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CERTIFICATION TEST PROCEDURES FOR AIRCRAFT APPROACH CONTROL, AN--ETC(U)
MAY 79
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DEPARTMENT OF THE NAVY

**NAVAL ELECTRONIC SYSTEMS ENGINEERING ACTIVITY**

Saint Inigoes, Maryland 20684

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(11) 1 May 79

IN REPLY REFER TO

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From: Commanding Officer, Naval Electronic Systems Engineering Activity, St. Inigoes
To: Distribution

Subj: (6) Revised Certification Test Procedures for Aircraft Approach Control, AN/SPN-41; distribution of Revision 1

Ref: (a) NAVELEX Project Order No. N0003979PO90029 dtd 21 Dec 1978

Encl: (1) NESEA Document Number 022-106A "Certification Test Procedures for Aircraft Approach Control AN/SPN-41" dtd 1 May 1979

1. The Commander, NAVELEX, by reference (a), tasked NESEA to update the ACLS certification test procedures to reflect the latest system configurations. The revised document contains the updated Category I electrical test procedures.

2. Enclosure (1) forwards copy(s) of the test procedures to be used by the certification team during certification of the AN/SPN-41. In addition, the test procedures will be used as a means of verifying the systems' certification status following maintenance actions.

3. Any questions concerning this matter may be directed to Mr. Francis Norris, NESEA Code 022, Autovon 356-3512, extension 8206, or commerical 301-862-8206.

C. M. PATTERSON
By direction

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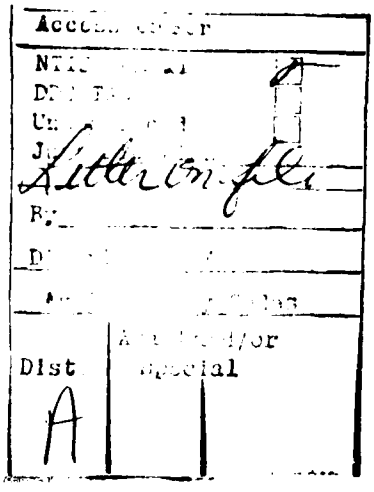


## I. INTRODUCTION.

Aircraft Approach Control AN/SPN-41, composed of shipboard and airborne equipments, can be used as an independent landing aid or as a Mode I monitor on AN/SPN-42A equipped carriers. In order to satisfactorily accomplish this monitoring, each piece of equipment must operate within allowable tolerances. These tests are designed to provide the criteria for initial and periodic checks of the system to ensure operation within acceptable limits.

There are three categories of certification tests. Category I tests are the basic equipment tests. Category II tests are pierside flights to check the system alignment and correlation of the AN/SPN-41 with the AN/SPN-42A and the Fresnel Lens Optical Landing System (FLOLS). Category III tests are the at-sea flight tests using aircraft equipped to record data.

## II. PRELIMINARY REQUIREMENTS.

The tests are written in the order that is considered most expeditious as far as time is concerned. When a complete certification is not required, the tests can be conducted in whatever order is desired by the testing agency.

The entire equipment checkout should be conducted upon completion of the initial equipment installation on a ship or after a major shipyard overhaul. Prior to the start of the tests, the equipments should be free of obvious electrical discrepancies and should operate reasonably well.

## III. TEST EQUIPMENT REQUIRED.

1. Alarm Test Card (supplied by NESEA).
2. Crystal Detector, Type PRD 6604-54 (supplied with equipment).
3. Dual Sweep Oscilloscope AN/USM-281 or equivalent.
4. Frequency Counter AN/USM-207 or equivalent.
5. Logic Probe, Hewlett Packard 10525A or equivalent.
6. Voltmeter, Simpson 250 or equivalent.
7. Theodolite, Type KERN DKM1 or equivalent.
8. Bubble Level Assembly, Elevation 398498-1 (supplied with equipment and rotated with calibrated bubble level supplied by certifying activity at the time of certification).
9. Bubble Level Assembly, Azimuth 398488-1 (supplied with equipment and rotated with calibrated bubble level supplied by certifying activity at the time of certification).

10. Boresight Telescope Assembly, 398036-1 (supplied with equipment).

11. Calibrated Receiving/Decoding Group AN/ARA-63 (supplied by NESEA).

## IV. OTHER USES OF CERTIFICATION TEST PROCEDURES.

As previously mentioned, the full range of tests presented in this handbook are intended for a complete system certification. Additionally, it is recommended that the tests be utilized for periodic equipment checks or recertification of particular components following maintenance action. However, although comprehensive and supplemental, the certification tests do not replace the Preventive Maintenance Schedule (PMS) equipment checks. Table I lists some of the vital units and subunits of the equipment. For each listed unit or subunit, the required test for verification of proper operation is given.

