

INCH-POUND
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MILITARY SPECIFICATION

INSTRUMENTS AND NAVIGATION EQUIPMENT, AIRCRAFT: INSTALLATION OF

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

1. SCOPE

1.1 Scope. This specification presents general and detail requirements for the installation of instruments and navigation equipment, both Government-furnished and contractor-furnished, for Navy aircraft.

2 APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2b).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Systems Requirements Department, Code SR3 Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6605

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SPECIFICATIONS

MILITARY

MIL-B-5087	Bonding; Electrical, and Lighting Protection, for Aerospace Systems
MIL-W-5088	Wiring, Aerospace Vehicle
MIL-H-5440	Hydraulic Systems; Aircraft Types I and II, Design and Installation Requirements for
MIL-C-6136	Conduit; Electrical Flexible, Shielded, Aluminum Alloy for Aircraft Installations
MIL-C-6390	Clamps and Instruments, Aircraft, Installation of
MIL-C-6818	Clamps and Instruments, Aircraft, Installation for
MIL-E-7080	Electric Equipment; Aircraft, Selection and Installation of
MIL-C-7188	Compasses, Pilot's Standby, Installation of
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-G-7940	Gages, Liquid Quantity, Capacitor Type, Installation and Calibration of
MIL-H-8891	Hydraulic Systems, Manned Flight Vehicles, Type III, Design, Installation and Data Requirements for, General Specification for
MIL-F-17874	Fuel Systems; Aircraft, Installation and Test of
MIL-I-18079	Installation of Angle of Attack and Sideslip Systems
MIL-C-18244	Control and Stabilization Systems; Automatic, Piloted Aircraft, General Specification for
MIL-O-19838	Oil Systems, Aircraft, Installation and Test of
MIL-N-25027	Nut, Self-Locking, 250 Deg. F, 450 Deg. F, and 800 Deg F
MIL-P-26292	Pitot and Static Pressure Systems, Installation and Inspection of

STANDARDS

FEDERAL

FED-STD-595	Colors Used In Government Procurement
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STANDARDS - Continued

MILITARY

MIL-STD-765	Compass Swinging, Aircraft, General Requirements for
MIL-STD-1247	Markings, Functions, and Hazard Designations of Hose, Pipe and Tube Lines for Aircraft Missiles, and Space Systems
MIL-STD-1353	Electrical Connectors, Plug in Sockets and Associated Hardware, Selection and Use of
MS26556	Case, Flight Report Holder and Map
MS28028	Thermometer Self-Indicating, Bimetallic
MS28042	Clamp, Instrument Mounting, Aircraft
MS28112	Instrument, Basic Standard Arrangement for Fixed Wing Aircraft
MS33549	Case, Instrument, 2-3/4 Dial, with Sump, Standard Dimensions for
MS33558	Numerals and Letters, Aircraft Instrument Dial, Standard Form of
MS33572	Instrument, Pilot, Flight, Basic, Standard Arrangement for Helicopters
MS33620	Chart, Hose Selection
MS33632	Wiring Diagram-Two-Pole Tachometer Generator and Percent RPM Tachometer Indicator
MS33638	Cases, Instrument, Flange Mounted, Aircraft
MS33639	Cases, Instrument, Clamp-Mounted, Aircraft

AIR FORCE - NAVY AERONAUTICAL

AND10405	Instrument Board-Installation of Vibration Insulated
AND20005	Drive-Type XV Engine Accessory

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

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PUBLICATIONS

NAVAL AIR SYSTEMS COMMAND

SD-24 General Specification for the Design and
Construction of Aircraft Weapons System

(Copies are available from DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2b).

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AIR 46A The Preparation and Use of Chromel-Alumel
Thermocouples for Aircraft Gas Turbine Engines

ARP 426 Compass System Installations

(Applications for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, (except for related associated detail specifications, specification sheets or MS standards) 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 Modifications, deviations and revisions. Modifications to, or deviations from, the requirements of this specification will be permitted only when specifically included in the detail specification for the aircraft involved, or when specifically approved by the acquiring activity in writing.

3.2 Instruments to be installed. The instruments to be installed in a given model aircraft, including instruments to be furnished for test purposes, shall be specified in the aircraft detail specification.

3.3 Instruments arrangement. The basic flight instruments shall be arranged in accordance with MS28112 or MS33572, as applicable. The directional indicator shall be installed near the centerline of the pilot's and the co-pilot's panels. Functionally related instruments shall be grouped together as panel space permits. The instrument arrangement shall be subjected to the approval of the acquiring activity.

3.4 Government-furnished equipment. Specified equipment for new construction Naval aircraft shall be Government selected and furnished in accordance with the aircraft detail specification.

3.4.1 Outline dimensions. The outline dimensions for Government-furnished equipment shall be in accordance with the aircraft detail specification.

