separately indicate low range and medium range. High-medium range will be indicated by simultaneously energizing the lamps which separately indicate high range and medium range. The indicator shall incorporate an accessory switch rated at 3 0 amp at 28v d.c. Provision shall be made inside the indicator for adjusting the operating points of all switches from zero to 30 divisions indicator reading. A fixed reference sector covering 2 divisions of the indicator dial shall be centered on the horizontal centerline on the right side of the face of the instrument in conformance with MS28062 or MS28067. Three additional indices shall be provided which can be adjusted by removing the bezel. Provision shall be made in the design to permit angular adjustment of the dial, indices, and pointer as an integral assembly in relation to the bezel, fixed reference sector, and switching points. By this adjustment it shall be possible to make any indicator reading between ten and twenty-six coincide with the center of the fixed reference sector

3.11.2 Switches - Each switch one through four shall be actuated by the pointer position relative to the fixed 3 o'clock reference index regardless of the dial

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unit value set at this index.

Switch No. 1	1.0 unit below 3 o'clock Position
Switch No. 2	0.5 unit below 3 o'clock Position
Switch No. 3	0.5 unit above 3 o'clock Position
Switch No. 4	1.0 unit above 3 o'clock Position
Switch No. 5	used for Stick-Shaker and adjusted independently from the other four switches

3.11.3 Power Warning Flag - A warning device shall be incorporated in the indicator face as shown in Figure 1 or Figure 2 which will immediately indicate when d. c. power failure occurs. The black letters shall be legible under night lighting conditions. The lighting shall not be entirely dependent upon one light source.

3.11.4 Adjustment Range of Indices - Indices shall be adjustable in increments not exceeding one-fourth of a dial division over the full length of the scale. Indices are not required to overlap one another or the fixed reference sector.

3.11.5 Damping - The indicator shall incorporate means for damping the motion of the pointer. For any error not exceeding 4.5 indicator dial divisions between the angle of attack transmitter and the indicator pointer, the latter shall correct this error at an angular rate proportional to the error. The error divided by this rate shall give a time constant of 0.8 ± 0.2 second.

3.11.6 Slewing Rate - For errors exceeding 10 indicator dial divisions between the angle of attack transmitter and the indicator, the pointer shall rotate through twenty dial divisions in not more than 3 seconds.

3.11.7 Warm-up Time - The time required for the indicator to warm-up prior to operation shall be kept to a minimum and shall not exceed one minute for standard conditions and two minutes under extreme conditions of -54°C .

3.11.8 Interchangeability of Reordered Indicators - Interchangeability shall exist in indicator reorder between units and all repairable assemblies, subassemblies, and parts of the supplier's designated model as previously manufactured unless otherwise contractually specified in 6.2. New supplier's indicator model shall be interchangeable with any previous manufacture (as specified in 6.2) of designated indicators in fit, form, function and system interface and without selection or alteration.

3.12 Identification of Product - Identification of product shall be per MIL-I-81400 with the following nameplate markings:

Indicator, angle of attack
 MS _____ (add proper MS and dash number)
 Manufacturer's name and supply code

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Manufacturer's Part No. _____
Manufacturer's Serial No. _____
Contract/Order No. _____
U. S. Property

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 - Items covered by this specification shall be subjected to the following inspections to determine compliance with all applicable requirements.

(a) Qualification Inspection - Tests performed on sample indicators submitted for approval as a qualified product.

(b) Quality Conformance Inspection - Tests performed on indicators manufactured and submitted for acceptance.

4.3 Qualification Inspection - The qualification inspection of the indicator shall consist of all of the examinations and tests of this specification performed in the order specified under the paragraph headed Test Methods and shall include the reliability test for the Reliability Qualification Phase.

4.3.1 Qualification Inspection Samples - Qualification inspection samples shall consist of a minimum of five indicators manufactured in accordance with this specification. The instruments submitted for qualification inspection shall have been previously subjected only to the individual and Sampling Plan A inspections. Three samples shall be forwarded with supplier's detailed quantitative test data, at the supplier's expense, to the laboratory designated in the letter of Authorization (Section 6.4). The supplier shall conduct Reliability Qualification Phase Tests on the other samples at his plant under government surveillance.