TABLE I

| Unit # | Nomenclature | Test # |
|---|---|---|
| 1 | Transmitting Set Control Group | 1, 2, 3, 4, 8 |
| 1A1 | Transmitting Set Control | Appropriate Parts of 1 |
| 1A2 | Coder Monitor | 2, 3, 4, 8 |
| 1A2A1 | Synchronizer | 4 |
| 1A2A4 | AZ Data Alarm | Appropriate Parts of 2 |
| 1A2A5 | AZ Transmitter Misfire Alarm | Appropriate Parts of 3 |
| 1A2A8 | AZ Coding Alarm | Appropriate Parts of 2 |
| 1A2A16 | EL Data Alarm | Appropriate Parts of 2 |
| 1A2A17 | EL Transmitter Misfire Alarm | Appropriate Parts of 3 |
| 1A2A20 | EL Coding Alarm | Appropriate Parts of 2 |
| 2 | EL Transmitter Group | Recertification |
| 2A1 | EL Stabilizer Platform | 9b, 10, 15, 16, 18 |
| 2A1A2 | EL Roll Gearbox | 9b, 10, 15, 16, 18 |
| 2A1A3 | EL Pitch Gearbox | 9b, 10, 15, 16, 18 |
| 2A1A4 | EL Electronics Drawer Assembly | 9b, 10, 15, 16, 18 |
| 2A2 | EL Antenna Drive Gear Assembly | 5b, 6b, 8, 15, 16, 18 |
| 2A2A1 | EL ADP | 5b, 18 |
| 2A4A1A2 | EL Antenna Drive Amplifier | 6b, 8 |
| 2E1 | EL Antenna | 6b, 8, 15, 16, 18 |
| 3 | AZ Transmitter Group | Recertification |
| 3A1 | AZ Stabilizer Platform | 9a, 10, 12, 13, 14, 17, 18 |
| 3A1A2 | AZ Roll Gearbox | 9a, 10, 12, 14, 17, 18 |
| 3A1A3 | AZ Yaw Gearbox | 9a, 10, 13, 14, 17, 18 |
| 3A1A4 | AZ Electronics Drawer Assembly | 9a, 10, 12, 13, 14, 17, 18 |

TABLE I (Cont'd)

| Unit # | Nomenclature | Test # |
|---|---|---|
| 3A2 | AZ Antenna Drive Gear Assembly | 5, 6, 11 |
| 3A2A1 | AZ ADP | 5a, 18 |
| 3A4A1A2 | AZ Antenna Drive Amplifier | 6b, 18 |
| 3E1 | AZ Antenna | 6a, 8, 13, 14, 17, 18 |
| 5 & 6 | AZ & EL Monitor | 18 |

## V. CERTIFICATION TESTS (CATEGORY I).

## TEST 1 - POWER SUPPLY

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to LOGIC TEST.

3. Select +5V dc and +28V dc on voltmeter of Test Set Group Control (Unit 9A4) and record the reading for each setting.

NOTE: The +28V dc setting is actually the output of the +24V dc power supply.

TABLE II

| SWITCH POSITION | REFERENCE VOLTAGE (V dc) | MEASURED VOLTAGE |
|---|---|---|
| +5V dc | +5 ±0.25 | |
| +28V dc | +24 ±2.4 | |

4. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 2 - DATA AND CODING ALARM TESTS

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover plate.

4. Remove Azimuth Data Counter card 1A2A9.

5. Insert test card and reinsert card 1A2A9 on test card.

6. Turn Local Function switch on Transmitting Set Control (Unit 1A1) to LOGIC TEST and allow two minutes warm-up.

7. On test card, press switch A and verify the AZ DATA indicator illuminates and the AZ READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

8. Press Alarm Reset on Unit 1A1 and verify the AZ DATA indicator extinguishes and the AZ READY indicator illuminates.

_____

9. On test card, press switch B and verify the AZ DATA indicator illuminates and the AZ READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

10. Press Alarm Reset on Unit 1A1 and verify the AZ DATA indicator extinguishes and the AZ READY indicator illuminates.

_____

11. On test card, press switch C and verify the AZ DATA and CODING indicators illuminate and the AZ READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

12. Press Alarm Reset on Unit 1A1 and verify the AZ DATA and CODING indicators extinguish and the AZ READY indicator illuminates.

_____

13. On test card, press switch D and verify the AZ CODING indicator illuminates and the AZ READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

14. Press Alarm Reset on Unit 1A1 and verify the AZ CODING indicator extinguishes and the AZ READY indicator illuminates.

_____

15. Turn Local Function switch on Unit 1A1 to OFF.

16. Remove test card, and reinsert card 1A2A9 directly into Unit 1A2.

17. Remove Elevation Data Counter card 1A2A21.

18. Insert test card and reinsert card 1A2A21 on test card.

19. Turn Local Function switch on Unit 1A1 to LOGIC TEST and allow two minutes warm-up.

20. On test card, press switch A and verify the EL DATA indicator illuminates and the EL READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

21. Press Alarm Reset on Unit 1A1 and verify the EL DATA indicator extinguishes and the EL READY indicator illuminates.

_____

22. On test card, press switch B and verify the EL DATA indicator illuminates and the EL READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

23. Press Alarm Reset on Unit 1A1 and verify the EL DATA indicator extinguishes and the EL READY indicator illuminates.

_____

24. On test card, press switch C and verify the EL DATA and CODING indicators illuminate and the EL READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

25. Press Alarm Reset on Unit 1A1 and verify the EL DATA and CODING indicators extinguish and the EL READY indicator illuminates.