3.4.2 Equipment weights. The weight of each item of Government-furnished equipment shall be as specified in the aircraft detail specification.

3.4.3 Equipment modification. Government-furnished equipment shall not be modified or reworked in any manner without the specific approval of the acquiring activity.

3.5 Contractor-furnished equipment. Unless otherwise specified, all mounting hardware, supports, panels or mounts, all electrical connector plugs, and fluid connection fittings for instruments and all hose, tubing, wiring, or conduit connected to or necessary for installation of equipment shall be furnished by the contractor and shall be in accordance with specifications as stated herein. If the contractor selects equipment which is peculiar to a given model aircraft, the equipment shall conform with acquiring activity design specifications and, at least six months in advance of the delivery of the first equipment, there shall be a proposed installation of the equipment (see 6.3). The proposal shall include installation drawings of the equipment, the instrument manufacturer's name and part number of each item of equipment, the location and quantity per aircraft of each item of equipment, and the delivery schedule for the equipment. If acceptable, the contractor will procure and furnish the equipment so selected.

3.5.1 Pointer and dial markings. The pointer and dial markings of instruments furnished by the contractor shall be durable, lusterless white color number 37875 of FED-STD-595 with a background of durable, lusterless black color number 37038 of FED-STD-595. There shall be a sketch of the proposed dial design, including details of marking, whenever instruments are furnished by the contractor. The form of the numerals and letter shall be in accordance with MS33558. Instrument cases shall be in accordance with MS33549, MS33638, or MS33639. The clamps for clamp-mounted instruments shall be in accordance with MS28042.

3.6 Handling of instruments. Due attention shall be given to the delicate nature of aircraft instruments in the storage, handling, and use thereof.

3.7 Instruments and instrument boards. Instruments and instrument boards shall be installed in accordance with the requirements of AND10405 and in accordance with the requirements of this specification. Vibration isolators shall be provided by the contractor.

3.7.1 Instrument boards. Instrument boards shall be of nonmagnetic electrically conducting material and shall be bonded in accordance with MIL-B-5087.

3.8 Instrument mounting in panel or board. All panel mounted instruments shall be mounted with the case lugs or mounting ring against the front of the panel so that the instrument shall be installed and removed from the front panel.

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3.8.1 Flange-mounted instruments. For flange-mounted instruments, 6-32 UNC self locking plate nuts conforming to MIL-N-25027 shall be installed on the rear of the panel for each instrument. The plate nuts shall be installed by welding or by the use of flush type rivets to leave the front of the panel smooth and free of surface obstructions. For clamp-mounted instruments, the clamps shall be in accordance with MIL-C-6818 and shall be installed in accordance with MIL-C-6390. Round-head brass mounting screws having a durable, lusterless black, oxidized nickel finish shall be provided for each instrument.

3.8.2 Instrument installation. Each instrument shall be installed and supplied with long electric wiring or conducting tubing to permit the instrument to be pulled out of the panel to expose the connection for assembly or disassembly purposes at the front of the panel. Means shall be provided to prevent fouling or objectionable interference of slack wiring or tubing when the instrument is installed in the panel.

3.9 Instrument range markers. Instrument range markers shall consist of white arcs to indicate normal operating ranges and red strips to indicate minimum and maximum limits.

3.10 Instrument lighting. Instrument lighting shall be as specified in the aircraft detail specification.

3.11 Instrument power requirements. Electrical power requirements for instruments are subject to the approval of the acquiring activity. Unless otherwise specified, inverters and alternators of acceptable capacity and type are Government-furnished to supply all alternating-current-operated instruments.

3.11.1 Circuit protective devices. Circuit protective devices shall be installed as specified in MIL-E-7080.

3.12 Electric and fluid connections.

3.12.1 Hose, tubing, wiring, or conduit. Hose, tubing, wiring, or conduit connected to shock-mounted or vibration-insulated instrument indicators, transmitters, or components shall be of an approved flexible type.

3.12.2 Electrical wiring. Electrical equipment shall be wired in accordance with MIL-W-5088 and MIL-E-7080.

3.12.2.1 Electrical wire. Electrical wiring used in the installation of equipment shall be in accordance with MIL-W-5088.

3.12.2.2 Electrical connector plugs. Unless otherwise specified, all mating electrical connector plugs for equipment shall conform to MIL-STD-1353.

3.12.2.3 Flexible conduit. Flexible conduit used in the installation of equipment shall be in accordance with MIL-C-6136.

3.12.3 Instrument fluid line tubing. Unless otherwise required, instrument fluid line tubing shall be 1/4 inch outer diameter and shall be selected and installed in accordance with MIL-H-5440 or MIL-H-8891, as applicable.

3.12.3.1 Instrument fluid line identification. Instrument fluid lines shall be identified in accordance with MIL-STD-1247.

