INCH-POUND

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SUPERSEDING
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DETAIL SPECIFICATION

INDICATOR, TURN AND SLIP, 28V DC

Inactive for new design after 1 April 1996.

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

1. SCOPE

1.1 Scope. This specification covers 28V DC, hermetically sealed turn and slip indicators.

1.2 Classification. The indicators are of the following types, as specified (see 6.2).

MS28041-1 - 4 Minute Turn, Dark Ball, Fluorescent Dial Marking
MS28041-1A - 4 Minute Turn, White Ball, Lusterless White Dial Marking
MS28041-1B - 4 Minute Turn, Dark Ball, Lusterless White Dial Marking
MS28041-1C - 4 Minute Turn, Dark Ball, Fluorescent Dial Marking
MS28041-1D - 4 Minute Turn, Dark Ball, Lusterless White Dial Marking
MS28041-2 - 2 Minute Turn, Dark Ball, Lusterless White Dial Marking
MS28041-2A - 2 Minute Turn, White Ball, Fluorescent Dial Marking

2. APPLICABLE DOCUMENTS

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

Comments, suggestions, or questions on this document should be addressed to Defense Logistics Agency Aviation VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616, or e-mailed to STDZNMGT@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at https://assist.daps.dla.mil/.

2.2 Government documents.

2.2.1 Specifications, standards, and handbook. The following specifications, standards and handbook form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

FED-STD-595/15044	- Blue, Gloss
FED-STD-595/17038	- Miscellaneous, Gloss
FED-STD-595/37038	- Miscellaneous, Flat or Lusterless
FED-STD-595/37875	- Miscellaneous, Flat or Lusterless

COMMERCIAL ITEM DESCRIPTION

A-A-59503	- Nitrogen, Technical

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-N-3336	- Nut, Sheet Spring, Instrument Mounting
MIL-E-5400	- Electronic Equipment, Aerospace, General Specification for
MIL-DTL-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	- Anodic Coatings for Aluminum and Aluminum Alloys
MIL-P-23408	- Plating: Tin-Cadmium (Electrodeposited)
MS28041	- Indicator, Turn and Slip, 28V DC, 1-7/8 Inch Dial
MS33558	- Numerals and Letters, Aircraft Instrument Dial, Standard Form of
MS33638	- Cases, Instrument, Flange Mounted, Aircraft
MIL-B-81793	- Bearings, Ball, Annular for Instruments and Precision Rotating Components
MIL-DTL-83488	- Coating, Aluminum, High Purity

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	- Identification Marking of U.S. Military Property
MIL-STD-461	- Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-704	- Aircraft Electric Power Characteristics
MIL-STD-810	- Environmental Engineering Considerations and Laboratory Tests
MIL-STD-889	- Dissimilar Metals

DEPARTMENT OF DEFENSE HANDBOOK

MIL-HDBK-781	- Handbook for Reliability Test Methods, Plans, and Environments for Engineering, Development Qualification, and Production

(Copies of these documents are available online at https://assist.daps.dla.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN WELDING SOCIETY

AWS B2.3/B2.3M	- Specification for Soldering Procedure and Performance Qualification

(Copies of this document are available from http://www.aws.org/ or from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.)

SAE INTERNATIONAL

SAE AMS-M-3171	- Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on
SAE AS8879	- Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter
SAE AS50881	- Wiring Aerospace Vehicle

(Copies of these documents are available from http://www.sae.org/ or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheet), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheet. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.3), a sample shall be subjected to first article inspection in accordance with 4.3.

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

a. Parts and materials requirements shall conform to MIL-E-5400.
b. Non-repairable subassemblies, as outlined in MIL-E-5400, shall be used when practicable. The general size of subassembly and the amount of circuitry to be included therein shall be approved by the procuring activity. Non-repairable subassemblies must be reliable (see 6.6).
c. Bearing selection will conform to MIL-B-81793.

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.4 Design and construction. The indicator shall conform to all applicable requirements of MIL-E-5400 for design, construction, and workmanship, except as otherwise specified herein.

3.4.1 Total weight. The total weight of the indicator, less mounting screws, shall not exceed 2 pounds.

3.4.2 Reliability.

3.4.2.1 Operational stability. The indicator shall operate with satisfactory performance, continuously or intermittently for a period of at least 2,500 hours without the necessity for an adjustment.

3.4.2.2 Operating life. The indicator shall have a minimum total operating life of 25,000 hours. Parts requiring scheduled replacement due to wear during the life of the indicator, and the wear-out life of such parts, shall be determined by the contractor and submitted to the procuring activity.

3.4.2.3 Reliability in mean-time-between-failures (MTBF). For the test program under 4.5.24, the specified mean operating time between failures shall be 2,000 hours. For this test program, a failure shall be considered to have occurred whenever the performance characteristics fall below the acceptance requirements (4.5.24.4) irrespective of whether or not the condition can be corrected by adjustment of operator controls.

3.3.3 Cabling and connections.

3.4.3.1 Cables and connectors. The indicator shall provide for the use of cables and connectors in accordance with MIL-E-5400.

3.4.3.2 Interconnection cabling. The indicator shall be capable of satisfactory operation using external wiring in accordance with the application requirements of SAE AS50881. The external wiring shall be unshielded, except that a minimum number of the individual wires may be shielded when demonstrated as necessary to meet interference control requirements and provided the assembly of the cable to its plugs may be easily accomplished. External cables and that portion of the connectors attached to the cables shall not be supplied as part of the indicator.

3.4.4 Interchangeability. The indicator shall meet the interchangeability requirements as defined in MIL-E-5400.

3.4.5 Electromagnetic interference (EMI). The indicator shall meet the EMI requirements of MIL-STD-461.

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

3.4.7 Nameplate. A nameplate shall be securely attached to the exterior of the case and shall be marked in accordance with MIL-STD-130, except that the National Stock Number marking shall be omitted.