_____

26. On test card, press switch D and verify the EL CODING indicator illuminates and the EL READY indicator extinguishes on the alarm panel of Unit 1A1.

_____

27. Press Alarm Reset on Unit 1A1 and verify the EL CODING indicator extinguishes and the EL READY indicator illuminates.

_____

28. Turn Local Function switch on Unit 1A1 to OFF.

29. Remove test card and reinsert card 1A2A21 directly into Unit 1A2.

30. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 3 - TRANSMITTER ALARM TESTS

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover plate.

4. Remove Azimuth Transmitter Misfire Alarm card 1A2A5.

5. Insert test card and reinsert card 1A2A5 on test card.

6. Turn Local Function switch on Transmitting Set Control (Unit 1A1) to LOGIC TEST and allow two minutes warm-up.

7. When both the AZ and EL READY indicators illuminate on alarm panel of Unit 1A1, turn Local Function switch to RADIATE at Unit 1.

8. On test card, press switch C and verify the AZ XMTR indicator illuminates and the AZ RADIATE indicator extinguishes on the alarm panel of Unit 1A1.

_____

9. Press Alarm Reset on Unit 1A1 and verify the AZ XMTR indicator extinguishes and the AZ RADIATE indicator illuminates.

_____

10. On test card, press switch E and verify the AZ XMTR indicator illuminates and the AZ RADIATE indicator extinguishes on the alarm panel of Unit 1A1. _____

11. Press Alarm Reset on Unit 1A1 and verify the AZ XMTR indicator extinguishes and the AZ RADIATE indicator illuminates.

_____

12. Turn Local Function switch on Unit 1A1 to OFF.

13. Remove test card and reinsert card 1A2A5 directly into Unit 1A2.

14. Remove Elevation Transmitter Misfire card 1A2A17.

15. Insert test card and reinsert card 1A2A17 on test card.

16. Turn Local Function switch on Unit 1A1 to LOGIC TEST and allow two minutes warm-up.

17. When both the AZ and EL READY indicators illuminate on alarm panel of Unit 1A1 turn Local Function switch to RADIATE at Unit 1.

18. On test card, press switch C and verify the EL XMTR indicator illuminates and the EL RADIATE indicator extinguishes on the alarm panel of Unit 1A1.

_____

19. Press Alarm Reset on Unit 1A1 and verify the EL XMTR indicator extinguishes and the EL RADIATE indicator illuminates.

_____

20. On test card, press switch E and verify the EL XMTR indicator illuminates and the EL RADIATE indicator extinguishes on the alarm panel of Unit 1A1.

_____

21. Press Alarm Reset on Unit 1A1 and verify the EL XMTR indicator extinguishes and the EL RADIATE indicator illuminates.

_____

22. Turn Local Function switch on Unit 1A1 to OFF.

23. Remove test card and reinsert card 1A2A17 directly into Unit 1A2.

24. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 4 - OVERSCAN AND SYNC ALARM TESTS

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to ANTENNA DRIVE and allow system to operate for two minutes.

3. At elevation site of the Elevation Transmitter Group (Unit 2), temporarily impede the antenna motion by momentarily gripping antenna counterweight.

4. At the alarm panel of Transmitter Set Control (Unit 1A1), verify the AZ and EL SYNC indicators illuminate and a flashing EL READY indicator illuminates.

_____

5. Press Alarm Reset on Unit 1A1 and verify the AZ and EL SYNC indicator extinguish and the EL READY indicator is steady ON when the antennas are back in synchronization.

_____

6. Turn Local Function switch on Unit 1A1 to ANTENNA DRIVE.

7. Physically push elevation antenna of Unit 2 to its upper mechanical stop and verify the EL OVERSCAN indicator illuminates, the EL READY indicator extinguishes on alarm panel of Unit 1A1, and the antenna scan is inhibited.

_____

NOTE: This is done by gripping the antenna and the counterweight simultaneously and exerting pressure in opposite directions.

8. Press Alarm Reset on Unit 1A1 and verify the EL OVERSCAN indicator extinguishes, the EL READY indicator illuminates, and the antenna resumes scanning.

_____

9. Physically push elevation antenna of Unit 2 to its lower mechanical stop; verify the EL OVERSCAN indicator illuminates, the EL READY indicator extinguishes on alarm panel of Unit 1A1, and the antenna scan is inhibited.

_____

10. Press Alarm Reset on Unit 1A1 and verify the EL OVERSCAN indicator extinguishes, the EL READY indicator illuminates, and the antenna resumes scanning.

11. At azimuth site of Azimuth Transmitter Group (Unit 3), physically push antenna to its left mechanical stop and verify the AZ OVERSCAN indicator illuminates, the AZ READY indicator extinguishes on alarm panel of Unit 1A1, and the antenna scan is inhibited.

NOTE: This is done by gripping the antenna and the counterweight simultaneously and exerting pressure in opposite directions.

12. Press Alarm Reset on Unit 1A1 and verify the AZ OVERSCAN indicator extinguishes, the AZ READY indicator illuminates, and the antenna resumes scanning.

13. Physically push azimuth antenna of Unit 3 to its right mechanical stop; verify the AZ OVERSCAN indicator illuminates, the AZ READY indicator extinguishes on alarm panel of Unit 1A1, and the antenna scan is inhibited.