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:

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Sample for Qualification Inspection

Indicator, Angle of Attack, (add proper MS number)Submitted by (Manufacturer's name, date and part number) for Qualification Inspection in accordance with Specification MIL-I-18856B(AS) under authorization (reference letter authorizing tests).

4.4 Quality Conformance Inspection - The supplier shall furnish all samples and shall be responsible for accomplishing all the inspections designated by the procuring activity. Quality conformance inspection shall be under the supervision of the government quality control representative. The supplier shall furnish test reports using MIL-T-18303 format showing detailed quantitative results for all tests required by this specification signed by an authorized representative of the supplier 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. Quality Conformance Inspection shall consist of the following tests:

- (a) Individual Tests
- (b) Sampling Plan A Tests
- (c) Sampling Plan B Tests
- (d) Reliability Assurance Tests
- (e) Longevity Tests
- (f) Maintainability Demonstration

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

Examination of Product
 Scale Error and Friction at Room Temperature
 Scale Error Voltage Variation
 Position Error
 Dielectric Strength
 Switching Point Hysteresis
 Slewing Rate
 Integral Lighting (Individual test)

4.4.2 Sampling Plans- The Sampling Plans shall consist of Sampling Plan A and Sampling Plan B tests. The test samples selected for sampling tests shall first have passed the Individual tests. The test samples which have been subjected to the Sampling Plan A test shall not be delivered on contract until they have been refurbished and resubmitted and passed all the Individual tests. Test samples which have been subjected to the Sampling Plan B test shall not be delivered on contract.

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<u>Quantity Offered for Acceptance</u>	<u>Quantity to be Selected for Sampling Plan A Tests</u>
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

When a defective indicator is detected, no items from those still on hand or later produced shall be accepted until the extent and cause of failure have been determined and appropriately corrected. In addition, when a failure occurs, shift to one sample out of the next fifteen and proceed as indicated (One from next 50, etc.)

4.4.2.1 Scope of Sampling Plan A Test - Each sample selected for Sampling Plan A Test shall be subjected to the following tests in the order listed:

Magnetic Effect
Power Consumption
High Temperature Operation
Low Temperature Operation
Damping
Vibration
Endurance
Integral Lighting (Sampling Plan A)
Adjustment Range of Switches
Adjustment Range of Indices

4.4.2.2 Sampling Plan B Test - 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, Angle of Attack, (add proper MS number)
Submitted by (Manufacturer's name, date) for Production
Acceptance Sampling Plan B Test of MIL-I-18856B(AS)
in accordance with Contract/Order No. _____
Manufacturer's Part No. _____

4.4.2.2.1 Sampling Plan B Approval - Approval of Sampling Plan B indicators shall be by the procuring activity upon satisfactory completion of the designated tests. Any design, material or performance defect made evident during this test shall be cor-

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rected by the contractor to the satisfaction of the procuring activity. Failure of the sample units to pass any of the tests shall be cause for deliveries of indicators under the contract to cease until proper corrective action is approved and accomplished.

4.4.2.2.2 Scope of Sampling Plan B Test - Each sample selected for Sampling Plan B Test shall be subjected to the following tests in the order listed:

Sampling Plan A Tests
 Electromagnetic Interference
 High Temperature Exposure
 Low Temperature Exposure
 Shock
 Integral Lighting Test (Sampling Plan B)
 Humidity
 Fungus Resistance
 Salt Fog
 Internal Examination
 Mounting Lugs
 Reflection Reducing Coating

4.5 Standard Conditions for Test - Unless otherwise specified, all inspection required by this specification shall be made under the following conditions:

Temperature	Room ambient $25 \pm 5^{\circ} \text{C}$
Pressure	Normal atmospheric (approximately 29.92 inches Hg)
Humidity	Room ambient 40 to 90 percent relative humidity
Input Power	$28 \pm 0.5 \text{v d.c.}$ $5 \pm 0.1 \text{v}$ (lighted indicators)

4.5.1 Tapping Test Readings - Unless otherwise specified, before a test reading is taken, the indicator can be tapped between 28 and 62 Hz (0.010 and 0.002 inch peak-to-peak amplitude respectively) at the peak acceleration of $\pm 0.4 \text{ g}$.