3.4.8 Standard conditions. The following conditions, unless otherwise specified, shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

Temperature	Room ambient (77 ±9 °F (25 ±5 °C))
Altitude	Normal ground
Vibration	None
Humidity	Room ambient up to 90 percent relative humidity
Input power voltage	27.5 ±0.5V DC

3.4.9 Environmental conditions. The indicator shall be capable of withstanding the following environmental conditions as required in section 4 herein:

a. Operating temperature. Continuous operation over a temperature range of -65 °F (-54 °C) to 160 °F (71 °C).
b. Exposure temperature. Exposure temperature from -80 °F (-62 °C) to 203 °F (95 °C).
c. Temperature-altitude. 0 to 70,000 feet.
d. Temperature shock. MIL-STD-810, method 503, procedure I-C. Constant extreme temperature shall be from -70 °F (-57 °C) to 160 °F (71 °C), with each duration of exposure to be not less than 4 hours.
e. Salt fog. Exposure to salt laden atmosphere.
f. Fungus. Fungus growth as encountered in a tropical climate.
g. Acceleration. MIL-STD-810, method 513, procedure I.
h. Vibration. MIL-STD-810, method 514, transportation categories 7 and 8, procedure 1.

3.4.10 Primary input power requirements. The indicator shall meet all applicable requirements of MIL-STD-704 and shall give specified performance from a 28V DC, 0.25 amp power source with characteristics as defined in MIL-STD-704 having limits as specified therein. The power required shall not exceed the specified amounts.

3.4.11 Transportability. The indicator shall be so constructed that no parts will work loose in service. It shall be built to withstand the strains, jars, vibration, and other conditions incident to shipment, storage, installation and service use.

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

3.6 Details requirements.

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

3.6.2 Case. The case shall conform to MS33638 with the length as specified in MS28041. The case and mounting flange shall be made of nonferrous, low-density metal, uniform in texture, having a smooth surface and shall be hermetically sealed. The case shall be finished with a lusterless black material in accordance with FED-STD-595/37038. The finishing material shall be of a durable type to withstand usage encountered in service.

3.6.2.1 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 and 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 that may be adversely affected by any atmosphere to which the instrument may be subjected in normal use in military aircraft.

3.6.2.2 Filling medium. The filling medium shall be a mixture of 90 percent nitrogen and 10 percent helium. The nitrogen used shall be in accordance with A-A-59503, type I, grade B, class 1. The filling medium shall contain not more than 0.006 milligram of water vapor per liter (dew point -85 °F (-65 °C)) at the filling pressure. The absolute pressure of the filling medium in the case shall be 1 ±0.1 atmosphere.

3.6.2.3 Reinforcement. The inside of the case around each connection shall be of sufficient strength to prevent damage to the case when the connections are tightened during installation of the indicator.

3.6.2.4 Cover glass. The cover glass shall be clear, flat, and free from flaws that interfere with the normal reading of the instrument. The glass shall not be fluorescent when exposed to ultraviolet light or rays in the 365 millimicrons region.

3.6.2.4.1 Dial to cover glass distance. The distance between the indicator dial and the inside of the cover glass shall be held to a minimum and shall not exceed 0.188 inch.

3.6.3 Dial. The dial shall conform to figure 1. All markings shall be durable to withstand the usage encountered in service, and be finished in fluorescent luminescent or lusterless white conforming to FED-STD-595/37875, and in lusterless black conforming to FED-STD-595/37038. The style and proportions of numerals and letters placed on the dial shall conform to MS33558.

3.6.3.1 Visibility of dial. The pointed, center mark 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 degrees with a perpendicular to the dial and whose small diameter is the aperture of the case.

3.6.4 Slip indicator.

3.6.4.1 Indicator tube glass. The glass of the slip indicator tube shall be made of clear annealed glass tubing free from any flaws that will seriously affect the readability of the inclinometer. The wall thickness shall be not less than 0.05 inch. The inside of the tube shall be smooth and uniform in order that the ball will roll smoothly when the indicator is slowly tipped to either side of the vertical plane of the dial while being tapped gently. The tube shall not leak when held at 160 °F (71 °C) for one hour.

3.6.4.2 Indicator ball. When slip indicators with dark balls are specified, the ball shall be of black glass or dark blue glass in accordance with FED-STD-595/17038 or FED-STD-595/15044 respectively. When slip indicators with white balls are specified, the ball shall be of white glass. The white color shall be in accordance with the following color notation following Munsell System color notations. The color shall be neutral not less than 9.0 value and no greater than 0.5 chrome. The ball shall be a highly polished accurate sphere and shall be 0.37 ±0.06 inch in diameter.

3.6.4.3 Damping liquid. The damping liquid used in the slip indicators shall be sufficiently colorless to preclude interference with visibility of the ball under daylight and night lighting conditions and under normal temperature and temperature extremes. Damping shall be such that when the indicator is inclined to the horizontal at an angle of 24 degrees, the time for the ball to roll from the zero mark to the end of the tube shall be not less than 0.2 second.

3.6.4.4 Slip indicator zero position and sensitivity. When the indicator is in the normal horizontal position, the ball shall rest at the zero mark within 0.03 inch. With the dial vertical, when the indicator is rotated about the longitude axis until the ball is just short of its limit, the angle of rotation shall be 8 ±2 degrees. The ball shall not stick at the high end of the tube.

3.6.5 Turn indicator.

3.6.5.1 Sensitivity element. The sensitive element of the turn indicators shall be operated on 28V DC. The element shall be so mounted that it reacts only to turns about the vertical axis. The indication shall be proportional to the rate of turn about the vertical axis.

3.6.5.2 Pointer. The pointer shall be as shown on figure 1. It shall be as light as practicable and sufficiently rigid to prevent oscillation under vibration. It shall be firmly attached to the mechanism and yet be readily adjustable. During static or dynamic balance, the deviation of the pointer from zero shall not exceed 0.010 inch for any stationary position.

