MILITARY SPECIFICATION

SYSTEM, INTEGRATED FLIGHT INSTRUMENTATION

This specification has been approved
by the Bureau of Naval Weapons,
Department of the Navy.

1. SCOPE

1.1 Scope - This specification covers certain design and all performance requirements for the procurement of an Integrated Flight Instrumentation System.

1.2 Classification - The integrated flight instrumentation system shall consist of the following items:

Horizontal Situation Indicator ID-1013/A
Remote Attitude Director Indicator
Flight Director Computer

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Military

MIL-S-3786	Switches, Rotary (Circuit Selector, Low Current Capacity)
MIL-S-3950	Switches, Toggle
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-E-5400	Electronic Equipment, Aircraft, General Spec. for
MIL-I-6181	Interference Control Requirements, Aircraft Equipment
MIL-R-7060	Radio Set AN/ARN-21
MIL-P-7788	Plate, Plastic Lighting
MIL-R-8019	Receiver, Radio R 541/ARN-14D
MIL-T-18303	Test Procedures; Preproduction and Inspection, for Aircraft Electronic Equipment, Format for
MIL-R-23094	Reliability Assurance for Production Acceptance of Avionic Equipment, General Specification for

MIL-R-18401	Radio Set AN/ARC-52 and AN/ARC-52X
MIL-R-22973	Reliability Index Determination for Avionics Equipment Models, General Specification for
MIL-R-25109	Radio Compass AN-ARN-6
MIL-R-25495	Radio Receiving Set AN/ARN-14
MIL-R-25497	Radio Receiving Set AN/ARN-18
MIL-D-25646	Direction Finder Group AN/ARA-25 installation of
MIL-I-23524	Indicator, Attitude Director, Remote
MIL-I-23366	Indicator, Horizontal Situation ID-1013/A
MIL-C-23367	Computer, Flight Director
MIL-D-22726	Digital Data Communication Set AN/ASW-13

2.2 Availability of Documents -

(1) When requesting specifications, standards, drawings, and publications refer to both title and number. Copies of this specification and applicable specifications required by Contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Naval Supply Depot, Code DCS, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania.

3. REQUIREMENTS

3.1 Preproduction - The components of the integrated flight instrumentation system furnished under this specification shall be products, samples of which have been tested and have passed the preproduction tests specified in the detail specifications for the components. The integrated flight instrumentation systems shall also be capable of passing the tests required in this specification.

3.2 The following information shall be displayed on each indicator with proper input signals and switching functions:

a. Remote Attitude Director Indicator

(1) Sphere bank, pitch and azimuth information (The freedom of sphere rotation about all axes is unlimited).

(2) Bank angle

(3) Rate of turn with inclinometer

(4) Vertical pointer- presents computed steering information for selected headings, Data Link command heading, Manual Instruments Landing System, Automatic Instruments Landing System, Automatic Instruments Landing System approach, bomb control mode (LABS), radio track (VOR/TAC) modes, or automatic carrier landing (ACL).

(5) Horizontal pointer - presents computed steering information for Automatic Instruments Landing System glide slope, bomb control mode (LABS), or automatic carrier landing (ACL)

(6) Displacement pointer - presents relative distance of aircraft above or below glide slope beam.

(7) Warning flags

(a) Vertical pointer alarm - Presents localizer or tacan invalid signals.

(b) Displacement pointer alarm - Presents glide slope invalid signals.

(c) Power failure

b. ID-1013/A Horizontal Situation Indicator

(1) Compass card - Magnetic compass heading

(2) Heading Marker - Command heading or manually set heading.

(3) Course Arrow - Command course, manually set course or data link course plus digital course indication.

(4) Course bar - Aircraft displacement from a manually or automatically selected track or target.

(5) To - From arrow - To-From indication from a selected radio facility or target.

(6) Bearing pointer #1 - Bearing for TACAN, VOR or ADF.

(7) Bearing pointer #2 - Bearing for ADF, UHF or DL.

(8) Distance display - Distance to radio facility or target.

(9) Mode words - NAV, DL, MAN, TAC TGT, HDG.

(10) Warning Flags

(a) Course bar flag - presents localizer or tacan invalid signals.

(b) Distance shutter - tacan distance reliability signals.

(c) Power failure - loss of power.

3.3 Mode operation - The flight director computer shall integrate the necessary signals for the following modes:

a. Navigation (AUTOMATIC)

b. Manual heading

c. Data link

d. Manual ILS

e. ILS

f. ILS approach

g. Radio track (VOR/TAC)

h. LABS

i. Automatic carrier landing (ACL)

3.4 Detail Requirements - The Remote attitude Director Indicator shall meet the requirements of Specification MIL-I-23524, the Horizontal Situation Indicator shall meet the requirements of Specification MIL-I-23366 and the Flight Director Computer shall meet the requirements of Specification MIL-C-23367.

3.4.1 The interconnection of the Integrated Flight Instrumentation System components shall be in accordance with Figure 1.

3.4.2 The following systems and components when installed upon a specific aircraft although not supplied as a part of the basic system are used with the system.

3.5 Input signal Function - The following input signals are required for operation of the integrated flight instrumentation system. Equipment providing compatible signals are also listed.

3.5.1 Roll and pitch input signal Function - The roll and pitch input signal shall be in the form of separate transmitter synchro three-wire stator outputs having comparable characteristics as the standard transmitter specified in Section 4 with the dial readings set at 180° for zero roll and pitch displacement. Increasing dial readings shall correspond to right roll and pitch up maneuvers. The signal gradient output level shall be 200 mv/degree.