4.5.2 Attitude - Unless otherwise specified, the indicator shall be tested in its normal operating position mounted in a 1/4 inch aluminum panel to simulate an aircraft installation.

4.5.3 Standard Transmitter - The indicator shall be tested with a transmitter conforming to MIL-T-19229 or an electrically equivalent test transmitter having a linear potentiometer of 2750 ohms ± 3 percent. The transmitter used shall be calibrated to eliminate errors.

4.5.4 Lighting - The indicator lighting system of lighted type indicators shall be energized and shall operate satisfactorily during all tests except humidity, fungus, shock, salt. The indicator lighting shall operate satisfactorily after completion of each test unless otherwise specified herein.

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4.5.5 Tolerances - Tolerances are given for major graduations. However, the same tolerances apply over the whole scale. (See Tables I and II.)

TABLE I

TEST SETTINGS AND TOLERANCES

Transmitter test settings (indicator divisions)	Division (indicator reading) tolerance	
	Room temperature scale error	High and low temperature scale error
0	0.25	0.5
2	0.25	0.5
4	0.25	0.5
6	0.25	0.5
8	0.25	0.5
10	0.25	0.5
14	0.25	0.5
20	0.25	0.5
24	0.25	0.5
30	0.25	0.5

TABLE II

TEST TOLERANCES

Test	Tolerance (indicator divisions)
Friction, room temperature	0.25
Friction, high temperature	0.50
Friction, low temperature	0.50
Position error	0.25
Vibration error	0.25

4.5.6 "OFF" Flag - The "OFF" flag shall disappear whenever the servo voltage is applied, and shall reappear whenever the voltage is removed.

4.5.7 Hunt and Jump - There shall be no noticeable hunting or jumping when the signal input is stationary. Under dynamic conditions, the peak-to-peak amplitude of hunting and jumping shall not exceed 1/4 degree of arc.

4.6 Test Methods - The procedure specified herein shall be supplemented by a procedure outlined in detail by the **supplier**. This procedure shall

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state the exact conditions under which measurements are to be made. The procedure shall include details for test of all electrical, mechanical, and performance characteristics as specified for the particular instrument, including provisions for indicating all variations in characteristics measured during the test procedure. This procedure is subject to the approval of the procuring activity.

4.6.1 Performance Check Under Standard Conditions - (Reference Run) - Prior to conducting environmental tests, the equipment shall be instrumented and checked for satisfactory performance under standard conditions. This performance check shall be made in accordance with the approved test procedure. A record shall be made of all data necessary to determine the complete operational and performance characteristics. This check shall include operation at both highest and lowest specified input voltages, switching off and on at least three times, and all phases of appropriate service operation and check situations.

4.6.2 Examination of Product - Each indicator shall be weighed and examined to determine conformance with workmanship, applicable drawings and other physical requirements not covered by tests.

4.6.3 Scale Error and Friction at Room Temperature - The indicator shall be connected through an electrical circuit to a standard transmitter and to a direct current of 28 volts. The shaft of the standard transmitter shall be rotated simulating an increase in angle of attack to the test settings specified in Table I. At each of the settings, two readings of the indicator shall be taken. The first reading shall be taken before the indicator is **tapped** and the second reading shall be taken after the indicator has been **tapped**. The difference between the two readings shall not exceed the **friction values** in Table II. The second reading shall not differ from the test setting of the transmitter by more than the amount specified in Table I. The test shall then be repeated simulating a decrease in angle of attack. The difference between the increasing and decreasing readings obtained after the indicator is **tapped** for the same transmitter settings shall not exceed 0.1 division.

4.6.4 Scale Error Voltage Variation - The scale error and friction at room temperature test (4.6.3) shall be repeated with the servo supply voltage set to the extreme landing voltage variations of Category B of MIL-STD-704.

4.6.5 Position Error - The indicator shall be held in the normal operating position and a reading taken. It shall then be **tapped** and a reading taken. This procedure shall be repeated as the indicator is held in each of the following positions:

- (a) dial face up
- (b) dial face down
- (c) right side down
- (d) right side up
- (e) bottoms up

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The maximum deviation of the five latter readings from the original reading shall not exceed the tolerance specified in Table II.