14. Press Alarm Reset on Unit 1A1 and verify the AZ OVERSCAN indicator extinguishes, the AZ READY indicator illuminates, and the antenna resumes scanning.

15. At the control panels of Units 1 and 4, set the Control Mode, Function, and the Glideslope Select switches as desired by operating personnel.

## TEST 5 - ADP ALIGNMENT.

## TEST 5a - AZIMUTH ADP ALIGNMENT.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover plate.

4. Remove Synchronizer card 1A2A1.

5. Insert extender card 9E1 or 9E2, reinsert card 1A2A1 on the extender card and ground pin 15.

6. Extend Antenna Control drawer (Unit 3A4A1) and remove Line Driver card 3A4A1A1.

7. Insert extender card 9E1 or 9E2 and reinsert card 3A4A1A1 on the extender card.

8. Connect the input lead of the oscilloscope to pin 31 (Azimuth Zero), and ground to pin 1 of the extender card.

9. Set controls on the oscilloscope as follows:

| | |
|---|---|
| Probe: | X10 |
| Vertical Sensitivity: | 0.2V/DIV |
| Horizontal Sweep: | 50 MS/DIV |
| Trigger Mode: | INT |
| Slope: | Negative (–) |

10. At Unit 1, set Local Function switch to ANTENNA DRIVE.

11. Check for three azimuth crossing pulses at 200 ms intervals.

---

12. Set the oscilloscope for 175 ms delay and set delayed sweep for 5 ms/div so that only the second pulse is seen.

13. Two alternating pulses will be seen on the display. Each pulse represents the timing of one half the scan. The difference in time between the alternating pulses is the ADP error. This error should be less than 0.2 ms. Should the error exceed this value proceed with Step 14. If the error is within tolerance, record and proceed to Step 27.

---

14. At Unit 1, set Local Function switch to OFF.

15. Disconnect waveguide assembly 3W5 from wavemeter 3Z1.

16. Disconnect BNC connector from detector diode 3Z2.

17. Remove cover from Antenna Drive (Unit 3A2).

18. Loosen ADP 3A2A1 clamp screws.

19. At Unit 1, set Local Function switch to ANTENNA DRIVE.

20. Rotate ADP 3A2A1 to minimize error.

21. Increase the oscilloscope delay and the delayed sweep speed to maintain the display (oscilloscope sensitivity should be increased to permit ADP adjustment to be within 0.2 ms). Record ADP error.

---

22. Tighten ADP 3A2A1 clamp screws.

23. On Unit 1, set Local Function switch to OFF.

24. Replace cover on Unit 3A2.

25. At Unit 1, set Local Function switch to ANTENNA DRIVE.

26. Verify ADP error is less than 0.2 ms.

27. At Unit 1, set Local Function switch to OFF.

28. Reconnect waveguide assembly 3W5 to wavemeter 3Z1.

29. Reconnect BNC connector to detector diode 3Z2.

30. Remove extender card from card 3A4A1A1 and reinsert card 3A4A1A1 directly into Unit 3A4A1.

31. Remove extender card; ground lead from card 1A2A1 and reinsert card 1A2A1 directly into Unit 1A2.

32. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 5b - ELEVATION ADP ALIGNMENT

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Antenna Control drawer (Unit 2A4A1) and remove Line Driver card 2A4A1A1.

4. Insert extender card 9E1 or 9E2 and reinsert card 2A4A1A1 on the extender card.

5. Connect the oscilloscope to pin 31 (Azimuth Zero), and ground to pin 1 of the extender card.

6. Set controls on the oscilloscope as follows:

| | |
|---|---|
| Probe: | X10 |
| Vertical Sensitivity: | 0.2V/DIV |
| Horizontal Sweep: | 50 MS/DIV |
| Trigger Mode: | INT |
| Slope: | NEGATIVE (–) |

7. At Unit 1, set Local Function switch to ANTENNA DRIVE.

8. Check for three azimuth crossing pulses at 200 ms intervals.

---

9. Set the oscilloscope delay for 175 ms and set delayed sweep for 5 ms/div so that only the second pulse is seen.

10. Two alternating pulses will be seen on the display. Each pulse represents the timing of one half the scan. The difference in time between the alternating pulses is the ADP error. This error should be less than 0.2 ms. Should the error exceed this value proceed with Step 11. If the error is within tolerance, record and proceed to Step 24.

---

11. At Unit 1, set Local Function switch to OFF.

12. Disconnect waveguide assembly 2W5 from wavemeter 2Z1.

13. Disconnect BNC connector from detector diode 2Z2.

14. Remove cover from Antenna Drive (Unit 2A2).

15. Loosen ADP 2A2A1 clamp screws.

16. At Unit 1, set Local Function switch to ANTENNA DRIVE.

17. Rotate ADP 2A2A1 to minimize error.

18. Increase the oscilloscope delay and the delayed sweep speed to maintain the display (oscilloscope sensitivity should be increased to permit ADP adjustment to be within 0.2 ms). Record ADP error.