3.5.2 Azimuth input signal Function - The azimuth input signal shall be in the form of a transmitter synchro three-wire stator output having comparable characteristics as the standard transmitter specified in Section 4 with the dial readings set at zero degrees for zero degrees (north) on the compass card. If the dial on the rotor of the standard transmitter is continuously rotated so that its heading indication increases, the azimuth ring heading shall increase (clockwise rotation of the card). The signal gradient output level shall be 200 mv/degree.

3.5.3 Radio signal Functions -

3.5.3.1 ILS Functions - The localizer deviation and alarm flag signals shall be provided by a Radio Receiver R54/ARN-14 conforming to Specification MIL-R-8019. The glide slope and alarm flag signals shall be provided by a Radio Receiver Set AN/ARN-18, conforming to Specification MIL-R-25497.

3.5.3.2 TACAN Functions -

a. Bearing - The bearing pointer servo input signal shall be in the form of a transmitting synchro device similar to the standard transmitter described in Section 4 with the dial readings set at zero degrees for the bearing pointer to be positioned at a reference of 180° (under the bottom lubber line). Rotation of the dial on the standard transmitter to an increasing heading shall cause the bearing pointer to rotate clockwise. The Radio Set AN/ARN-21 conforming to Specification MIL-R-7060 plus instrument converter, or equivalent system, shall be used to obtain this signal.

b. Course deviation and To-From - The input circuit to the TO-FROM INDICATOR shall provide sufficient current to operate a 250-0-250 microampere (zero center) meter and be connected to give a full scale deflection to TO with the deviation bar centered when the bearing selector is set on the bearing to station, and to give a full scale deflection to FROM with the deviation bar centered when the bearing selector is set 180° from the original position. The meter shall pass through zero as the bearing selector is rotated through points approximately 90° and 270° from the original setting. This input signal may be obtained from the Radio Set AN/ARN-21 plus instrument converter. The input signal to the deviation bar shall provide 150 microamperes for full deflection of the course bar (2 dots deflection). The course bar mechanism shall have a resistance of 1000 ohms. The Radio Set AN/ARN-21 plus instrument converter shall provide compatible signals.