3.12.3.2 Threads. All instrument connections shall have straight threads conforming to MIL-S-7742 unless otherwise specified by the acquiring activity.

3.13 Pitot-static systems. Pitot-static tubes, pitot tubes, and flush static ports shall be installed in accordance with MIL-P-26292.

3.14 Correction cards and card holders. Correction cards with card holders shall be provided for recording altimeter and airspeed indicator corrections and compass residual deviations. Correction cards shall be mounted close to the instruments they serve. However, the instrument arrangement shall not be compromised by complying with this requirement.

3.15 Automatic flight control (AFC) and stabilization systems. These systems serve to stabilize and control aircraft throughout various maneuvers as selected or directed by the human pilot or other control means. The variety of maneuvers which can be performed depends on the type of equipment installed.

3.15.1 Automatic pilot equipment installation. The automatic pilot equipment as specified in the aircraft detail specification shall be installed in accordance with MIL-C-18244 and the manufacturer's operation and maintenance instructions handbook.

3.15.2 Guarding and protection of cockpit controlling. Guarding and protection of cockpit controlling means such as switches, knobs, and engagers, shall be installed to minimize inadvertent hard-over maneuvers.

3.16 Attitude and directional gyro reference indicators. These are remote indicating or direct reading gyroscopic instruments, functioning to indicate the attitude, direction, and rate of turn of the aircraft in space.

3.16.1. Attitude and directional instruments installation. The attitude and directional gyro reference instruments shall be installed in accordance with the manufacturer's operation maintenance instructions handbook and approved installation instructions (EI).

3.16.2 Compass and directional-gyro reference systems. Compasses are classified as either (1) direct or remote reading magnetic or (2) compass-controlled directional-gyro stabilized systems. Direct reading magnetic compasses are self-contained magnetic instruments affected by the earth's magnetic field. Compass controlled directional-gyro stabilized systems are utilized either by synchronizing gyro information to the earth's magnetic meridian or as low-drift free gyro systems. Directional-gyro stabilized compass systems include directional controlled gyro magnetic transmitter, amplifier, and remote indicator linked electrically so that accurate and stabilized indications of aircraft heading are obtained from movement of the transmitter in the earth's magnetic field or action of the free gyro. Systems incorporate electrical output utilized for (1) heading or directional intelligence for electronic, navigational, bombing, and armament systems or (2) directional control of the aircraft through control and stabilization systems.

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3.16.2.1 Installation and compensation.

3.16.2.1.1 Compasses and gyro reference systems Compasses shall be installed in accordance with MIL-C-7188 for direct reading compasses and ARP 426 for remote indicating compasses and gyro reference systems shall be swung and compensated in accordance with MIL-STD-765.

3.16.2.1.2 Transmitter. The transmitter detects the direction of the lines of force of the earth's magnetic field and transmits this information electrically to the directional-gyro unit. The transmitter consists of a pendulous sensing element sealed in a case and adjustable compensating magnets. The magnets may be positioned to oppose the local deflecting forces causing disturbance to the earth's magnetic field. The transmitter shall be located far from all sources of local magnetic deviation such as electrical cables, engines, and indicating transmitters. Magnetic materials shall not be used in the installation of the transmitter.

3.16.2.1.3 Transmitter installation. The transmitter shall be shock-mounted or vibration insulated only if the amplitude of vibration (as measured from the mean or average position) exceeds 0.010 inch in the range of normal operating engine rpm. The transmitter shall be installed at a location where aircraft acceleration loadings will not exceed the design limitations of the transmitter.

3.16.2.1.4 Compass deviation The contractor shall compensate each compass and compass indicator and insert properly filled out deviation cards in each compass card holder.

3.16.2.1.5 Transmitter's angular displacement. In order that the angular displacement of the transmitter with respect to the longitudinal axis of the aircraft may be more readily estimated, mounting brackets shall be provided with one degree markings or graduations extending five degrees on each side of a zero mark. The brackets shall be marked and installed so that the graduations are adjacent to the lubber line of the transmitter with the zero mark aligned with the longitudinal axis of the aircraft.

3.16.2.2 Pilot's standby compass. The pilot's standby compass shall be installed and tested in accordance with MIL-C-7188.

3.17 Position indicating systems. Wheels, flaps (wing, cowl, inter-cool, oil cooler), controls, trim tabs, and other position indicating equipment shall be installed when specified in the aircraft detail specification. The indicators shall be readily visible to the proper member of the flight crew.

3.17.1 Position indicating equipment. Position indicating equipment shall be installed so that on calibrated indicator dials, the indications shall be within ± 2 degrees of the actual angular position of the part at any point in the travel of the part.

3.17.2 Wheel position indicating equipment. All wheel position indicating equipment shall clearly indicate the unlocked, locked-down and locked-up positions of each wheel unit.