_____

19. Tighten ADP 2A2A1 clamp screws.

20. At Unit 1, set Local Function switch to OFF.

21. Replace Unit 2A2 cover.

22. At Unit 1, set Local Function switch to ANTENNA DRIVE.

23. Verify ADP error is less than 0.2 ms.

24. At Unit 1, set Local Function switch to OFF.

25. Reconnect waveguide assembly 2W5 to wavemeter 2Z1.

26. Reconnect BNC connector to detector diode 2Z2.

27. Remove extender card from card 2A4A1A1 and reinsert card 2A4A1A1 directly into Unit 2A4A1.

28. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 6 - ANTENNA SCAN FREQUENCY ADJUST.

## TEST 6a - AZIMUTH ANTENNA SCAN FREQUENCY ADJUST.

NOTE: Perform Test 5a (Azimuth ADP Alignment) prior to starting this test.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover plate.

4. Remove Synchronizer card 1A2A1.

5. Insert extender card 9E1 or 9E2, reinsert card 1A2A1 on the extender card and ground pin 15.

6. Extend Antenna Control drawer (Unit 3A4A1) and remove Line Driver card 3A4A1A1.

7. Insert extender card 9E1 or 9E2 and reinsert card 3A4A1A1 on the extender card.

8. Connect counter to pin 31 (Azimuth Zero), and ground to pin 1 of the extender card.

9. Set counter to read 10 Period Average.

10. Disconnect waveguide assembly 3W5 from wavemeter 3Z1.

11. Disconnect BNC connector from detector diode 3Z2.

12. Remove cover from Antenna Drive (Unit 3A2).

13. Remove sector gear 3A2MP53 by removing three allen screws securing it to the sector gear hub.

14. Secure counterweight arm in REST position..

15. At Unit 1, set Local Function switch to ANTENNA DRIVE.

16. Observe period of oscillations on counter. Period should be 200 ±0.5 ms. If the period is not within tolerance, proceed with Step 17. If period is within tolerance, record and proceed to Step 18.

17. Add or remove laminated adjustable counterweights (shims) 3MP17, 3MP18, and 3MP19 to adjust for proper period of 200 ±0.5 ms.

NOTE: To increase period, add weight proportionally to 3MP17, 3MP18, and 3MP19; to decrease period remove weight. Two shims should be added to or removed from 3MP17 for each one added to or removed from 3MP18 and 3MP19.

18. At Unit 1, set Local Function switch to OFF.

19. Release counterweight arm and reinstall sector gear 3A2MP53.

20. At Unit 1, set Local Function switch to ANTENNA DRIVE.

21. Observe period of oscillations on counter. Period should be 200 ±0.2 ms. If the period is not within tolerance, proceed with Step 22. If period is within tolerance, record and proceed to Step 23.

---

22. Add or remove laminated adjustable counterweights (shims) 3MP13 and 3MP14 in equal amounts at each end of counterweight arm to adjust for proper period of 200 ±0.2 ms.

NOTE: To increase period, add weight; to decrease period, remove weight.

---

23. At Unit 1, set Local Function switch to OFF.

24. Replace Unit 3A2 cover.

25. At Unit 1, set Local Function switch to ANTENNA DRIVE.

26. Observe counter and verify the antenna period is 200 ±0.2 ms.

27. At Unit 1, set Local Function switch to OFF.

28. Reconnect waveguide assembly 3W5 to wavemeter 3Z1.

29. Reconnect BNC connector to detector diode 3Z2.

30. Remove extender card from card 3A4A1A1 and reinsert card 3A4A1A1 directly into Unit 3A4A1.

31. Remove extender card, ground lead from card 1A2A1 and reinsert card 1A2A1 directly into Unit 1A2.

32. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 6b - ELEVATION ANTENNA SCAN FREQUENCY ADJUST

NOTE: Perform Test 5b (Elevation ADP Alignment) prior to starting this test.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Antenna Control drawer (Unit 2A4A1) and remove Line Driver card 2A4A1A1.

4. Insert extender card 9E1 or 9E2 and reinsert card 2A4A1A1 on the extender card.

5. Connect counter to pin 31 (Azimuth Zero), and ground to pin 1 of the extender card.

6. Set counter to read 10 Period Average.

7. Disconnect waveguide assembly 2W5 from wavemeter 2Z1.

8. Disconnect BNC connector from detector diode 2Z2.

9. Remove cover from Antenna Drive (Unit 2A2).

10. Remove sector gear 2A2MP53 by removing three allen screws securing it to the sector gear hub.

11. Secure counterweight arm in REST position.

12. At Unit 1, set Local Function switch to ANTENNA DRIVE.

13. Observe period of oscillations on counter. Period should be 200 ±0.5 ms. If the period is not within tolerance, proceed with Step 14. If period is within tolerance, record and proceed to Step 15.

---

14. Add or remove equal amounts of laminated adjustable counterweights (shims) 2MP15 and 2MP21 to adjust for proper period of 200 ±0.5 ms.

NOTE: To increase period, add weight proportionally to 2MP15 and 2MP21; to decrease period, remove weight.

15. At Unit 1, set Local Function switch to OFF.

16. Release counterweight arm and reinstall sector gear 2A2MP53.

17. At Unit 1, set Local Function switch to ANTENNA DRIVE.

18. Observe period of oscillations on counter. Period should be 200 ±0.2 ms. If the period is not within tolerance, proceed with Step 19. If period is within tolerance, record and proceed to Step 20.