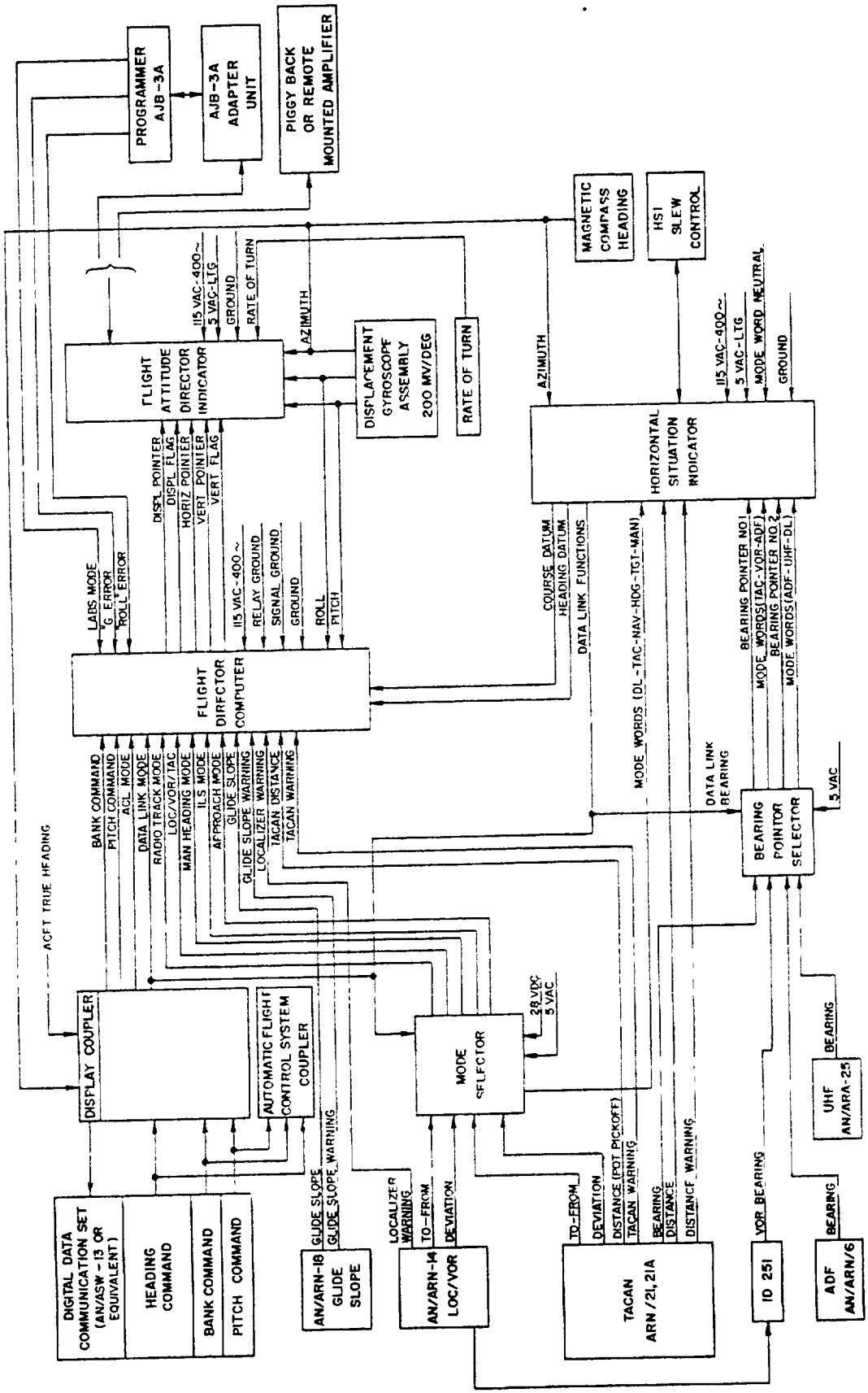


FIGURE 1 INTEGRATED FLIGHT INSTRUMENTATION SYSTEM BLOCK DIAGRAM

c. Range - The input signal shall be suitable to drive three receiver type synchros which display units, tens, and hundreds. The numerals shall be centered every 36° of synchro shaft rotation. The receiver synchros are Clifton Type CRC-8-A-1, or equivalent. The thousand digit consists of fixed number "1" which is covered by a shutter when unexcited. Excitation of 26 volt direct current to the shutter shall display the thousand digit. With the standard transmitter specified in Section 4 properly connected and the rotors of both the receiver synchros and the transmitter excited, the distance dial of each receiver synchro shall position "0" when the standard transmitter is set on zero degrees. Rotation of the standard transmitter synchro to 36° shall result in "1" being positioned on the distance dial. Increasing numerical dial readings on the receiver synchros shall be indicated for each 36° of the transmitter rotation. The AN/ARN-21 TACAN receiver plus instrument converter shall provide compatible inputs for this indication.

3.5.3.3 VOR Functions

a. Bearing - The bearing pointer input signal to the HSI shall have the characteristics described under TACAN installations. Compatible inputs shall be provided by an Indicator ID-251/ARN when operating in conjunction with a Radio Receiver Set AN/ARN-14 conforming to Specification MIL-R-25495.

b. Course deviation and To-From - The deviation bar and TO-FROM input signals shall have the characteristics described under TACAN installations presentation. Compatible inputs shall be provided by a Radio Receiver AN/ARN-14.

3.5.3.4 Command Functions

a. Command course - Any remote course command signal input shall be similar to the standard transmitter specified in Section 4. The course arrow shall position to zero degrees north on the azimuth ring when the transmitter is set to zero degrees. The course arrow shall rotate in an increasing heading indication on the azimuth ring (clockwise) when the dial of the standard transmitter is rotated in an increasing heading indication (dial counterclockwise).

b. Command heading - Remote heading command signal inputs shall be identical to those specified for the course command.

3.5.3.5 UHF Function

a. Bearing - The bearing input signal to the HSI shall have the characteristics described under TACAN installations. Compatible inputs shall be provided by a AN/ARA-25 UHF direction finder conforming to Specification MIL-D-25646 used with a AN/ARC-52 UHF command radio set receiver conforming to Specification MIL-R-18401 to indicate the relative bearing of a transmitting station from the aircraft.

3.5.3.6 ADF Function

a. Bearing - The bearing input signals to the HSI shall have the characteristics described under TACAN installations. Compatible inputs shall be provided by a AN/ARN-6 radio compass conforming to Specification MIL-R-25199.

3.5.3 7 Automatic carrier landing (ACL) Function

a. Pitch

(1) Pitch command - The pitch command input signal to the flight director computer shall be in the form of a transformer-fractionator in the data link. Signal outputs from the transformer secondary are shared with the automatic flight control system coupler. Transformer primary excitation shall be 26 volts 400 cps supplied by the pitch channel of the automatic flight control system. Pitch command signals in phase with the reference phase shall cause the horizontal pointer of the attitude director to deflect upward indicating a commanded nose-up pitch moment.

(2) Pitch error - The source of the pitch error signal is as described under Pitch command. Pitch error signals in phase with the reference phase shall cause the displacement pointer of the attitude indicator to deflect upward indicating that the aircraft is below the desired glide path. Additional information concerning the utilization of pitch error signals is given in Section 6.

b. Bank

(1) Bank Command - The bank command input signal to flight director computer shall be as described under Pitch command above. Bank command signals in phase with the reference phase shall cause the vertical pointer of the attitude indicator to deflect to the right indicating a commanded right wing down movement.

(2) Bank Error - The source of the bank error signal is as described in the Pitch command. Bank error signals in phase with the reference phase shall cause the deviation bar of the horizontal situation indicator to deflect to the left indicating that the aircraft is to the right of the desired glide path. Additional information concerning the utilization of bank error signals is given in Section 6.