3.17.3 Lock switches. Unless otherwise specified, the lock switches for wheels or for other parts, when required in connection with position indicating equipment, shall be furnished and installed by the contractor and shall be of an approved type.

3.17.4 Electrical installation of position indicating equipment. The electrical installation of position indicating equipment shall be subject to approval by the acquiring activity.

3.17.5 Contractor-furnished position indicating instruments. Contractor-furnished position indicating instruments shall be in accordance with the military specifications. Where there is no military specification, acquiring activity approval is required.

3.18 Quantity gage systems

3.18.1 Fuel quantity gage system. Unless otherwise specified, the contractor shall furnish and install for the fuel system a null-balancing electronic capacitor-type quantity gage system with linear indicator scales in accordance with MIL-F-17874 and the specifications incorporated in the aircraft detail specification.

3.18.1.1 Installation and calibration of fuel quantity gage system. The installation and calibration of the fuel quantity gage system shall be in accordance with MIL-G-7940

3.18.2 Oil Quantity gage system. The installation and calibration of the oil quantity gage system shall be in accordance with MIL-O-19838.

3.18.3 Other fluids quantity gage systems. Quantity gage systems for fluids other than fuel and oil shall be as specified in the aircraft detail specification and shall be installed in accordance with the manufacturer's operation and maintenance instructions handbook.

3.19 Pressure indicating equipment. Pressure gages shall be installed for applications specified in the aircraft detail specification.

3.19.1 Pressure gage equipment. Pressure gage equipment includes the following:

- Manifold pressure gages
- Torque and brake mean effective pressure (BMEP) gages
- Fuel pressure gages
- Oil, hydraulic fluid, and pneumatic pressure gages

3.19.2 Pressure gage equipment classification. Pressure gage equipment is classified as (1) direct reading or (2) remote indicating. Remote indicating pressure gage equipments include a transmitter and indicator linked together electrically so that the indicator follows the movement of the transmitter.

3.19.3 Dials of pressure gages. The dials of some pressure gages do not indicate by name the specific pressures which are to be measured; e.g., engine oil, brake system, emergency system. This information shall be provided by the contractor by means of a nameplate or marking on the panel below the pressure gage.

3.19.4 Manifold pressure gages. The gage shall be connected to a low point in the intake manifold and the tubing connected to the transmitter or to the gage shall be arranged so as to slope continuously from the gage or transmitter down to the manifold connection so that any moisture condensing in the tubing will drain to the manifold. In aircraft where the length or unavoidable dips in the line may

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be conductive to collection of condensate, the contractor shall install drainage sumps or a purging system subject to approval by the acquiring activity

3.19.4.1 Manifold pressure gage lines. No equipment other than additional supplementary manifold pressure gages shall be connected to the manifold pressure gage line.

3.19.5 Torque and brake mean effective pressure gages The torque pressure gage is an oil pressure gage which indicates a pressure created by torque reaction in the torque nose of the engine. This oil pressure is proportional to the propeller shaft torque.

3.19.5.1 BMEP gage. The BMEP gage is a variation of the torque pressure gage. It senses the same oil pressure but is calibrated according to a specified engine constant and indicates the theoretical mean pressure existing in the engine cylinders.

3.19.5.2 Torque pressure gages. Torque pressure gages are furnished with a vent connection in anticipation of installations where the pressure on the opposite side of the oil pressure piston will not be atmospheric. When the vent inlet of the gage is not connected to the engine, a threaded plug having a 1/16 inch diameter hole drilled through it shall be installed in the vent inlet of the gage.

3.19.5.3 Torque nose pressure. In some cases, the torque nose delivers an oscillating pressure. In such cases, a restrictor in the gage line may be installed to prevent excessive oscillation of the pointer. A surge chamber may be installed to reduce pointer vibration.

3.19.6 Fuel pressure gages. Reciprocating engine fuel pressure gages indicate the differential between the pressure of the fuel entering the carburetor and the pressure at the carburetor deck. The port marked "P" of the fuel gage or transmitter shall be connected to the fuel pressure port of the carburetor. The port marked "V" of the fuel pressure gage or transmitter shall be connected to the carburetor deck.

3.19.6.1 Carburetor deck pressure. Some engines have a carburetor deck pressure which does not deviate appreciably from atmospheric pressure. In such installations, a vent tube shall be connected to the vent inlet of the gage or transmitter, the opposite end of the tube being located to provide drainage of fuel in the event of internal failure of the instrument.

3.19.6.2 Restriction snubber. A restriction snubber or orifice shall be provided in the fuel pressure gage line at the carburetor to prevent fluctuation of the pointer and to prevent the rapid loss of fuel in case of a break in the line.

3.19.6.3 Other equipment. No other equipment shall be connected to the fuel pressure gage line.

3.19.7 Oil, hydraulic and pneumatic pressure gages. Hydraulic pressure gages shall be installed in accordance with MIL-H-5440 or MIL-H-8891.