3.6.5.3 Mechanism adjustment. Means shall be provided to adjust or correct the sensitivity of the indications and, if necessary, the damping of the indications. The adjusting means shall be set in the neutral position, within an amount of one-quarter part of the total range of adjustment, in order that a sufficiently large range of adjustment in each direction will be available. This means of adjustment shall be reasonably simple to manipulate and of a nature that adjustment shall be reasonably simple to manipulate and of a nature that adjustment can be accomplished with tools ordinarily possessed by an instrument technician.

3.6.6 Screw threads. Screw threads 0.060 inch in diameter or larger shall be in accordance with SAE AS8879.

3.6.7 Electrical requirements.

3.6.7.1 Insulation. The complete electrical system shall be so insulated from the indicator cases that they will be capable of withstanding a voltage of 500V DC for a period of 1 minute.

3.6.7.2 Case markings. The following markings, in durable lusterless white or natural metal finish, shall be permanently and legibly marked on the back of the indicator cases beside the electrical receptacle to identify the electrical connector pins with which they shall be radially aligned:

Pin	Markings
A	+28V DC Power
B	Power Return

3.6.7.3 Electric connector. The electric connector shall be a sealed connector.

3.6.7.4 Voltage variation. The indicators shall operate satisfactorily with a power source ranging from 26 to 30V DC. The indicator motor shall start and come up to a useful speed with 23 volts applied.

3.6.7.5 Wiring. Internal wiring shall be color coded, neat and accomplished in such a manner that individual wires may be easily traced. The wiring shall be insulated from the instrument case.

3.6.7.6 Motor. The indicator shall utilize an AC motor that does not incorporate slip rings, contacts, brushes, or other similar elements.

3.6.7.7 Inverter. An inverter assembly shall be incorporated.

3.6.8 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.

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

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

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

3.6.8.3.1 Dissimilar metals. Dissimilar metals as defined in MIL-STD-889 shall not be used in intimate contact with each other, unless suitably protected against electrolytic corrosion by means of protective coatings.

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

3.6.8.3.3 Aluminum alloy parts. When practicable, 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-DTL-5541.

3.6.8.3.4 Steel parts. Steel parts shall be coated with ion vapor deposited aluminum, where practicable, in accordance with MIL-DTL-83488, type I or II, as applicable and of a class that is adequate to achieve the degree of protection required. Other protective coating, in lieu of MIL-DTL-83488, may be used if demonstrated to be satisfactory and approved by the cognizant engineering activity. Cadmium plating must be avoided when satisfactory alternative processes can be used. 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 conform to 3.6.8.4.

3.6.8.4 Protective treatment. Where 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 conditions, shall not be used.

3.6.8.5 Fungus-proof materials. Materials which are nutrients for fungi shall not be used where it is practicable to avoid them. Where used, they shall be treated with a fungicidal agent acceptable to the procuring activity. If used in a hermetically sealed enclosure, fungicidal treatment shall not be necessary.

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

3.6.9 Mounting hardware. The contractor shall furnish removable spring nuts conforming to MIL-N-3336 in sufficient quantity to install the instrument. The contractor shall furnish sufficient mounting hardware to install the indicator. The screws shall be round-head brass machine screws having a durable lusterless black, oxidized or nickel finish. The length shall be sufficient to mount the instrument on panels up to 0.375 inch thick.

3.6.9.1 Envelope. A durable envelope containing the mounting hardware shall be furnished by the contractor and be packaged with each indicator and marked as follows:

IMPORTANT
THIS ENVELOPE CONTAINS
MOUNTING HARDWARE

3.6.10 Workmanship. The indicator, including all parts and accessories shall be so constructed and finished that it will be free from all defects that may affect proper functioning in service. Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils, marking of parts and assemblies, welding and brazing, plating, riveting, machine screw assemblies, and freedom of parts from burrs and sharp edges.

3.6.10.1 Dimensions. Dimensions and tolerances shall be as specified. Where dimensions and tolerances may affect the interchangeability, operation, or performance of the indicator, they shall be held or limited accordingly.

3.6.10.2 Fabrication. Machining, drilling, and forming shall be performed with the use of accurate templates, jigs, and gauges that are regularly audited for accuracy and calibrated as per the manufacturers recommendations.

3.6.10.3 Screw assemblies. Assembly screws shall be tight. The word tight means that the screws cannot be tightened appreciably without damage or injury to the screw threads or heads.

3.6.10.4 Gears. Gear assemblies shall be properly aligned and meshed and shall be operable without interference, tight spots, loose spots or other irregularities. Where required for accurate adjustments, gear assemblies shall be as free as possible from backlash.

3.6.10.5 Cleanup. The indicator shall be thoroughly cleaned to remove loose, spattered or excess solder, metal chips and other foreign matter after final assembly. Burrs and sharp edges, as well as rosin flash that might crumble, shall be removed.

3.6.10.6 Soldering. Soldering shall be performed in accordance with AWS B2.3/B2.3M.

3.6.11 Magnetic property. When held in various positions around a free magnet at a distance of 5.5 inches in a magnetic field having a horizontal intensity of 0.18 ±0.01 oersted, the deflection of the magnet shall not exceed 5 degrees with and without power supplied.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.3).

b. Conformance inspection (see 4.4).

4.2 Inspection conditions. The inspection conditions are described under the individual test to which they apply.

4.3 First article inspection.

4.3.1 Test sample. Unless otherwise specified, the test samples shall consist of three indicators. The samples shall be identical to the production equipment. The samples shall be identified with the manufacturer's part number and other information as required by the procuring activity. For first article reliability tests the sample size shall be a minimum of six and a maximum of nine.

4.3.2 First article tests. The test samples shall be subjected to all the tests described under paragraph 4.5.

4.3.3 Government tests. When specified by the procuring activity (see 6.2), the samples that were subjected by the contractor to first article tests and an untested sample shall be delivered at the contractor's expense to a specified government laboratory for additional testing.