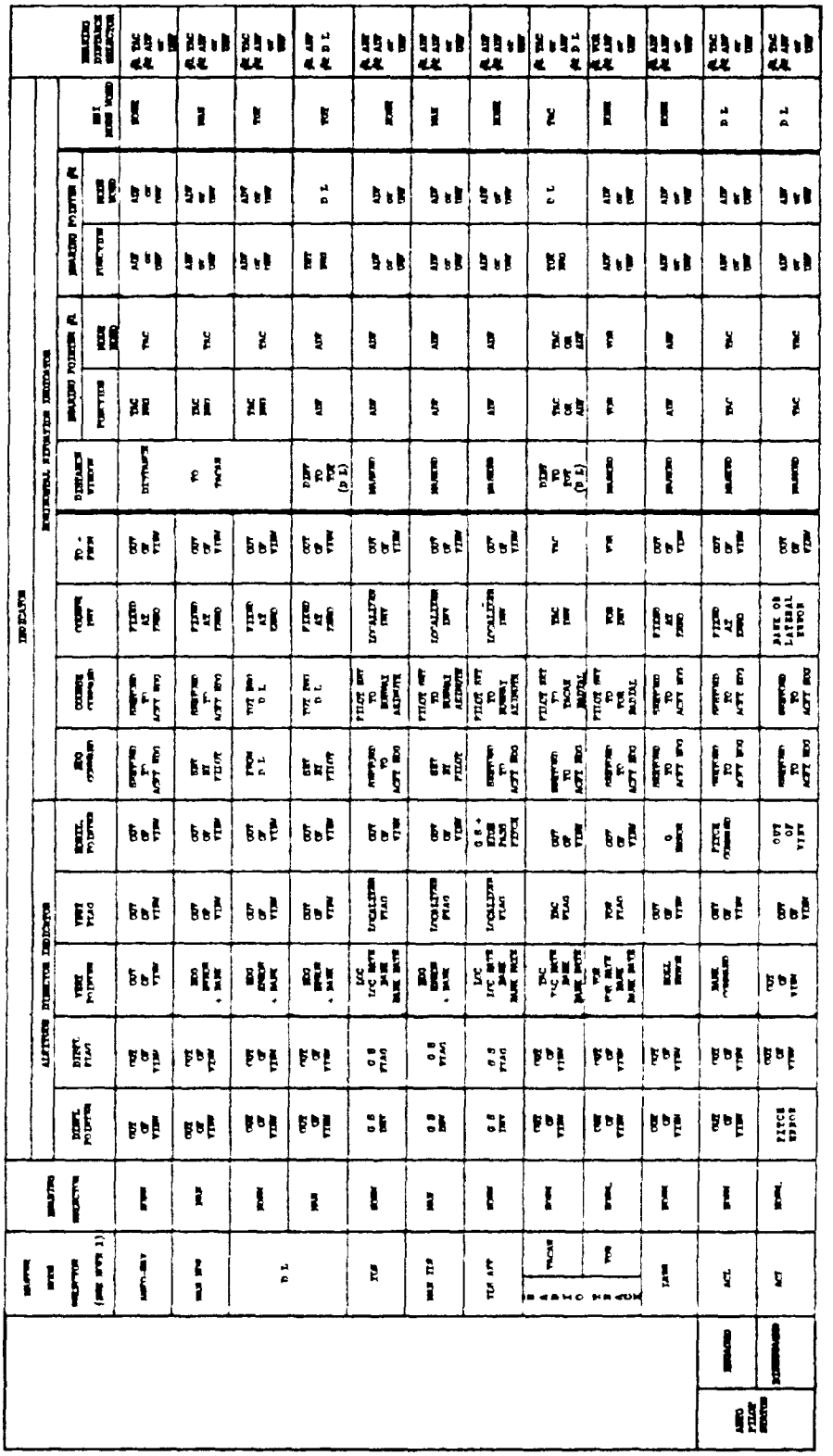
3.5.4 Rate of turn input signals - The rate of turn input signal shall be directly proportional to the rate of yaw of the aircraft. The direct current output shall be 1.0 milliampere ±2-1/2 percent when the sensor is rotated at the rate of 180° per minute.

3.5.5 AJB-3A Function

a. "G Error" - The "G Error" signal shall be the output of a Wheatstone Bridge circuit located in the programmer section of the Flight Director Signal Adapter AN/AJB-3A. This signal shall indicate the error or difference between the "g's" programmed and the actual g's of the test.

b. "Roll Error" - The "Roll Error" signal shall be the output of the roll/yaw adapter portion of the Flight Director Signal Adapter AN/AJB-3A. This signal shall indicate roll/yaw deviation.

3.6 Mode Switching - The switches of the Mode Selector shall be mounted with the instrument panel to provide for desired selection of indicator presentation during the various flight modes of the aircraft in accordance with the requirements of Figure 2. The basic modes of the flight director computer are as specified under Mode operation. Use of any or all of these modes is dependent on the mission of the aircraft. All modes and switching functions shall be approved by the procuring activity. Mode selection switches shall be approved by the procuring activity. Mode selection switches shall conform to the applicable requirements of Specification MIL-S-3786 and MIL-S-3950. The Mode Selector shall be lighted in accordance with Specification MIL-D-7788.



NOTES:

1. MASTER MODE SELECTOR BASED ON FLIGHT DIRECTOR COMPUTER MODES.

FIGURE 2 - MODE CHART - INTEGRATED FLIGHT INSTRUMENTATION SYSTEM

3.7 Performance - The system shall perform satisfactorily when subjected to the tests specified in Section 4 of this specification.

3.7.1 Reliability - The system shall meet the requirements of Specification MIL-R-22973 and MIL-R-23094.

3.7.2 Reliability in Mean Time Between Failures - The system shall have a minimum of 500 hours of mean (operating) time between failures when tested and accepted as outlined under the requirements of 4.4.3.

4. QUALITY ASSURANCE PROVISIONS

4.1 Contractor's Responsibility - The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the government. Inspection records of the examinations and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification when such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Classification of Tests - The inspection and testing of the system covered by this specification shall be classified as follows:

(a) Preproduction Tests: Preproduction tests are those tests performed after award of contract on sample system to determine that the system meets all the requirements of this specification. The sample system shall be representative in design, performance, and configuration of the system which will be produced on the manufacturer's production line.

(b) Acceptance Tests - Acceptance tests are those tests performed on systems manufactured and submitted for acceptance under the contract.

4.3 Preproduction Tests - Preproduction test samples shall consist of three systems manufactured in accordance with this specification. Preproduction tests will be conducted by the procuring agency. The samples submitted shall not have been previously tested except for individual test. The preproduction test samples shall be forwarded by the contractor, at his expense, to the testing laboratory designated by the procuring activity.

4.3.1 Scope of Preproduction Tests - Preproduction tests shall consist of all tests required to demonstrate that the system meets all applicable requirements. These tests shall include but not be limited to all the tests listed under Test Methods (4.8).