3.19.7.1 Restriction snubber. A restriction snubber or orifice shall be provided in the gage line located far from the gage or transmitter to prevent the

rapid loss of oil in case of a break in the gage line and to prevent fluctuation of the pointer.

3.19.7.2 Other equipment to oil pressure gage lines. No other equipment other than supplementary pressure gages, pressure switches, or restrictions shall be connected to oil pressure gage lines.

3.20 Temperature indicating systems. Three types of temperature indicating systems are used in Naval aircraft:

Electrical resistance type
Thermocouple type
Bi-metal type

3.20.1 Electrical resistance type. The electrical resistance type temperature indicating system consists of a bulb and an indicator. This system is used to indicate the temperature of lubricating oil, coolant, carburetor air, free air, cylinder heads. Thermometer bulbs provided with holes for safety wiring shall be safety wired.

3.20.1.1 Thermometer bulb installation. When the thermometer bulb is installed in a fluid line, the "well" that is the sensitive part of the bulb shall be completely immersed in the direct flow of the medium.

3.20.1.2 Measurement of free air temperature. The bulb, when used for measurement of free air temperature, shall be installed so that it will not be subjected to the direct rays of the sun, slipstream of the propeller, or the exhaust gases. When the bulb is installed so that its projection becomes a hazard to personnel, or is likely to be broken, or damaged during handling of the aircraft, it shall be protected by a guard.

3.20.2 Thermocouple type. Thermocouple type systems installed in accordance with AIR 46A are used to indicate turbine engine tail pipe or inlet temperatures, and cylinder head temperatures on engines which do not have provisions for installation of a resistance bulb. Chromel-alumel thermocouples are used for turbine engines and iron-constantan for reciprocating engines. Both thermocouple systems incorporate the cold junction compensation in the indicator and require an external circuit of thermocouple lead wire. Lead wire is cut to length from various standard sizes (resistance per foot) and a resistor is included in the circuit to obtain the required external resistance.

3.20.2.1 Leads. All leads, wiring, and components shall be supported to prevent vibration failures.

3.20.2.2 Firewall connectors. The firewall connectors shall be either the straight or angle type.

3.20.2.3 Terminals. Terminals for the firewall connector are furnished with the connectors. Other terminals may be furnished by the contractor but shall be subject to specific approval by the acquiring activity.

3.20.3 Bi-metal type. The requirements of 3.20.1.2 are applicable also to the installation of free air thermometers of the bi-metal type conforming to MS28028. Military thermometer bulbs provided with holes for safety wiring shall be safety wired.

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3.21 Tachometer systems All tachometers are of the remote indicating type consisting of a synchronous indicator and a generator designed for mounting on standard accessory drive AND20005. Indicators and generators for turbine engines are not interchangeable with reciprocating engine indicators and generators.

3.21.1 Reciprocating engine tachometers. Reciprocating engine tachometers indicate crankshaft revolutions per minute (rpm). The generator is a four pole generator and is driven at one half crankshaft speed. Indicators are either single or dual, non-sensitive or single sensitive. The dual non-sensitive indicator is available with a built in synchroscope. Separate synchroscope indicators are available for two and four engine aircraft

3.21.2 Turbine engine tachometers Turbine engine tachometers indicate percent of rated turbine rpm. The generator is a two pole generator and is driven at 4200 rpm when the turbine is at rated speed; at rated speed the indicator is at "100 percent".

3.21.3 Installation of tachometers. The installation of tachometers shall be in accordance with MS33632.

3.21.4 Electrical connectors. Electrical connector plugs and all nuts or bolts used in mounting tachometer generators shall be safety wired.

3.22 Fuel flowmeter systems. When listed in the aircraft detail specification, the fuel flowmeter systems shall provide the rate of fuel flow in pounds per hour for each engine. The installation shall be in accordance with the requirements incorporated in the aircraft detail specification and the manufacturer's installation, operation, and maintenance instructions.

3.23 Navigation equipment For the purpose of this specification the following equipment is included in the term "Navigation Equipment":

- Compass reference
- Binoculars
- Chart boards
- Computers
- Data boards
- Drift meters
- Dead reckoning tracers
- Attitude and directional gyros
- Ground position plotters
- Navigation computer sets
- Navigation computer groups
- Navigator's cases
- Periscopic sextant mounts
- Plotting boards
- Plotting boards bases
- Sextants
- Watches
- Watch cases

3.23.1 Navigation equipment installation. Navigation equipment shall be installed in accordance with this specification and with the manufacturer's operation and maintenance instructions handbook. Installation of the drift meter, astrocompass, or sextant shall be made so that normal aircraft vibration shall not impair the taking of sights

3.23.1.1 Ground position indicators. When listed in the aircraft detail specification, ground position indicators shall be installed by the contractor. The installation shall be in accordance with the requirements incorporated in the aircraft detail specification and the manufacturer's operation and maintenance instructions handbook.