---

19. Add or remove laminated adjustable counterweights (shims) 2MP13 and 2MP14 in equal amounts at each end of counterweight arm to adjust for proper period of 200 ±0.2 ms.

NOTE: To increase period, add weight; to decrease period, remove weight.

20. At Unit 1, set Local Function switch to OFF.

21. Replace Unit 2A2 cover.

22. At Unit 1, set Local Function switch to ANTENNA DRIVE.

23. Observe counter and verify the antenna period is 200 ±0.2 ms.

24. At Unit 1, set Local Function switch to OFF.

25. Reconnect waveguide assembly 2W5 to wavemeter 2Z1.

26. Reconnect BNC connector to detector diode 2Z2.

27. Remove extender card from card 2A4A1A1 and reinsert card 2A4A1A1 directly into Unit 2A4A1.

28. At the control panels of Units 1 and 4, set the Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 7 - TRANSMITTER FREQUENCY ALIGNMENT.

## TEST 7a - AZIMUTH TRANSMITTER FREQUENCY ALIGNMENT.

NOTE: Recently calibrated wavemeter and calibration chart to be installed during AN/SPN-41 certification by certifying activity.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to XMTR, ADJ.

3. Allow 10 minute warm-up period after transmitter comes to RADIATE.

4. Loosen locking screw and set wavemeter 3Z1 to the ship's channel setting using calibration card (77°) for appropriate wavemeter setting. Tighten locking screw.

5. Set Variable Attenuator, 3AT1, to 0 dB and switch tuning indicator switch on the Radio Transmitter (Unit 3A3) to ON.

6. Remove Unit 3A3 tuning access screw and adjust tuner until tuning indicator starts to flash.

7. Increase Variable Attenuator, 3AT1, setting and retune. Repeat until flashing occurs over a small tuning range, less than 1/2 turn of the tuning screw. Center tuning screw in this range.

8. Reduce Variable Attenuator, 3AT1, by 1/2 turn and replace tuning access screw on Unit 3A3.

9. At the control panels of Units 1 and 4, set Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 7b - ELEVATION TRANSMITTER FREQUENCY ALIGNMENT.

NOTE: Recently calibrated wavemeter and calibration chart to be installed during AN/SPN-41 certification by certifying activity.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to XMTR, ADJ.

3. Allow 10 minute warm-up period after transmitter comes to RADIATE.

4. Loosen locking screw and set wavemeter 2Z1 to the ship's channel setting using calibration card (77°) for appropriate wavemeter setting. Tighten locking screw.

5. Set Variable Attenuator, 2AT1 to 0 dB and switch tuning indicator switch on the Radio Transmitter (Unit 2A3) to ON.

6. Remove Unit 2A3 tuning access screw and adjust tuner until tuning indicator starts to flash.

7. Increase Variable Attenuator, 2AT1, setting and retune. Repeat until flashing occurs over a small tuning range, less than 1/2 turn of the tuning screw. Center tuning screw in this range.

8. Reduce Variable Attenuator, 2AT1, by 1/2 turn and replace tuning access screw on Unit 2A3.

9. At the control panels of Units 1 and 4, set Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 8 - ANTENNA PRESET VERIFICATION.

NOTE: Perform Tests 5a (Azimuth ADP Alignment), 5b (Elevation ADP Alignment), 6a (Azimuth Antenna Scan Frequency Adjust), and 6b (Elevation Antenna Scan Frequency Adjust) prior to starting this test.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Glideslope Select to SERVICE.

2. At Unit 1, set Local Function switch to OFF.

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover plate.

4. Remove Azimuth Driver/Receiver Interface card 1A2A27.

5. Insert extender card 9E1 or 9E2 and reinsert card 1A2A27 on the extender card.

6. At Unit 1, set Local Function switch to ANTENNA DRIVE.

7. Connect the input lead of oscilloscope to pin 7 (Azimuth Sector), and ground to pin 1 of the extender card.

8. Observe oscilloscope for a wide positive pulse of 62 ±2 ms and record.

---

NOTE: If the sector gate is out of tolerance, the preset count for the Limit Pulse Counter on 1A2A2 will have to be adjusted. This should only be accomplished by the certifying activity unless the preset count is extremely misadjusted to the point of causing DATA or OVERSCAN indicators to illuminate.

9. At Unit 1, set Local Function switch to OFF.

10. Remove extender card and reinsert card 1A2A27 directly into Unit 1A2.

11. Remove Elevation Driver/Receiver Interface card 1A2A29.

12. Insert extender card 9E1 or 9E2 and reinsert card 1A2A29 on the extender card.

13. At Unit 1, set Local Function switch to ANTENNA DRIVE.

14. Connect the input lead of the oscilloscope to pin 7 (Elevation Sector), and ground to pin 1 of the extender card.

15. Observe oscilloscope for a wide positive pulse of 31 ±1 ms and record.

---

NOTE: If the sector gate is out of tolerance, the preset count for the Limit Pulse Counter on 1A2A2 will have to be adjusted. This should only be accomplished by the certifying activity unless the preset count is extremely misadjusted to the point of causing DATA or OVERSCAN indicators to illuminate.