4.3.2 Preproduction Test Sample Identification - The test samples shall be plainly identified by securely attached, durable tags marked with the following information:

Sample for Preproduction Testing
(Name of equipment)_____
Submitted by (Manufacturer's name, date) for
Preproduction Testing in accordance with
Specification MIL-_____under contract
or order number.
MS_____
Type Number_____(if any)
Manufacturer's Part Number

4.3.3 Accessory Material - In addition to the complete equipment submitted for service approval tests; the contractor shall also submit the accessory material and design and test data specified in Specification MIL-E-5400. This information shall indicate the physical and electrical characteristics of the equipment and establish the equipment's compliance with applicable requirements.

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

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

4.4 Acceptance Tests - The acceptance tests shall consist of the individual tests and the sampling plan tests of this specification. The contractor shall furnish all samples and shall be responsible for accomplishing the required tests, except that the Sampling Plan B Tests shall be conducted at a Government Laboratory designated by the procuring activity. Acceptance tests, except for Sampling Plan B tests, shall be under the supervision of the Government Inspector. The contractor shall furnish test reports showing quantitative results for all tests required by this specification, signed by an authorized representative of the contractor or laboratory as applicable. Acceptance or approval of material during the course of manufacture shall in no case be construed as a guarantee of the acceptance of the finished product. Acceptance tests shall consist of the following:

a. Individual Tests
b. Sampling Tests
c. Reliability Assurance Tests

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

a. Examination of Product

b. Operational Test

c. Manufacturing Run In Test

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

4.4.2.1 Sampling Plan A Sample Selection - Sampling Plan A samples shall be selected at random in accordance with the following schedule:

Quantity of Systems Offered for Acceptance		Quantity to be Selected for Testing	
First	15	1	(See *Note)
Next	50	1	
Next	75	1	
Next	100	1	
Each additional 200 or fraction thereof		1	

*NOTE: When sampling plan B is involed the quantity shall be zero. When sampling plan B is to be omitted the quantity shall be one.

4.4.2.1.1 Sampling Plan A Tests - Each sample selected for Sampling Plan A testing shall be subject to the following tests, conducted in the order listed:

a. Complete operational test at ambient room conditions and nominal input voltages, making all necessary measurements to assure that all applicable specification requirements have been met.

b. Operational test at certain environmental conditions. The conditions may vary for each equipment tested and should be based on results of the preproduction test including High Temperature operation, Low Temperature Operation and Altitude.

c. Manufacturing run in test specified in 4.7.2 except that the test duration shall be 120 hours with no restriction on the number of failures. However, each failure shall be analyzed as to cause and remedial action necessary to reduce the possibility of its recurrence in future equipment.

d. Integral Lighting Test

4.4.2.2. Sampling Plan B Instructions - Two systems shall be selected at random from the first 15 produced on contract and submitted within 10 days after manufacture. Sampling Plan B tests shall also be conducted after any design or material change. These samples shall be forwarded to a Government Laboratory designate by the procuring activity. Each sample shall be plainly identified by a securely attached, durable tag marked with the following information:

(Name of equipment)_____
Submitted by (Manufacturer's name, date)
for production acceptance Sampling Plan B testing, in accordance with Contract/Order No._____.
Manufacturer's part number_____

4.4.2.2.1 Sampling Plan B Test - Each sample selected for Sampling Plan B testing shall be subjected to the following tests, conducted in the order listed:

Sampling Plan A Tests

Radio interference tests

High Temperature Test

Low Temperature Test

Temperature Shock Test

Altitude Test

Vibration Test

Life Test

4.4.3 Reliability Assurance Tests - Equipments selected for reliability assurance tests shall first have passed the individual tests.

4.4.3.1 MTBF Determination - Tests shall be performed to determine the MTBF of the instrumentation system. Specification MIL-R-22973 shall be used as a guide for the determination. The procedure to be followed is outlined in the following paragraphs.

4.4.3.2 Test Procedure Outline - A Detailed Reliability Test Procedure Outline shall be submitted to and approved by the procuring activity prior to initiation of the tests. The Test Procedure must include, but is not limited to:

a. Instrumentation System duty cycle.
b. Performance characteristics to be measured.
c. Failure criteria.

4.4.3.3 Test Procedure - Three instrumentation systems shall be utilized for the reliability determination which shall be performed at Test Level III of Specification MIL-R-22973. The instrumentation system shall be run until 2000 hours have been completed or until there is a total of nine failures. The tests must be completed within four months of the date of the first contract delivery and repeated within thirty days. If a 330 hour MTBF has not been demonstrated, acceptance of instrumentation systems will be withheld until corrective action is taken and its effectiveness is demonstrated. Instrumentation systems used for these tests may be refurbished and delivered upon satisfactory completion of the tests.

4.4.3.4 Reliability Procedure - Reliability Procedure 1 from Specification MIL-R-23094 shall be used.

4.4.3.5 Accept-Reject Criteria - Figure 13 of Specification MIL-R-23094 shall be used to determine the accept-reject criteria.

4.4.4 Equipment Failure - Should a failure occur during the sampling tests, the following action shall be taken:

a. Determine the cause of failure.
b. Determine if the failure is an isolated case or design defect.
c. Submit to the procuring activity proposed corrective action intended to reduce the possibility of the same failure(s) occurring in future tests.
d. Where practical, include a test in the individual tests to check all equipment for this requirement until reasonable assurance is obtained that the defect has been satisfactorily corrected.

4.5 Test Conditions -

4.5.1 Standard Conditions - Unless otherwise specified, all tests required by this specification shall be made under the following conditions:

Temperature	Room ambient 25° C + 5° C
Pressure	Normal atmospheric (Approximately 29.92 inches Hg)
Humidity	Room ambient up to 90% relative humidity
*Input Power	115 + 1.0 V AC, 26 ± 0.5 V AC, 400 cps 27.5± 0.5 V DC

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

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

4.5.4 Integral Lighting - The lighting of the system shall be energized and shall operate satisfactorily during all tests. The lighting shall operate satisfactorily after completion of each test.