4.3.3.1 Data to accompany test samples. When it is required that test samples be furnished to the procuring activity, they shall be accompanied with the following data:

a. Brief operating data to enable test personnel to correctly operate the equipment.
b. Engineering data in the form of assembly drawings (2 sets) and calibration tests of the indicators.

4.4 Conformance inspections. Conformance inspections shall consist of:

a. Individual tests (see 4.4.1).
b. Sampling tests (see 4.4.2, 4.4.3, 4.4.4).

4.4.1 Individual tests. Each indicator shall be subjected to the following tests as described under 4.5.

a. Examination of product (see 4.5.1).
b. Low voltage operation (see 4.5.2).
c. Manufacturing run-in test (see 4.5.3).
d. Turn indicator static balance (see 4.5.4).
e. Turn indicator dynamic balance (see 4.5.5).
f. Turn indicator sensitivity (see 4.5.6).
g. Turn indicator damping (see 4.5.7).
h. Slip indicator visibility (see 4.5.8).
i. Slip indicator filling (see 4.5.9).
j. Slip indicator zero position (see 4.5.10).
k. Slip indicator friction (see 4.5.11).
l. Slip indicator damping (see 4.5.12).
m. Slip indicator sensitivity (see 4.5.13).
n. Seal (see 4.5.14).

4.4.2 Sampling plan A. Indicators shall be selected at random in accordance with the following schedule and subjected to the following tests as described under 4.5:

Production quantity	Total number of samples
1-10	1
11-60	2
61-135	3
136-235	4
Each additional 200 or fraction thereof	1

a. Individual tests (see 4.4.1).
b. Magnetic effect (see 4.5.15).
c. Current (see 4.5.20).
d. Voltage variation (see 4.5.21).
e. Slip indicator leak (see 4.5.22).
f. Transient susceptibility (see 4.5.23).

4.4.3 Sampling plan B. Three indicators selected at random from the first 20 on contract or order shall be subjected to the following tests as described under 4.5:

a. Individual tests (see 4.4.1).
b. Vibration resonance (oscillation) (see 4.5.16.1).
c. Low temperature operation (see 4.5.17).
d. High temperature operation (see 4.5.18).
e. Temperature-altitude (see 4.5.19).
f. Low temperature exposure (see 4.5.25).
g. High temperature exposure (see 4.5.26).
h. Acceleration (see 4.5.27).
i. Vibration (see 4.5.16).
j. Salt fog (see 4.5.28).
k. Mounting lug pull (see 4.5.29).
l. Temperature shock (see 4.5.30).
m. EMI (radio noise interference) (see 4.5.31).
n. Helium test (see 4.5.32).
o. Internal examination (see 4.5.33).

4.4.4 Sampling plan C. A minimum of 6 and a maximum of 9 indicators shall be selected at random from the first 20 on contract or order and shall be subjected to the following test as described under 4.5:

a. Individual tests (see 4.4.1).
b. Reliability test (see 4.5.24).

4.5 Test methods.

4.5.1 Examination of product. Each indicator shall be examined carefully to determine that the material and workmanship requirements have been met. This examination must be performed prior to hermetic sealing and must be verified by a government inspector.

4.5.2 Low voltage operation. The electrical power, with the voltage reduced to 23 volts, shall be applied to the indicator. The indicator motor shall start and come up to a useful speed.

4.5.3 Manufacturing run-in test. Each indicator shall be operated under the conditions specified herein for a period of 6 hours without failure. A failure shall be defined as anything that causes malfunctioning of the indicator. Only those adjustments will be permitted which can be made by using such during the normal use of the indicator.

a. Temperature, ambient room.
b. Humidity, ambient room.
c. Vibration: Any selected frequency within the range of 20 to 30 Hz (excluding resonant points) and a minimum amplitude of ±3 g-forces (g's).

The indicator shall be vibrated (without vibration isolators) for a period of 10 minutes prior to the beginning of the 6-hour period of operation. Where feasible, the indicator shall be operated during this vibration period for the purpose of detecting flaws and imperfect workmanship. Operation within the specified limits of satisfactory performance is not necessarily required during the vibration period. The direction of vibration should be vertical to the normal mounting plane for 5 minutes and lateral to that plane for 5 minutes. Where it is not feasible to vibrate the indicator in 2 directions, the vertical direction shall be used. During the 6-hour period of operation following the 10-minute vibration period, the indicator shall be mechanically cycled periodically through its various phases of operation. Should a failure occur, it should be repaired and the test started over, except that the 10-minute vibration period need not be repeated. When it is certain the failures occur, corrective action shall be taken to eliminate this defect from future indicators. A record shall be kept of all failures. The 6-hour period specified above may be composed of two 3-hour periods to conform to standard working hours.

4.5.4 Turn indicator static balance. The indicator shall be placed in stationary position and the pointer checked with no power applied. The deviation of the pointer from zero shall not exceed 0.010 inch for any stationary position.

4.5.5 Turn indicator dynamic balance. The indicator shall be placed in the normal stationary position and the pointer position checked with the gyro operated on 28V DC. The deviation of the pointer from zero shall not exceed 0.010 inch for any stationary position.

4.5.6 Turn indicator sensitivity. The indicator shall be placed in the normal position and operated on 28V DC. The instrument shall be turned about the vertical axis at the rates specified below. The deflection of the pointer shall also conform to the tolerances specified in table I. This test shall be made after the power has been applied for a period of not more than 3 minutes. The rates of turning may be measured with a timer, or one indicator may be accurately checked against a timer and then used as a standard for testing other indicators. The movement of the pointer shall be smooth throughout its range.

TABLE I. Pointer deflection.