4.6.6 Dielectric Strength - A potential of 200 volts (root mean square) alternating current at commercial frequency 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 instrument as a result of this test. The calculated leakage resistance shall exceed 10 megohms. This potential shall not be applied more than three times on any one unit during the entire test on that unit.

4.6.7 Switching Point Hysteresis - While the indicator is being tapped in accordance with 4.5.1, the dial reading at which a switch operates shall be noted with the dial indication being increased and again with the indication being decreased. The difference between the two readings shall not exceed 0.5 indicator dial divisions. This test shall be performed for all switching points.

4.6.8 Slewing Rate - The pointer shall be set at an indication of thirty. The electrical current shall then be cut off and the transmitter probe manually displaced to a position corresponding to zero indicator reading. Electrical power shall then be applied and the time necessary for the pointer to arrive at an indication of ten shall be recorded. This test shall be repeated for rotation in the opposite direction (zero to twenty) and the time required for pointer travel recorded. The time necessary for ascent and descent shall be averaged and shall not exceed 3.0 seconds. The times required for ascent and descent shall not vary from each other by more than 10 percent of the greater value.

4.6.9 Integral Lighting - Each indicator shall be subjected to and shall meet the requirements of the individual tests specified in MIL-L-25467 and MIL-L-27160 as required for red or white lighting.

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 and 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 one degree. This test shall be repeated with no power applied.

4.6.11 Power Consumption - The power consumption test shall verify the electrical requirements of the designated indicator.

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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 $71 \pm 2^\circ \text{C}$ 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 $71 \pm 2^\circ \text{C}$, the indicator shall be subjected to and shall meet the requirements specified for the high temperature scale and friction error test. The tolerances shall not exceed the amounts specified in Tables I and II.

4.6.13 Low Temperature Operation - (This test may be combined with the low 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 $-54 \pm 2^\circ \text{C}$ 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 $-54 \pm 2^\circ \text{C}$ the indicator shall be subjected to and shall meet the requirements specified for the low temperature scale and friction error test. The tolerances shall not exceed the amounts specified in Tables I and II.

4.6.14 Damping - The ratio of indicator error to the rate at which the error is being corrected shall be checked at indicator errors of 2 and 4 dial divisions for conformance with the damping requirements specified in Section 3. The current in, or voltage across, the control circuit of the indicator may be used as a measure of the indicator error. This test shall be made with test power applied.

4.6.15 Vibration - The indicator shall be tested in accordance with MIL-STD-810, Method 514, Procedure I, Figure 514-1, Curve B. With the pointer set at midscale for the test, pointer and "OFF" flag vibration and variation shall not exceed the tolerance specified in Table II. The integral lighting shall not flicker during the vibration test. Upon completion of the vibration, the indicator shall be subjected to and shall meet the requirements of the following tests:

- (a) Scale error and friction at room temperature.
- (b) Position error.
- (c) Slowing rate.
- (d) Integral lighting (Individual test).
- (e) Switching Point Hysteresis.
- (f) Dielectric strength.

No parts shall become loose, nor shall damage to any part of the indicator result from this test.

4.6.16 Endurance - The indicator shall be connected to a test transmitter, a set of approach lights, a set of pilot signal lights, and test power applied. The

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transmitter shall be continually cycled at a rate of 0.5 to 1.5 indicator dial divisions per second for a period of 4 hours followed by a period of 5 minutes during which no power is applied to the indicator and the "OFF" flag is visible. During the operating cycle, the indicator shall exhibit positive switching to the lights without flicker or other interruption. This cycle shall be repeated a sufficient number of times to extend the operating time of the indicator to a total of 100 hours. At the end of the 100-hour operating period, the indicator shall be subjected to and shall meet the requirements of the Individual tests.

4.6.17 Integral Lighting Sampling Plan A - The Integral Lighting Sampling Plan A specified in MIL-L-25467 and MIL-L-27160 shall be performed on and met for the indicator as required for red or white lighting.

4.6.18 Adjustment Range of Switches - Each switching point specified in 3.11.2 shall be adjustable throughout the range of zero to 30 indicator divisions.

4.6.19 Adjustment Range of Indices - Indices shall be adjustable in increments not exceeding one-fourth of a dial division over the full length of the scale. All indices shall rotate with the dial when it is adjusted to read between 10 and 26 units at the fixed reference.