4.6 Test Equipment

4.6.1 Standard Synchro Test Transmitter - A standard calibrated synchro with minimum and known errors shall be an Eclipse-Pioneer Type AY201-1, or approved equivalent, high precision transmitting synchro. A 0° to 360° dial clamped to the rotor of the synchro shall be settable, rotatable, and readable through 360° of rotation to 6 minutes of arc. The following procedure shall be used to calibrate the test synchro.

a. The rotor leads shall be designated as H and C and with one stator lead designated as Z and connected to C. When a potential of 26 volts is applied to H and C (C being ground) the dial shall be positioned on zero degrees and clamped to the rotor when:

(1) The voltage across H and Y is maximum.
(2) The voltage across the remaining two stator leads X and Y is minimum.
(3) The voltage across X and Z shall increase before it decreases for increasing heading indication of the dial. The voltage X to Z and Y to Z shall be in phase with the excitation voltage C to H when the dial reading is zero. For increasing heading indication of the dial the voltage X to Y shall increase and be in phase with the excitation voltage C to H. The test transmitter will be set at an index reference of Zero and a positive rotation reference XYZ.

4.7 Test Methods

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

4.7.2 Manufacturing Run In Test - Each system shall be operated under the conditions specified for a period of 6 hours without failure. A failure shall be defined as anything which causes malfunctioning of the system. Only those adjustments will be permitted which can be made by using such controls and adjustments that are accessible to the operator during the normal use of the system.

4.7.3 Interference Test - Interference tests shall be conducted in accordance with the procedures of MIL-I-6181.

4.7.4 Altitude Test - The system shall be tested in accordance with Procedure VI condition E of Specification MIL-E-5272.

4.7.5 High Temperature Test - The system shall be tested in accordance with Procedure II of Specification MIL-E-5272.

4.7.6 Low Temperature Test - The system shall be tested in accordance with Procedure II of Specification MIL-E-5272.

4.7.7 Temperature-Shock Test - The system shall be tested in accordance with Procedure I of Specification MIL-E-5272.

4.7.8 Vibration Test - The system shall be tested in accordance with Procedure XIII of Specification MIL-E-5272.

4.7.9 Integral Lighting Test - Each system shall be subjected to and shall meet the requirements of the tests specified in Specification MIL-L-25467.

4.7.10 Life Test - The life test shall consist of 1000 hours of operation on the equipments submitted to the government laboratory.

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

4.7.10.2 Life Performance Check - At approximately 8-hour intervals during the test, a limited performance check shall be made.

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

a. Part Number
b. The circuit reference symbol-number
c. The part function
d. Name of the manufacturer
e. The number of hours which the part operated prior to failure

4.7.10.4 Failure Report - In the event of a failure, the Government Inspector shall be notified immediately. A report shall be submitted to the procuring activity upon completion of the test. In this report, the contractor shall propose

suitable and adequate design or material corrections for all failures which occurred. The procuring activity will review such proposals and determine whether they are acceptable.

4.7.11 Operational Tests - Equipment shall be subjected to the following operational tests to determine compliance with all the requirements of this specification. This test shall also be used to determine satisfactory operation during and after each environmental test as applicable.

4.7.11.1 Mode Operation -

4.7.11.1.1 Auto-Nav Mode - The flight mode selector switch shall be placed in the AUTO-NAV position and the heading switch shall be placed in the NORM position. Electrical power shall be applied to the equipment. The displacement pointer, displacement pointer flag, vertical pointer, vertical pointer flag, and horizontal pointer on the attitude director shall be deflected out of view. The heading marker of the HSI shall indicate magnetic heading. Both TACAN and VOR inputs signals shall be supplied by suitable test equipment. With the course arrow of the HSI aligned to the course setting on the test equipment, the #1 bearing pointer shall rotate until it is aligned with the course arrow (within $\pm 1^{\circ}$). Deviation and To-From signals shall be supplied to the receiver and the deviation bar and To-From arrow in the HSI shall follow the sense and magnitude of the input signal.

a. For TACAN installations, the digital distance indication in the HSI shall be activated by the test equipment and accurate operation indicated. When the TACAN signal is valid, the distance shutter shall disappear from view.

4.7.11.1.2 Manual Heading Mode - With the flight mode selector switch in the MANUAL HEADING position, the heading switch shall be placed in the MAN position. With the vertical gyro in its zero bank position (as indicated on the attitude director) and with the heading marker on the HSI set to the indicated magnetic heading, the vertical pointer of the attitude director shall appear in view and shall be centered. The heading marker on the HSI shall be moved clockwise and then counter clockwise from the magnetic heading. The vertical pointer shall move right and left respectively with the motion of the heading marker. The displacement pointer, horizontal pointer, vertical warning flag and displacement warning flag shall remain out of view.

4.7.11.1.3 Data Link (DL) Mode -

a. With the flight mode selector switch in the DATA LINK position, the heading switch shall be placed in the NORM position. Data link signals shall be supplied to the flight director computer and HSI by suitable test equipment. The vertical pointer shall appear in view. The displacement pointer, displacement warning flag, horizontal pointer, and vertical pointer warning flag shall disappear from view. The heading marker of the HSI shall indicate the commanded heading. The HSI course arrow and bearing pointers shall indicate such bearings as are dictated by the particular test requirements. Digital distance information

shall be in accordance with that for TACAN installations. With the vertical gyro in its zero bank position (as indicated on the attitude director) and with the heading marker on the HSI set to the indicated magnetic heading, the vertical pointer of the attitude director shall be centered. The command heading indication shall be activated by the test equipment and accurate operation of the heading marker and vertical pointer indicated.

b. With the flight mode selector switch in the DATA LINK position, the heading switch shall be placed in the MAN position. Course arrow, bearing pointer #2 and distance indications are the same as in above. MANUAL movement of the heading marker in the HSI clockwise and counterclockwise shall cause the vertical pointer to move right and left respectively as the Manual Heading mode.