3.23.1.2 Dead reckoning tracers. When listed in the aircraft detail specification, dead reckoning tracers shall be installed by the contractor. The installation of the dead reckoning tracer shall be governed by its application in the aircraft and by the requirements set forth in the aircraft detail specification and the manufacturer's operation and maintenance instructions handbook.

3.23.2 Stowage provisions. Light, secure, compact, and safe stowage provisions, convenient and readily accessible to the navigator, are required for the following equipment, when listed in the aircraft detail specification.

- Binoculars (with case)
- Computers
- Drift meters
- Navigator's cases (compass and dividers)
- Parallel rulers
- Plotting boards
- Plotting board bases
- Sextants (with case)
- Aircraft navigational watch case
- Matches

3.23.2.1 Binocular and sextant case stowage. Binocular and sextant cases shall be stowed in an upright position, so that the binoculars or sextant shall be removed from the case without the case being unsecured or removed from its stowage.

3.23.2.2 Navigator's drawer. A three-compartment drawer, or equivalent, shall be provided for the stowage of (1) maps and charts; (2) computers, plotters, dividers, and compasses; and (3) stop watches and the aircraft navigational watch case if stowage provisions for the watch case are not made in the navigator's table. The chart-containing portion of the drawer shall have dimensions not less than 20 by 30 inches.

3.23.2.3 Aircraft navigational watch case stowage. The aircraft navigational watch case shall be mounted in a level position either in the navigator's table or in the front portion of the navigator's drawer. When mounted in the table, the viewing glass of the case shall be beneath a flush transparent portion of the table's surface, and the case and watch shall be readily visible to the navigator. Clearance shall be provided for the protective metal cover plate on the case to uncover the viewing glass. When mounted in the drawer, the case and watch shall be readily visible to the navigator from his seated position when the drawer is partially opened. The case shall be capable of being easily removed from its stowed position without the use of tools. The navigation watch shall be installed in the watch case.

3.23.3 Chart boards, plotting boards, and plotting board bases.

3.23.3.1 Usage. The chart board serves as a base and holder for the navigational plotting board and also provides a compartment for stowage of certain

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charts, photographs, papers, pencils, and erasers. The chart board and plotting board are used as a unit in aircraft which do not carry a navigator

3.23.3.1.1 Chart board tray A chart board tray shall be furnished by the contractor to serve as a holder for the chart board in both the stowed and "Out" position. The tray installation shall conform to all specifications as described herein for chart board installations with the exception that it need not be readily removable from the guides or rail supports.

3.23.3.1.2 Knee-pad chart plotting board. When no chart board is specified for fighter, attack, or trainer type aircraft, a knee-pad chart plotting board or data board may be issued as squadron equipment or pilot's personal gear. A safe, convenient stowage space shall be provided for the leg-mounted boards in the above types of aircraft.

3.23.3.1.3 Aircraft carrying a navigator. In aircraft which carry a navigator, no chart board is used, other means of stowage being provided for navigational data and equipment, but the plotting board is used in connection with the plotting board base when specified in the aircraft detail specification.

3.23.3.1.4 Magnetic materials. Chart boards which are made of magnetic materials shall not be installed in Naval aircraft.

3.23.3.2 Chart board installation. When specified in aircraft for use at a station not supplied with a desk or table, the chart board shall be installed so that when it is in the "Out" or "ready-for-use" position it shall be mechanically held at a height and position convenient to the user when the aircraft is in normal flight attitude. In the pilot's cockpit, chart boards shall be installed high above the stick and the clearance between the chart board in the "Out" position and the stick in any position shall be not less than one inch.

3.23.3.2.1 Chart boards supports. Chart boards shall be installed in rigid supports or guides which do not project beyond the surface of the instrument panel. The chart board shall slide fore and aft in guides so that in the stowed position the edge of the chart board is approximately flush with the instrument panel. The chart board in any position shall not interfere with the shock mounting of the instrument panel.

3.23.3.2.2 Chart board removal and insertion. Where a chart board tray is supplied by the contractor, it shall be designed to allow the pilot or responsible aircrew member to quickly and easily remove and insert the chart board using one hand and it shall contain the chart board so as to hold it in place in any flying attitude of the aircraft. The contractor shall supply permanently installed springs, clips, fasteners, or mating receptacle to secure the chart board in place without requiring alteration of the chart board.

3.23.3.2.3 Basic flight instruments. All the basic flight instruments, at least the airspeed indicator, the gyro horizon and directional-gyro, or primary compass shall be visible with the chart board in the "Out" position.