4.6.20 Electromagnetic Interference - The electrical system of the indicator shall be tested for conducted and radiated ~~susceptible~~ interference in accordance with MIL-STD-461 for Class ID equipment. The test shall be performed with the indicator electrically connected to simulate an angle of attack system installation. The radio interference shall be determined for the condition of simulated constant angle of attack and for the condition of variation in angle of attack. Short duration noise from lamp switching may deviate from the limits by 20 db.

4.6.21 High Temperature Exposure - The indicator shall be tested in accordance with MIL-STD-810, Method 501, Procedure I at $71 \pm 2^\circ \text{C}$ for 24 hours. After the indicator has returned to room temperature, it shall be subjected to and shall meet the requirements specified in the Room temperature scale and friction error test and switching point hysteresis test.

4.6.22 Low Temperature Exposure - The indicator shall be tested in accordance with MIL-STD-810, Method 502, Procedure I at $-62 \pm 2^\circ \text{C}$ for 48 hours. After the indicator has returned to room temperature, it shall be subjected to and shall meet the requirements specified in the Room temperature scale and friction error test and switching point hysteresis test.

4.6.23 Shock - The indicator shall be tested in accordance with MIL-STD-810, Method 516, Procedure I, Figure 516-2 to verify the shock test requirements of MIL-I-81400. The indicator shall then be subjected to and shall meet the individual test requirements.

4.6.24 Humidity - The indicator shall be tested in accordance with MIL-STD-810, Method 507, Procedure I. After the testing procedure, the indicator shall

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be immediately subjected to and shall meet the requirements specified in the Room temperature scale and friction error test and switching point hysteresis test. There shall be no evidence of corrosion.

4.6.25 Fungus Resistance - The indicator shall be tested in accordance with MIL-STD-810, Method 508, Procedure I except that the exposure period shall be 14 days. After the testing procedure has been completed, any evidence of the growth of fungi in the indicator found upon inspection shall be cause for the rejection of the indicator or of any lot represented by the tested indicator.

4.6.26 Salt Fog - The indicator shall be tested in accordance with MIL-STD-810, Method 509, Procedure I. After the testing procedure, the indicator shall be subjected to and shall meet the requirements specified in the Individual tests.

4.6.27 Integral Lighting Test (Sampling Plan B) - The indicator shall be subjected to the life test specified in MIL-L-25467 and MIL-L-27160. (This test shall be run concurrently with the Endurance and Reliability Assurance tests if practicable.)

4.6.28 Internal Examination - The case of the indicator shall be removed and the mechanism including the electrical system of the indicator shall be examined. Repeat the adjustment range of switches and indices tests. Any deterioration or damage which could in any manner prevent the indicator from meeting functional requirements during service life shall be cause for rejection.

4.6.29 Mounting Lugs - The case of the indicator shall be mounted face downward on the moveable head of a suitable testing machine with the face of the case in a horizontal plane so that the mounting lugs receive no added support. A suitable pin shall be inserted through the hole in the mounting lug and attached to a pull strap in the stationary head of the machine. A load of 175 pounds shall be applied for one minute to each lug in a direction toward the front of the case **without damage.**

4.6.30 Reflection Reducing Coating - The cover glass and lighting wedges shall be subjected to and meet the Test Methods of MIL-C-14806.

4.7 Reliability Assurance Tests - Reliability Assurance Tests shall be conducted using MIL-STD-781 for Qualification Phase and Production Acceptance Phase Tests. Each indicator selected shall first have passed the individual tests. Test Level F of MIL-STD-781 shall be used for the 1,500 hour MTBF reliability tests while cycling the indicator in accordance with the endurance test and performing the individual tests at 200-hour intervals.

4.7.1 Reliability Qualification Phase Tests - Prior to approval of the indicator, between 2 and 6 indicators shall be tested as outlined in MIL-STD-781, under the section entitled 'Qualification Phase of Production Reliability Tests.' For the Qualification Phase the Accept-Reject Criteria for Test Plan III shall be used.