4.7.11.1.4 ILS Mode - The flight mode selector switch shall be placed in the ILS position. The heading switch shall be placed in the NORM position. With the vertical gyro in the zero bank position, the course arrow of the HSI set to the selected magnetic heading and with the radio inputs zero, the vertical pointer and the displacement pointer shall appear in view and be centered in the attitude director. The pointer alarm flags shall also appear in view. A signal input shall be provided by an ILS tester to the ILS receiver to simulate radio signals. Localizer deviation signal shall be provided to indicate correct deflection of the deviation bar in the HSI. The vertical pointer in the attitude director shall be offset an amount proportional to the localizer deviation and the vertical pointer warning flag shall disappear when the signal is valid.

4.7.11.1.5 MAN-ILS Mode - With the flight selector switch in the MAN-ILS position, the heading switch shall be placed in the MAN position. The heading marker in the HSI shall be set to the selected heading with zero radio signal the attitude director display shall be the same as in the ILS mode. Movement of the heading marker in the HSI clockwise and counter clockwise shall cause the vertical pointer to move right and left respectively as in the Manual heading mode.

4.7.11.1.6 a. ILS Approach Mode - The flight mode selector switch shall be placed in the ILS-APP position and the heading switch in the NORM position. With zero glide slope radio signal and the course arrow of the HSI aligned with the selected magnetic heading the attitude director presentation shall be as in the ILS mode initially except that the horizontal pointer shall come into view and center. A signal input shall be provided by an ILS tester to the ILS receiver to simulate the radio signals. Localizer deviation signals shall be applied and the vertical pointer and deviation bar shall operate identical to the procedure established in the ILS mode. Glide slope radio signals shall be applied to the receiver and

the displacement pointer in the attitude director shall be offset in the correct direction an amount equal to the displacement signal. Motion of the horizontal pointer in the direction of the displacement signal shall also result. Both warning flags shall be driven out of view when valid radio signals are supplied.

b. ILS approach manual mode - With the flight mode selector switch in the ILS-APP position, the heading switch shall be placed in the Man position. The display shall appear identical to that in the ILS-APP mode except that movement of the heading marker in the HSI shall result in equivalent deflection of the vertical pointer as demonstrated in the Manual heading mode.

4.7.11.1.7 Radio track -

a. VOR installations - The flight mode selector switch shall be placed in the RADIO TRACK position. The heading switch shall be placed in the NORM Position. With the vertical gyro in the zero bank position, the course arrow of the HSI set to the selected magnetic heading and with the radio inputs zero, the vertical pointer shall appear in view and be centered in the attitude director. The pointer alarm flag shall also appear in view. A signal input shall be provided by suitable test equipment to the AN/ARN-14 receiver to simulate radio signals. Localizer deviation signal shall be provided to indicate correct deflection of the deviation bar in the HSI. The vertical pointer in the attitude director shall be offset an amount proportional to the localizer deviation and the vertical pointer warning flag shall disappear when the signal is valid.

b. TACAN Installations - The flight mode selector switch shall be placed in the RADIO TRACK position. The heading switch shall be placed in the NORM position, the course arrow of the HSI set to the selected magnetic heading and with the radio inputs zero, the vertical pointer shall appear in view and be centered in the attitude director. The pointer alarm flag shall also appear in view. Signal inputs shall be provided by suitable test equipment to the AN/ARN-21A radio set conforming to Specification MIL-R-7060 to simulate radio signals. TACAN deviation and bearing signals shall be provided to indicate correct deflection of the deviation bar and bearing pointer #1 respectively in the HSI. The vertical pointer in the attitude director

shall be offset an amount proportional to the TACAN deviation and the vertical pointer warning flag shall disappear when the signal is valid. TACAN distance signals shall be provided to indicate correct range information on the digital range counter in the HSI. The distance shutter shall disappear when the signal is valid.

4.7.11.18 Low Altitude Bombing System (LABS) Mode - With the flight mode selector switch in the LABS position, the heading switch shall be placed in the NORM position. The vertical pointer and the horizontal pointer shall appear in view and be centered in the attitude director. Signal inputs shall be provided by an AJB-3A tester to the Flight Director Signal Adapter (AN/AJB-3A) to simulate bombing error signals. The vertical pointer in the attitude director shall be offset an amount proportional to "roll error." The horizontal pointer in the attitude director shall be offset an amount proportional to the "G error."

4.7.11.1.9 Automatic carrier landing (ACL) Mode -

a. Automatic Control - With the flight mode selector in the ACL position and the automatic flight control system engaged, the vertical pointer and horizontal pointer shall appear in view and be centered in the attitude director indicator. Signal inputs shall be provided by AN/ASW-13 test equipment to the AN/ASW-13 or equivalent unit to simulate data link signals. Pitch and bank command signals shall be provided to indicate correct deflection of the horizontal and vertical pointers in the attitude director. The vertical pointer in the attitude director shall be offset an amount proportional to the bank command. The horizontal pointer in the attitude director shall be offset an amount proportional to the pitch command.

b. Manual Control - With the flight mode selector in the ACL position, the vertical gyro in the zero bank and vertical position, and the automatic flight control system disengaged, the vertical pointer and horizontal pointer shall appear in view and be centered in the attitude director. Signal inputs shall be provided by AN/ASW-13 test equipment to the AN/ASW-13 unit (Specification MIL-D-22726) to simulate data link signals. Pitch and bank error (situation) signals shall be provided to indicate correct deflection of the displacement pointer in the attitude indicator and the deviation bar of the horizontal situation indicator. The deviation bar in the HSI shall be offset an amount proportional to the bank or lateral error. The displacement in the altitude director

shall be offset an amount proportional to the pitch error.