Rate of turning in degrees per minute	Deflection of pointer tips in inches	
	MS28041-1, -1A, -1B, -1C, -1D	MS28041-2, -2A
36	0.06 ±0.01	-
90	0.16 ±0.03	0.08 ±0.03
180	0.31 ±0.06	0.16 ±0.03
360	0.63 ±0.06	0.31 ±0.06

4.5.7 Turn indicator damping. The indicator shall be placed in the normal operating position on a rate table and operated for 5 minutes. The indicator shall then be rotated about its vertical axis at a rate that causes full-scale deflection of the pointer and then the rotation shall be stopped suddenly. The motion of the pointer shall be so damped that the pointer returns to the zero mark without crossing it, in not less than one second, and not more than 3 seconds, and without oscillation or noise other than that encountered in normal operation.

4.5.8 Slip indicator visibility. The indicator shall be so tipped that the ball is at rest at either end of the tube. No less than one-half of the ball shall be visible when the ball is viewed from a position 12 inches directly in front of the zero mark of the slip indicator.

4.5.9 Slip indicator filling. The indicator shall be so tipped that all the air in the tube is trapped in the expansion chamber end of the tube. The position of the mounting lugs of the indicator shall be in a vertical plane with the line joining the centers of the two lower mounting holes in a horizontal plane. No part of the air bubble shall be visible when the indicator is viewed from a position 12 inches directly in front of the zero mark of the slip indicator.

4.5.10 Slip indicator zero position. The two lower adjoining mounting holes of the indicator shall be placed in the normal horizontal position, and the indicator shall be gently tapped. The glass ball shall rest at the zero mark of the slip indicator within 0.03 inch.

4.5.11 Slip indicator friction. The indicator shall be slowly tipped to either side of the vertical plane of the dial. The ball shall roll smoothly when the indicator is gently tapped.

4.5.12 Slip indicator damping. The plane of the mounting lugs of the indicator shall be placed in a vertical position with the line joining the centers of the two lower or two upper mounting holes inclined to the horizontal at an angle of 24 degrees, in order that the ball will roll to the opposite end of the tube. The time of roll of the ball from the zero mark of the indicator to the end of the tube shall be not less than 0.2 second.

4.5.13 Slip indicator sensitivity. With the dial vertical, the indicator shall be rotated about the longitudinal axis to the right until the ball is just short of its limit. The angle of rotation shall be 8 ±2 degrees. The test shall be repeated rotating the instrument to the left. The same tolerance shall apply. The ball shall not stick at the high end of the tube.

4.5.14 Seal. The indicator shall be tested for leaks by means of a mass spectrometer type of helium leak detector and the differential pressure existing when the test is conducted shall be the same as that to which the instrument is filled, approximately 1 atmosphere. The leak rate shall be based on a 1-atmosphere differential pressure with pure helium as the filling medium. Under these conditions, (1 atmosphere differential pressure with pure helium as the filling medium) the leak rate shall not exceed 0.10 micron cubic foot per hour. Equivalent helium leak rates for the same hole size at other differential pressures and helium-nitrogen mixtures, or both, shall be calculated by the manufacturer. The leak test shall be conducted either with the instrument evacuated and surrounded by helium, or after the instrument has been filled. As an alternate test, an immersion leak test may be performed in accordance with MIL-STD-810, method 512, procedure 1.

4.5.15 Magnetic effect. The indicator shall be tested with no power applied. The indicator shall be revolved about a short bar magnet compass with the nearest part of the indicator 5.5 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 if 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 position 0, 45, 90,

135, 180, 225, 270, and 315 degrees. At each of these positions the indicators shall be rotated 360 degrees about its horizontal axis. The deflection of the compass at any of the specified positions shall not exceed 5 degrees. This test shall be repeated with power applied to the indicator. The same tolerance shall apply.

4.5.16 Vibration. The indicator shall be tested in accordance with MIL-STD-810, method 514, transportation categories 7 and 8, procedure I. The maximum magnitude of pointer vibration shall not exceed 0.03 inch double amplitude, and the slip indicator ball shall not differ from its zero position by more than 0.06 inch.

4.5.16.1 Oscillation. The indicator shall be tested in accordance with MIL-STD-810, method 514, transportation categories 7 and 8, procedure I. The peak-to-peak amplitude of oscillation shall be 0.008 radian with a frequency range of 4 to 7 Hz. Under these conditions, the vibration of the pointer shall not exceed 0.020 inch single or 0.040 inch double amplitude.

4.5.17 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 subject to an ambient temperature of -65 °F (-54 °C) for a period of 4 hours. At the end of the 4-hour period and with the temperature maintained at -65 °F (-54 °C), the indicator shall be subjected to and shall meet the requirements specified in the turn indicator sensitivity (low temperature) test (see 4.5.17.1), and the slip indicator damping (low temperature) test (see 4.5.17.2). There shall be no slip indicator leakage as a result of these tests.

4.5.17.1 Turn indicator sensitivity (low temperature). The indicator shall be mounted in the normal operating position on a rate table and operated for 10 minutes maximum. The indicator shall then be rotated about the vertical axis at 180 degrees per minute for MS28041-1, MS28041-1A, MS28041-1B, MS28041-1C, MS28041-1D, and 360 degrees per minute for MS28041-2 and MS28041-2A. The pointer deflection shall be 0.31 ±0.06 inch. The rotation shall then be stopped and the pointer shall return smoothly without oscillation to the zero position within 0 ±0.01 inch. The test shall be performed in both directions of rotation.

4.5.17.2 Slip indicator damping (low temperature). The slip indicator damping test shall be repeated and the time for the ball to travel from the zero mark to the extreme end of the tube shall not be greater than 4 seconds.

4.5.18 High temperature operation. (This test may be combined with the high temperature exposure test at the direction of the testing agency.) The indicator shall be properly connected and power shall be applied. The indicator shall then be subjected to an ambient temperature of 160 °F (71 °C) for a period of 4 hours. At the end of the 4-hour period, and with the temperature maintained at 160 °F (71 °C), the indicator shall be subjected to and shall meet the requirements specified in the turn indicator sensitivity (high temperature) test (see 4.5.18.1). There shall be no slip indicator leakage as a result of these tests.