3.23.3.2.4 Chart board guide or support. A ball-end spring latch shall be provided in the chart board guide or support on each side. The spring stiffness shall hold the chart board and the chart board tray securely in place. The latches shall permit the chart board and tray to be readily changed from the "Out" position to the stowed position and vice versa using one hand when stowage is

provided behind the panel and to be removed entirely from the guides or supports using one hand. Other means to secure the chart board and tray in the "Out" position and the stowed position may be provided, subject to specific approval by the acquiring activity.

3.23.3.2.5 Locking device. A locking device shall be provided which will retain the chart board and tray in the stowed position against forward accelerations of the aircraft of approximately 5 g. For the type of chart boards having drawers, both the chart board and the drawer shall automatically lock when pushed into the stowed position in installations which provide stowage of the chart board behind the instrument panel.

3.23.3.2.6 Design of chart board installation. The chart board installation shall be such that at least three and one fourth inches of each chart board leg or chart board tray leg is supported when the chart board is in the "Out" position. The chart board in any position shall be contained in such manner as to be structurally supported in place in any flying attitude of the aircraft. The entire chart board surface shall extend clear of the instrument panel in the "Out" position and the top of the chart board shall be free to open not less than 80 degrees.

3.23.3.2.7 Stowage of the chart board. If space or aircraft configuration does not permit stowage of the chart board behind the plane of the instrument panel, stowage shall be provided in any position in the cockpit which permits the pilot conveniently and by means of one hand to move the chart board from the stowed to the "Out" position and vice versa. The "Out" position installation shall be that as described (see 3.23.3.2.6). Deviations from this installation shall be made only upon specific approval of the acquiring activity.

3.23.3.2.8 Lighted chart board. Where a lighted chart board which requires an external power supply is specified, power shall be provided and the plugs or receptacles to mate with the connector shall be supplied as a part of the chart board.

3.23.3.3 Plotting board base installation. Space shall be provided on the navigator's table to hold this base, and storage provisions convenient to the navigator shall be provided for the base and plotting board assembly when the navigator's table must be cleared.

3.23.4 Drift meters. Two types of drift meters may be employed in Naval aircraft:

Vertical type
Horizontal type

Drift meters shall be installed in the navigator's work area in a location which will provide maximum convenience in use, taking into consideration such factors as accessibility, body position of the navigator, and head room. Drift meters shall be retractable if subject to damage from water spray or other external causes of damage or misuse when not being operated. Drift meters shall be installed so as not to be subject to stresses or strains which could cause bending of the tube and resulting misalignment of the optical system.

3.23.4.1 Vertical type drift meter installation. The vertical type drift meter shall be installed perpendicular to the horizontal plane of the aircraft in normal flight attitude. A line through the 0 and 180 degrees marks of the azimuth

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scale shall be parallel to the fore and aft axis of the aircraft within 0.5 degree. The 0 degree mark shall be forward.

3.23.4.1.1 Rotation of the vertical drift meter. Rotation of the vertical drift meter through 360 degrees in azimuth shall be possible without mechanical interference. The objective end of the drift meter shall project through the bottom of the fuselage a minimum distance required to obtain an angular visibility of 35 degrees on each side of the longitudinal axis from the vertical to 85 degrees aft of the vertical. The acquiring activity shall be advised of the required length of drift meter to meet these requirements.

3.23.4.1.2 Drift meter protection. The drift meter tube shall be protected at the point of passage through the fuselage.

3.23.4.2 Horizontal type drift meter installation. The horizontal type drift meter shall be installed with the objective tube projecting horizontally through the fuselage of the aircraft. The tube should protrude a distance so that the fuselage will not be in the field of view of the sight.

3.23.4.2.1 Drift reading. When the grid lines are parallel within 0.5 degree to the fore and aft axis of the aircraft, the drift reading shall be zero.

3.23.4.3 Drift meter installation. The installation of the drift meter shall be in accordance with the manufacturer's operation and maintenance instructions handbook.

3.23.5 Periscopic sextants. When the periscopic sextant is specified, the navigation dome and astrocompass are not required.

3.23.5.1 Periscopic sextant mount. The periscopic sextant mount shall hold the periscopic sextant to provide the navigator complete and unobstructed visibility of the celestial hemisphere from -10 degrees to +92 degrees in elevation in any direction.

3.23.5.2 Sextant mount installation. The sextant mount shall be installed on the fuselage overhead at a position convenient to the navigator and at such a location that will permit him to utilize to the maximum extent the full capabilities of the sextant. An unobstructed view throughout 360 degrees in azimuth at all altitudes of 15 degrees and above is required when the aircraft is in normal horizontal flying attitude. The mount shall be installed so that it is within 3 degrees of horizontal when the aircraft is in normal horizontal flying attitude. The mount shall be installed so that the lubber line is aligned within 0.25 degree of the longitudinal axis of the aircraft. Means shall be provided to enable the navigator to adjust his height to an optimum eye level for operation of the periscopic sextant. The mount shall be so located that doors, hatches, or other structure will neither interfere with the taking of sights nor strike the mount or the sextant in its operating ("UP" or "DOWN") position. Hand room shall be provided to permit operating the crank of the azimuth counter. The mount shall be installed using a gasket or spacer which will not cause strain or distortion of the mounting plate of the mount when it is fastened to the aircraft. A seal or sealing compound shall be used to prevent water leakage. The mount installation shall be designed so that no well or depression will exist which would retain water over the mount opening.