4.7.11.1.10 Other Mode Operation - Where additional flight modes are specified in Figure 2 similar operation shall be demonstrated for each mode to prove compliance with the applicable mode switching as established on the Figure 2 chart.

4.7.11.2 Dual Cockpit Switching - To assist proper installations operations, the test procedures outlined under Mode operation shall be accomplished with two mode selectors. Manual settings of heading or course by the Mode Selector in command shall result in the identical settings to be repeated on the HSI's to within $\pm 2^{\circ}$. This procedure shall be accomplished in accordance with 4.8.4 requirement.

4.7.11.3 Attitude Director Operation - Upon applying power to the system, the sphere of the attitude director shall erect to a zero pitch and zero bank indication, within 3 minutes of application of power. The Off flag shall also disappear within 3 minutes. The pitch trim knob shall be rotated to the stop in a clockwise direction (approximately 1/2 turn) and the sphere shall indicate between 10° and 20° dive. The pitch trim knob shall then be rotated to the stop in a counter-clockwise direction (approximately 1/4 turn) and the sphere shall indicate 5° and 10° climb.

4.7.11.4 Azimuth accuracy - The system shall be aligned with a precisely known true magnetic system heading and the indicated magnetic heading of the system recorded. This shall be accomplished by aligning the attitude indicator sphere and the HSI course arrow accurately with the top lubber line of the HSI and reading the indicated $1/4^{\circ}$ on the digital course counter at the bottom of the HSI. The indicated heading shall not differ from the true magnetic heading by more than $\pm 1^{\circ}$.

4.8 Rejection and Retest - Equipment which has been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the government inspector. Units rejected after retest shall not be resubmitted without the specific approval of the procuring activity.

5. PREPARATION FOR DELIVERY

5.1 General - The equipments shall be preserved, packaged, packed and marked for the level of shipment specified in the contract or order in accordance with the detail equipment specifications.

6. NOTES

6.1 Intended Use - The integrated flight instrumentation system covered by this specification is intended to provide indications of pitch, roll, azimuth, rate of turn and flight director command information on the remote attitude director indicator, and magnetic heading, bearing, range, course, course deviation, TO-FROM and command course, and heading on the ID-1013/A horizontal situation indicator in an integrated fashion for fighter, bomber, or cargo aircraft. The system is designed to provide displays that quicken pilot interpretation and unburden pilot mental computation in various flight modes.

6.2 Automatic Carrier Landing Mode - In this mode the utilization of command or error signals for display purposes may be accomplished in the following manner:

a. Command signals may be presented on the attitude director crosspointers as a function of automatic pilot status.

b. Command signals may be presented on the attitude director crosspointers while error signals would be presented on the attitude indicator displacement pointer (longitudinal error) and HSI deviation bar (lateral error).

c. Command signals may be presented on the attitude director crosspointers while error signals would be presented on an ID-249 indicator or equivalent.

6.3 Definitions -

6.3.1 Whenever the words "Attitude Director" are utilized in this specification, it will be understood to mean the Remote Attitude Director Indicator.

6.3.2 Whenever the abbreviation HSI is used in this specification, it will be understood to mean the ID-1013/A Horizontal Situation Indicator.

6.4 Provisions for Preproduction Tests - The manufacture of instruments on contract shall not commence until the samples submitted are pronounced satisfactory by the procuring activity. When a contractor is in continuous production of the instrument from contract to contract, the submission of further preproduction samples on the subsequent contracts may be waived at the discretion of the procuring activity. Approval of preproduction samples or the waiving of preproduction tests does not preclude the requirement of acceptance testing.

6.4.1 It shall be understood that the instrument supplied under contract or order shall be identical to the corresponding preproduction sample in design, construction, quality, material, workmanship and method of manufacture. Deviation from the standards of the preproduction sample shall be made only by the procuring activity. Evidence of unauthorized change shall constitute cause for rejection.

SPECIFICATION ANALYSIS SHEET
NAVWEPS FORM 4121/3 (8-62)

FORM APPROVED
BUDGET BUREAU NO 45 R309

INSTRUCTIONS

This sheet is to be filled out by Government or contractor personnel involved in the use of this specification in procurement of products for ultimate use by the activity shown on the reverse of this sheet.

This sheet is provided for obtaining information which will aid the activity shown in insuring that through use of this specification suitable products can be procured with a minimum amount of delay and at the least cost.

Comments and the return of this sheet will be appreciated.

Fold on dotted lines on reverse side, staple in corner, and send to the activity shown

SPECIFICATION (No. and abbrev. title)

ORGANIZATION	CITY	STATE

CONTRACT NUMBER	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$

MATERIAL PROCURED UNDER A DIRECT GOVERNMENT CONTRACT ☐ OR A SUBCONTRACT ☐

HAS ANY PART OF THIS SPECIFICATION CREATED PROBLEMS OF REQUIRED INTERPRETATION IN PROCUREMENT USE
(If so, give paragraph number and wording, and recommendations for correcting the deficiencies.)

2 COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3 IS THE SPECIFICATION RESTRICTIVE?
☐ YES ☐ NO IF YES, IN WHAT WAY

4 REMARKS *(Attach any pertinent data which may be of use in improving this specification. If additional papers are attached, send this form and papers in an envelope. This form is addressed for use in window envelope when appropriate.)*

SUBMITTED BY *(Print name and title)*	DATE

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