4.5.18.1 Turn indicator sensitivity (high temperature). The indicator shall be mounted in the normal operating position on a rate table and operated for 10 minutes maximum. The indicator shall then be rotated about the vertical axis at 180 degrees per minute for MS28041-1, MS28041-1A, MS28041-1B, MS28041-1C, MS28041-1D, and 360 degrees per minute for MS28041-2 and MS28041-2A. The pointer deflection shall be 0.31 ±0.06 inch. The rotation shall then be stopped and the pointer shall return smoothly without oscillation to the zero position within 0.03 inch. The test shall be performed in both directions of rotation.

4.5.19 Temperature-altitude. The indicator shall be tested in accordance with MIL-STD-810, method 520, procedure I. Temperature-altitude shall be from sea-level to 70,000 feet, -79.6 °F (-62 °C) to 203 °F (95°C).

4.5.20 Current. A DC ammeter shall be connected in the 28V DC line between the indicator and the source of power. The current consumption at starting shall not exceed 1.1 amperes. After a period of 3 minutes running time, the current required shall not exceed 0.25 ampere.

4.5.21 Voltage variation. The indicator shall be subjected to and shall satisfactorily pass the turn indicator sensitivity test when operated on an electrical potential of 26V and 30V DC.

4.5.22 Slip indictor leak. The size of the air bubbles in the tube shall be determined with the indicator at room temperature. The indicator shall then be maintained at a temperature of 160 ±3.6 °F (71 ±2 °C) for a period of not less than 1 hour. The size of the air bubble shall then be determined with the indicator at room temperature. There shall be no appreciable change in the size of the air bubble before and after the indicator has been subjected to the high temperature. This test may be combined with the test specified in 4.5.18.1.

4.5.23 Power requirements. The DC transient levels for transient susceptibility test shall be as follows:

a. Voltage transient abnormal steady state limit (ASSL).

(1) With 30 volts applied to the indicator, apply a transient up to the 80-volt level for 50 milliseconds.
(2) Repeat the transient pulses 15 times.
(3) Apply a transient up to the 73-volt level for 200 milliseconds.
(4) Repeat this 200-millisecond pulse 1 time.
(5) With 28.5 volts applied to the indicator apply 15 pulses (-6 volts). Hold the last 22.5 level for 35 seconds.

Note: For the preceding ASSL testing, use a 1 to 5 second interval between pulses.

b. Emergency steady state limit.

(1) With 22.5 volts applied to the indicator, turn off the power for 7 seconds and then back to 22.5 volts for 10 seconds. Repeat 15 times.

(2) With 28.5 volts applied to the indicator, drop the voltage to 16.5 volts for 2 minutes and then increase to 28.5 volts. Repeat 15 times.

c. Spike voltage normal steady state limits.

(1) With 28.5 volts applied to the indicator, apply a spike up to the +600 volt level for 10 microseconds. Apply 25 of these spikes 1 to 2 seconds apart.
(2) Repeat the above procedure with -600 volt pulses.
(3) With 28.5 volts applied to indicator, apply a +160 volt pulse for 100 microseconds. Repeat 25 times.
(4) With 28.5 volts applied to the indicator, apply a -120 volt pulse for 100 microseconds. Repeat 25 times.

Note: During this transient susceptibility testing, the indicator will be turned about the vertical axis at 180° per minute to check for normal pointer deflection. The emergency operations requirements of MIL-STD-704 shall apply during these tests. Between pulses pointer deflection should be 0.31 ±0.06 inch. This applies to all transients tests except at the 22.5 volt level, deflection may be 0.31 ±0.12 inch. The indicator current consumption will be monitored during all of the tests and any change in current exceeding 10 percent is considered a failure. Loss of pointer deflection or abnormal deflection is considered a failure.

4.5.24 Reliability test. Indicators selected for reliability testing (see 6.4) shall have previously been subjected to and passed the individual tests specified in paragraph 4.4.1.

4.5.24.1 Test level. The equipment inspection conditions shall be of the most severe for those under the fighter, transport, or helicopter categories. It shall be established that the indicators under test operate at room temperature. Each indicator shall then be subjected to a low room temperature. The low temperature test shall be conducted in accordance with 4.5.17 and the high temperature test in accordance with 4.5.18. If a particular indicator has already been subjected to tests of 4.5.17 and 4.5.18, the tests need not be repeated but each indicator to be tested under 4.5.24.1 must already have passed the tests of 4.5.17 and 4.5.18. The indicators shall be subjected to the same angular motions as used in the life tests throughout the reliability tests.

4.5.24.2 Duty cycle. The indicator shall operate for a period of 2.5 hours and be off for a period of 0.5 hour.

4.5.24.3 Accept-reject criteria. Test data may be evaluated as described in MIL-HDBK-781.

4.5.24.4 Performance characteristics to be measured. At least once each week the indicator shall be subjected to and meet the requirements of the following tests:

a. Turn indicator static balance (4.5.4).
b. Turn indicator dynamic balance (4.5.5).
c. Turn indicator sensitivity (4.5.6).

d. Slip indicator zero position (4.5.10).
e. Slip indicator friction (4.5.11).
f. Slip indicator sensitivity (4.5.13).

A daily observation (on each workday) shall be made of each indicator in order to detect obvious failures.

4.5.24.5 Failure criteria. Whenever performance characteristics fall below the acceptance requirement (4.5.24.4) at least one failure has occurred. If subsequent analysis reveals that several parts have deteriorated, each shall be counted a failure, unless one caused the other to fail. MIL-HDBK-781 may be used for guidance.

4.5.24.6 Preventative maintenance. During the period of the tests no preventative maintenance measures may be performed upon the indicator.