4.7.2 Reliability Production Acceptance (Sampling) Phase Tests -

Between 2 and 6 indicators shall be selected at random from each lot for testing as outlined in MIL-STD-781 under the section entitled "Production Acceptance (Sampling) Phase of Production Reliability Tests." The Accept-Reject Criteria for Test Plan V shall be used to determine the length of the tests until an accept or reject decision is reached for each lot. Unless otherwise specified in the contract or order, no indicators shall be shipped until an Accept decision is reached under each lot. The indicators to be tested shall be selected at random throughout the month by the cognizant government inspector.

4.7.3 Reliability Procedures and Reports - Reliability procedures and reports shall be submitted in accordance with MIL-STD-781.

4.7.4 Longevity Tests - Longevity tests shall be performed on two indicators in accordance with Test Plan XXVIII and Test Level F of MIL-STD-781 for a minimum of 15 periods of endurance testing of 200 hours each and the Individual tests performed after each period. Indicators from the Reliability Qualification Phase may be used to accumulate the total testing time of 3,000 hours for each indicator. Maintenance may be performed provided the total cost of servicing and replacement of parts throughout the longevity test does not exceed the "cost to repair" any indicator as specified in the contract (see 6.2).

4.8 Maintainability Demonstration - Maintainability demonstration shall be in accordance with MIL-STD-471 and shall be performed on a minimum of three selected repair tasks. The tasks and timing of the tasks shall be selected in advance and shall be approved by the procuring activity.

4.9 Supplemental Test Procedures - The procedures used for conducting qualification and quality conformance and longevity inspections shall be prepared by the **supplier** 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 test deemed necessary to determine compliance with the requirements of this specification or the contract. 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 **may** be provided and 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.

4.10 Reconditioning of Tested Equipment - An indicator which has been subjected to quality conformance inspection shall be reconditioned by the contractor by replacing all wear or damaged items and made "good as new." All reworked indicators resubmitted for acceptance shall meet all the individual tests.

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4.11 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 the action taken to correct the defects found in the original shall be furnished the government inspector.

5. PREPARATION FOR DELIVERY

5.1 General - The indicator shall be preserved, packaged, packed and marked for the level of shipment specified in the contract or order in accordance with MIL-STD-794 and MIL-I-81400.

6. NOTES

6.1 Intended Use - The angle of attack indicators covered by this specification are intended for use in aircraft to provide the pilot with visual indication of the local angle of attack of the aircraft and to operate carrier approach lights, pilot's signal lights and an accessory.

6.2 Ordering Data - Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) The quantity, MS part number and type number, if any, of the indicator desired.
- (c) Interchangeability with the original supplier's designated model (3.11.8).
- (d) Levels of packaging and packing **and labeling desired.**
- (e) The laboratory that shall conduct tests.
- (f) Reliability assurance tests, procedures and reports (see 4.7), **and lot size.**
- (g) Cost to repair one indicator (see 4.7.4).
- (h) Approved test procedures available (see 4.9).

6.3 Definitions - Definitions shall be in accordance with Definitions of MIL-I-81400.

6.3.1 Scale Error - Scale error is defined as the difference between the indication of the indicator and the corresponding calibrated standard.

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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 supplier is directed to Provisions Governing Qualification SD-6 and urged to arrange to have the products that he propose to offer to the Federal Government tested for qualification, in order that he 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, Department of the Navy, Washington, D. C. 20360, and information pertaining to qualification of products may be obtained from that activity.

6.5 Precedence of Documents - When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence applies.

- (a) Contract - The contract shall have precedence over any specification.
- (b) 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.
- (c) Referenced specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

6.6 Asterisks - Asterisks are not used in this revision to identify the extensive changes with respect to the previous issue.

Preparing Activity:
NAVY - AS

(Project No. 6610-N001)

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No 119-R004
INSTRUCTIONS		
<p>This sheet is to be filled out by personnel either Government or contractor, involved in the use 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 (as indicated on reverse hereof).</p>		
SPECIFICATION		
MIL-I-18856B(AS) INDICATOR, ANGLE OF ATTACK, 28V. D.C.		
ORGANIZATION (of submitter)	CITY AND STATE	
CONTRACT NO	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
MATERIAL PROCURED UNDER A		
<input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> 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? <input type="checkbox"/> YES <input type="checkbox"/> 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)		DATE

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