16. At Unit 1, set Local Function switch to OFF.

17. Remove extender card and reinsert card 1A2A29 directly into Unit 1A2.

18. At the control panels of Units 1 and 4, set Control Mode, Function, and Glideslope Select switches as desired by operating personnel.

## TEST 9 - STABLE PLATFORM TEST DEFLECTION.

## TEST 9a - AZIMUTH STABLE PLATFORM TEST DEFLECTION.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control to OPERATE.

3. At Azimuth Transmitter Group (Unit 3), set Operate/Test Deflect switch, 3A1A4S3, to TEST DEFLECT.

4. Set Roll switch, 3A1A4S1, to the following settings and record in Table III the indication on Roll platform dial; also insure that no platform oscillations occur at each setting:

TABLE III

| ROLL SETTING ($^0$) | DIAL READING | REFERENCE ($\pm 0.01^0$) |
|---|---|---|
| –5 | | 5.000 |
| –5/6 | | 9.166 |
| 0 | | 0.000 |
| +5/6 | | 0.834 |
| +5 | | 5.000 |

5. Set Yaw switch, 3A1A4S2, to the following settings and record in Table IV the indication on Yaw platform dial; also insure that no platform oscillations occur at each setting:

TABLE IV

| YAW SETTING ($^0$) | DIAL READING | REFERENCE ($\pm 0.01^0$) |
|---|---|---|
| –2.5 | | 7.500 |
| –5/6 | | 9.166 |
| 0 | | 0.000 |
| +5/6 | | 0.834 |
| +2.5 | | 2.500 |

6. At Unit 3, return Operate/Test Deflect switch, 3A1A4S3, to OPERATE.

7. At the control panels of Units 1 and 4, set the Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

TEST 9b - ELEVATION STABLE PLATFORM TEST DEFLECTION.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control to OPERATE.

3. At Azimuth Transmitter Group (Unit 3), set Operate/Test Deflect switch, 2A1A4S3, to TEST DEFLECT.

4. Set Roll switch, 2A1A4S1, to the following settings and record in Table V the indication on Roll platform dial; also insure that no platform oscillations occur at each setting:

TABLE V

| ROLL SETTING ($^0$) | DIAL READING | REFERENCE ($\pm 0.01^0$) |
|---|---|---|
| –5 | | 5.000 |
| –5/6 | | 9.166 |
| 0 | | 0.000 |
| +5/6 | | 0.834 |
| +5 | | 5.000 |

5. Set Pitch switch, 2A1A4S2, to the following settings and record in Table VI the indication on Pitch platform dial; also insure that no platform oscillations occur at each setting:

TABLE VI

| PITCH SETTING ($^0$) | DIAL READING | REFERENCE ($\pm 0.01^0$) |
|---|---|---|
| –5 | | 5.000 |
| –5/6 | | 9.166 |
| 0 | | 0.000 |
| +5/6 | | 0.834 |
| +5 | | 5.000 |

6. At Unit 3, return Operate/Test Deflect switch, 2A1A4S3, to OPERATE.

7. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 10 - STABILIZATION DIRECTIONAL TEST.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, and Platform Control to OPERATE (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to OFF, Platform Control switch to OPERATE, and Stabilization Cut Out switch in azimuth radome to OFF.

3. Remove Stabilization drawer (Unit 3A1A4), remove K14 and reinsert Unit 3A1A4.

4. At Unit 1, set Local Function switch to LOGIC TEST and azimuth radome Stabilization Cut Out switch to BOTH.

NOTE: Verify that AN/SPN-41 stabilization source is SINS.

5. Pull MSR unit out of cabinet and switch OFF the inputs to the unit. Before offsetting the MSR, ensure that everyone is off the lines to prevent injuries and damage to the equipment. Move MSR in increments and directions shown in Table VII. Verify by observing Yaw and Roll dials located on azimuth pedestal. Ensure communications via sound-powered phones to the azimuth radome.

NOTE: For BOW TO STBD - turn Heading X180 on MSR cw.
For BOW TO PORT - turn Heading X180 on MSR ccw.
For STBD UP - turn Roll X180 on MSR cw.
For STBD DOWN - turn Roll X180 on MSR ccw.

TABLE VII

| AXIS | DIRECTION | AMOUNT | DIAL READING | VERIFIED |
|---|---|---|---|---|
| Yaw | PRESENT HEADING | 0 | 0.0 | |
| Yaw | BOW TO STBD | $3^0$ ($3^0$) | $3.0^0$ | |
| Yaw | BOW TO PORT | $3^0$ ($3^0$) | $7.0^0$ | |
| Roll | 0.0 | 0.0 | 0.0 | |
| Roll | STBD UP | $3^0$ ($3^0$) | $7.0^0$ | |
| Roll | STBD DOWN | $3^0$ ($3^0$) | $3.0^0$ | |

6. At Unit 1, set Local Function switch to OFF and azimuth radome Stabilization Cut Out switch to OFF.

7. Remove Unit 3A1A4, reinstall K14, and reinsert Unit 3A1A4.

8. At Unit 1, set Local Function switch to LOGIC TEST and Stabilization Cut Out switch in azimuth radome to BOTH.

9. Move MSR Heading X180 20° to port and verify AN/SPN-41 Yaw stabilization slews to a limit and then corrects toward 0° on Yaw stabilization vernier dial. Verify that course to fine switching occurs between 2° and 3° of 0°. Record where switching occurs.