4.5.24.7 Length of tests. Each indicator under test shall be operated until either a failure has occurred or an accept-reject decision has been reached. In the event an indicator fails during the test, it shall either be returned to a serviceable condition and again be placed on test or a replacement test indicator shall be placed on test in order that the test sample size remain constant throughout the test.

4.5.24.8 Disposition of equipment. Indicators that have been subjected to the reliability tests shall not be delivered on contract until they have been refurbished, resubmitted and passed all the individual tests.

4.5.25 Low temperature exposure. The indicator shall be tested in accordance with MIL-STD-810, method 502, procedure I. At the end of the exposure period, the indicator shall be subjected and shall meet the requirements of the turn indicator sensitivity (low temperature) test (see 4.5.17.1). The indicator shall then be returned to room temperature and allowed to saturate for a minimum of 4 hours. It shall then be subjected to and shall meet the requirements specified in the individual tests.

4.5.26 High temperature exposure. The indicator shall be tested in accordance with MIL-STD-810, method 501, procedure I. At the end of the exposure period, the indicator shall be subjected and shall meet the requirements of the turn indicator sensitivity (high temperature) test (see 4.5.18.1). The indicator shall then be returned to room temperature and allowed to saturate for a minimum of 4 hours. It shall then be subjected to and shall meet the requirements specified in the individual tests.

4.5.27 Acceleration. The indicator, not operating, shall be mounted and accelerated, first in its vertical axis, and then in each of two axes that are perpendicular to the vertical axis and to each other in accordance with MIL-STD-810, method 513, procedure I. The indicator shall be subjected to an acceleration of 20 g's in each of the above axes for a period of 30 seconds. At the end of this acceleration, the indicator shall meet the requirements specified for turn indicator sensitivity. No damage to the indicator shall result from the test.

4.5.28 Salt fog. The indicator, with the gyro not operating but with the external connections made to simulate installed conditions, shall be tested in accordance with MIL-STD-810, method 509. At the conclusion of the test, the indicator shall be subjected to and shall meet the requirements specified in the following tests.

a. Low voltage operation (4.5.2).
b. Turn indicator static balance (4.5.4).
c. Turn indicator dynamic balance (4.5.5).
d. Turn indicator sensitivity (4.5.6).
e. Turn indicator damping (4.5.7).

4.5.29 Mounting lug pull. The indicator case shall be mounted face downward on the removable 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 1 minute to each lug in a direction toward the front of the case. The lugs shall withstand the applied load without fracture, and there shall be no damage to any part of the indicator. The indicator shall then be subjected to and shall meet the requirements specified in the seal test.

4.5.30 Temperature shock. The indicator shall be tested in accordance with MIL-STD-810, method 503, procedure I-C. Constant extreme temperature shall be from -70 °F (-57 °C) to 160 °F (71 °C), with each duration of exposure to be not less than 4 hours. At the end of this test, the indicator shall be subjected to and shall meet the requirements of the seal test.

4.5.31 EMI (radio noise interference). The electrical system of the indicator shall be tested for conducted and radiated radio noise interference in accordance with MIL-STD-461.

4.5.32 Test for helium. The indicator case shall be punctured, or the filling tube cut, and the indicator subjected to the test for helium by means of mass spectrometer type helium detector. Failure to detect helium shall be cause for rejection.

4.5.33 Internal examination. The case of the indicator shall be opened and the internal mechanism examined. Any deterioration or damage that could in any manner prevent the indicator from meeting functional operation or maintenance requirements during service life shall be cause for rejection.

4.6 Presubmission testing. No item, part, or complete indicator shall be submitted by the contractor until it has been tested and inspected by the contractor and found to comply, to the best of contractor's knowledge and belief, with all applicable requirements.

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

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. The turn and slip indicator is intended for use in aircraft to indicate the rates of rotation of the aircraft about its vertical axis and the lateral attitude of the aircraft relative to the apparent vertical.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type (see 1.2).
c. The quantity and MS part number of the instrument desired.
d. Whether government tests are required and if required, the laboratory at which government tests are to be conducted (see 4.3.3).
e. Packaging requirements (see 5.1).

6.3 First article. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

6.4 Reliability test plan and report. Prior to starting the reliability test, the manufacturer will submit a detailed reliability test plan for formal approval by the procuring activity. The manufacturer may refer to the requirements specified in test plan I-D of MIL-HDBK-781 as a guide for the reliability test plan. The manufacturer will prepare a final report that summarizes the achieved reliability of the test samples. The report will also contain test procedures, details of any malfunctions, and applicable charts and graphs showing failures/MTBF plotted against test time and other pertinent test data. The manufacturer may refer to the guidelines outlined in MIL-HDBK-831 for preparing the report.

6.5 Test values. Normal and limiting values of performance data should be determined at input voltages of 27.5 ±0.5V DC. These data are to be used in testing the equipment at installation points for compliance with minimum acceptable standard performance.

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

6.7 Nonrepairable subassemblies. As a general rule, nonrepairable subassemblies should be encapsulated or hermetically sealed. The number of connections internal to the subassembly should be held to a minimum. Detail parts of tolerances and ratings should be so selected that the life of the subassembly is greater than that of a similar repairable one. With few exceptions (such as high voltage power supplies), the nonrepairable subassembly should evidence a MTBF greater than 5,000 hours, and for many applications this figure must be nearer 50,000 hours.

6.8 Precedence of documents. When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence will apply:

a. Contract: The contract will have precedence over any specification.
b. This specification: This specification will have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, must be specifically approved in writing by the procuring activity.
c. Referenced specifications: Any referenced specification will have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications will apply to the extent specified.