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3.23.5.3 Periscopic sextant installation. The installation of the periscopic sextant shall be in accordance with the manufacturer's operation and maintenance instructions handbook.

3.23.6 Periscopic sextant astro-windows. Astro-windows or observation domes shall be placed in the immediate vicinity of the periscopic sextant mount in accordance with the provisions of SD-24.

3.23.7 Map or data cases. A map or data case conforming to MS26556 shall be provided for the pilot in accordance with the provisions of SD-24. The case shall be readily accessible to the pilot.

3.24 Accelerometers. The accelerometer is a self-contained, direct-reading instrument which indicates acceleration of the aircraft along its vertical axis. The accelerometer shall be rigidly mounted so that the plane of the dial is vertical when the aircraft is in normal flight attitude. It shall be mounted in a position which will permit it to be easily read and reset by the pilot in flight. Installations in shock mounted panels are not desired because they give erroneous indications caused by resonance during taxiing over rough terrain and in certain flight conditions where buffeting is encountered.

3.25 Inclinometers. Inclinometers are provided to indicate, in degrees of arc, the attitude of the aircraft in relation to a fixed datum reference, usually the lateral or the longitudinal leveling datum references.

3.25.1 Laterally mounted inclinometer reading. When mounted laterally, the inclinometer shall read zero when the aircraft is level as indicated by a level placed on the lateral leveling datum reference.

3.25.2 Longitudinally mounted inclinometer reading. When mounted longitudinally, the inclinometer shall read zero when the aircraft is level as indicated by a level placed on the longitudinal leveling datum references.

3.26 Angle of attack and sideslip systems. Angle of attack and sideslip systems provide pilots indication, approach light operation, artificial stall warning, and signals for armament computers. Angle of attack and sideslip systems shall be installed in accordance with MIL-I-18079

3.27 Head up display system (HUD). The installation of the HUD shall be subject to the approval of the acquiring activity.

3.28 Vertical display system (VED). The installation of the VED shall be subject to the approval of the acquiring activity.

3.29 Horizontal tactical display system (HTD). The installation of the HTD shall be subject to the approval of the acquiring activity.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The

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Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements

4.1.1 Responsibility for compliance. All items shall meet all requirements of section 3. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Tests. Tests shall be conducted to determine that all instruments function properly after installation, that all instrument electrical circuits are operative, and that there are no leaks in instrument suction, pressure, or other lines. Any defects which may be found shall be corrected prior to delivery of the aircraft.

4.3 Inspection reports. There shall be a report in duplicate stating that the aircraft instrument installation has been subjected to the required inspection and tests and found to comply with the requirements of this specification (see 6.3).

4.4 Previous acceptance or approval. Previous acceptance or approval of material or release of any design by the Government shall in no case be construed as a guaranty of final acceptance.

5. PACKAGING

This section is not applicable to this specification.

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 installation requirements specified herein are intended for use in installing instruments and navigation equipment in aircraft.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2)

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific

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acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirement List (DD Form 1423) must be prepared to obtain the data, except where DOD-FAR Supplement 227.405-70 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
3.5	DI-DRPR-81000	Product drawings and associated lists	---
3.5	DI-DRPR-81001	Conceptual design drawings and associated lists	---
3.5	DI-DRPR-81002	Developmental design drawings and associated lists	---
4.3	DI-NDTI-80809A	Test/inspection reports	---
4.1.1	DI-NDTI-80809A	Test/inspection reports	10.2.7, only

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Subject term (key word) listing.

Automatic flight control
Compass
Gages
Gyroscope
Head up display system
Pitot-static system
Quantity gage system
Temperature indicating system

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

Preparing Activity
Navy - AS

(Project 6605-N413)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-I-18373B(AS)	2. DOCUMENT DATE (YYMMDD) 93/7/30
3. DOCUMENT TITLE INSTRUMENTS AND NAVIGATION EQUIPMENT, AIRCRAFT: INSTALLATION OF		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (include Zip Code)	d. TELEPHONE (include Area Code) (1) Commercial (2) AUTOVON (if applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME COMMANDING OFFICER, NAVAL AIR ARE CENTER AIRCRAFT DIVISION LAKEHURST SYSTEMS REQUIREMENTS DEPARTMENT	b. TELEPHONE (include Area Code) (1) Commercial (908) 323-7488	(2) AUTOVON 624-7488
c. ADDRESS (include Zip Code) CODE SR3 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	