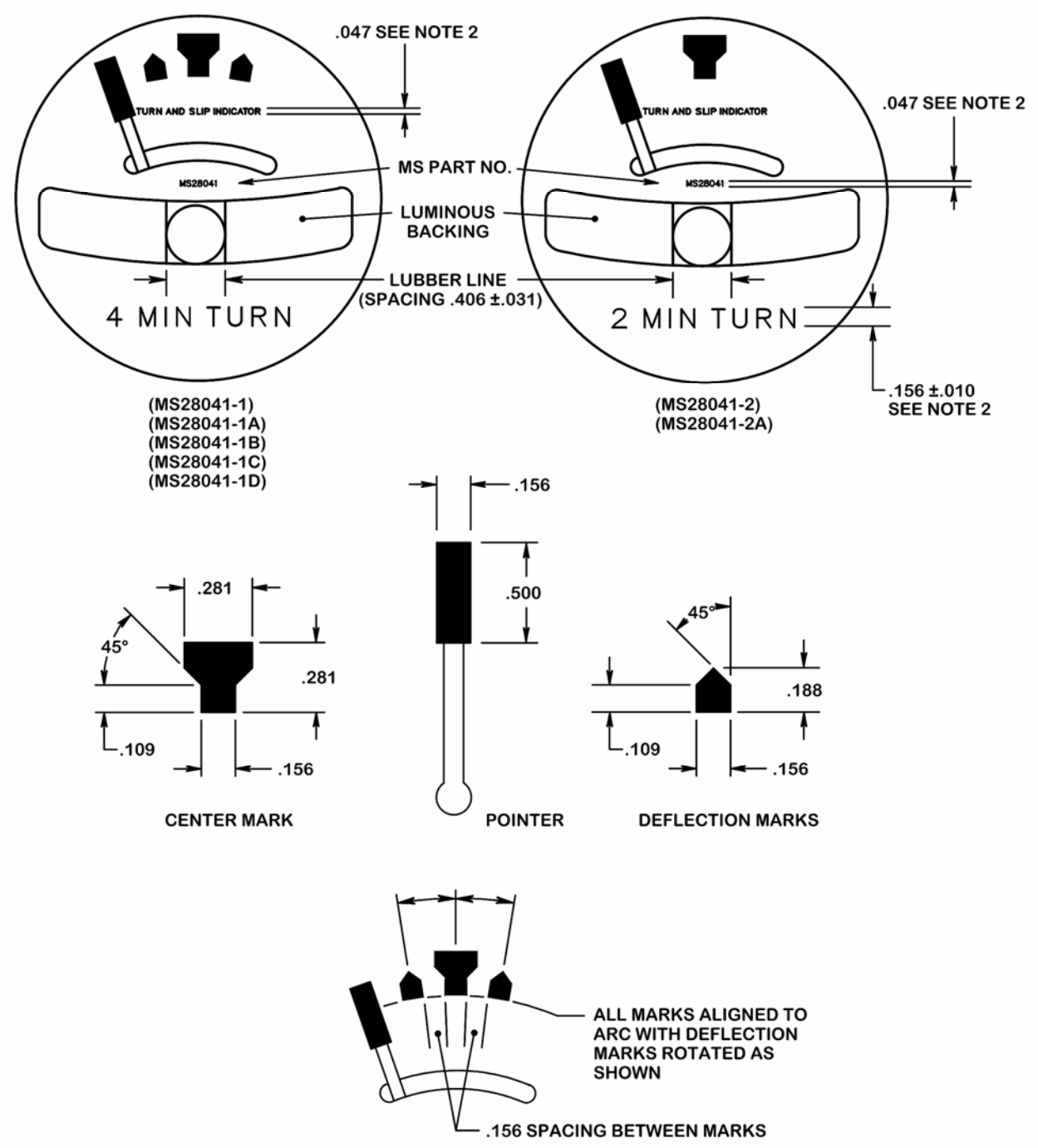
6.9 Definition of hermetic seal. A hermetic seal is defined as a perfectly closed and airtight seal made between metallic and metallic or between metallic and vetric materials. A hermetic seal is not intended to include seals accomplished by gaskets.

6.10 International standardization agreement implementation. This specification implements STANAG 7140. When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at https://assist.daps.dla.mil/.

6.11 Subject term (key word) listing.

Aircraft instrument
Dial
Gyro
Hermetic seal
Lateral attitude
Rotation rates
Vertical axis

6.12 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.



NOTES:
1. All dimensions are in inches.
2. Same dimensions are for both dials.

FIGURE 1. Markings, dial and pointer.

<table>
<tr><th>Marking</th><th>Height or length</th><th>Width of line or graduation ±.005</th><th>Material or finish</th></tr>
<tr><td>Center mark</td><td rowspan="7">As shown on figure</td><td rowspan="3">As shown on figure</td><td rowspan="7">Fluorescent luminescent or lusterless white FED-STD-595/37875</td></tr>
<tr><td>Two needle-width deflection marks</td></tr>
<tr><td>Shaded portion of pointer</td></tr>
<tr><td>Rear half and bottom of indicator tube for dark ball</td></tr>
<tr><td>Visible part of two wires on front and top of inclinometer</td><td rowspan="2"></td></tr>
<tr><td>One wire on each side of inclinometer ball in zero position</td></tr>
<tr><td>Lettering, 4 min turn, 2 min turn</td><td rowspan="4">.016</td></tr>
<tr><td>Lettering, Turn and slip indicator</td><td rowspan="2">.047</td><td rowspan="5">Lusterless black FED-STD-595/37038</td></tr>
<tr><td>MS part number</td></tr>
<tr><td>Dial background</td><td rowspan="2"></td></tr>
<tr><td>Rear half and bottom of indicator tube for white ball</td><td></td></tr>
</table>

FIGURE 1. Markings, dial and pointer - Continued.

Custodians:
Army - AV
Navy - AS
Air Force - 99
DLA - GS

Review Activity:
Air Force - 71

Preparing Activity:
DLA - GS1

(Project 6610-2010-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST database at https://assist.daps.dla.mil/.