NOTE: Course to fine switching can be observed on the YAW vernier dial as a marked decrease in speed in the return to 0°.

10. Move MSR Heading X180 20° to starboard and verify AN/SPN-41 stabilization slews to a limit and then corrects toward 0° on Yaw stabilization vernier dial. Verify that course to fine switching occurs between 2° and 3° of 0°. If out of tolerance, adjust 3A1A4U6. Record where switching occurs.

11. Move MSR in increments and directions shown in Table VIII. Verify by observing Pitch and Roll dials located on elevation pedestal. Ensure communications via sound-powered phones to the elevation radome.

NOTE: For BOW UP - turn Pitch X180 on MSR ccw.
For BOW DOWN - turn Pitch X180 on MSR cw.
For STBD UP - turn Roll X180 on MSR cw.
For STBD DOWN - turn Roll X180 on MSR ccw.

TABLE VIII

| AXIS | DIRECTION | AMOUNT | DIAL READING | VERIFIED |
|---|---|---|---|---|
| Pitch | 0.0 | 0.0 | 0.0 | |
| Pitch | BOW UP | 3° (3°) | 3.0° | |
| Pitch | BOW DOWN | 3° (3°) | 7.0° | |
| Roll | 0.0 | 0.0 | 0.0 | |
| Roll | STBD UP | 3° (3°) | 7.0° | |
| Roll | STBD DOWN | 3° | 3.0° | |

12. Return MSR in SINS to the normal operating configuration.

13. At the control panels of Units 1 and 4, set the Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 11 - MK19 GYRO/SINS VERIFICATION.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. Record MK19 Gyros and SINS ship's mistrim and direction data in Table IX in degrees. Compute the differences and record in Table IX.

TABLE IX

| AXIS | SINS | FWD MK19 | AFT MK19 | DIFFERENCE | |
|---|---|---|---|---|---|
| | | | | SINS/FWD | SINS/AFT |
| Pitch | | | | | |
| Roll | | | | | |

NOTE: Use APPENDIX C to convert minutes to degrees.

3. Ensure stabilization source for the AN/SPN-41 is SINS.

4. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control to OPERATE.

5. At Elevation Transmitter Group (Unit 2), record ship's mistrim and direction in Table X by observing stabilization vernier dials.

6. At Azimuth Transmitter Group (Unit 3), record ship's mistrim and direction in Table X by observing stabilization vernier dial.

7. Switch stabilization source for the AN/SPN-41 from SINS to MK19.

NOTE: If two MK19 Gyros (FWD and AFT) are on board, use FWD MK19. Repeat Steps 7 through 9 using AFT MK19.

8. At Unit 2, record ship's mistrim and direction in Table X by observing stabilization vernier dials.

9. At Unit 3, record ship's mistrim and direction in Table X by observing stabilization vernier dials.

10. Compute and record the difference between stabilization sources in Table X.

TABLE X

| AXIS | SINS | FWD MK19 | AFT MK19 | DIFFERENCE | |
|---|---|---|---|---|---|
| | | | | SINS/FWD | SINS/AFT |
| Elevation Pitch | | | | | |
| Elevation Roll | | | | | |
| Azimuth Roll | | | | | |

11. Compare Pitch and Roll differences in Table IX with Table X and verify that Table X is within $\pm 0.05^0$ of Table IX. Record.

Pitch _____

Roll _____

12. At the control panels of Units 1 and 4, set the Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 12 - AZIMUTH ROLL STABILIZATION ALIGNMENT.

NOTE: Before proceeding with this test, ensure Test 5a (Azimuth ADP Alignment) has been completed satisfactorily.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

NOTE: Ensure SINS is connected to the system and it is in the NAVIGATE mode.

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to OPERATE.

3. At Azimuth Transmitter Group (Unit 3), set circuit breaker 3A4A4CB1 to OFF.

4. Extend Antenna Control drawer (Unit 3A4A1) and remove Line Driver card 3A4A1A1.

5. Insert extender card 9E1 or 9E2 and reinsert card 3A4A1A1 on the extender card.

6. Connect logic probe tip to pin 31 (Azimuth Zero), +5V lead to pin 34, and ground lead to pin 1 of the extender card.

7. Remove antenna hub 3MP28 from the shaft by removing six screws which are located on the antenna hub; also remove four screws which mount waveguide 3W2 to rotary joint 3W1. Remove four screws which mount rotary joint 3W1 to clamp 3MP27.

8. Remove antenna 3E1 with hub 3MP28.

9. Install shaft locking set screw on the antenna shaft and adjust to light hand pressure.

10. At Unit 3, set circuit breaker 3A4A4CB1 to ON, Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT, and Roll and Yaw test deflect switches 3A1A4S1 and 3A1A4S2 to $0^{o}$.

11. By slight rotation of the antenna shaft the Azimuth Zero pulse should trigger the logic probe. Tighten the shaft locking set screw at the point where the logic probe is triggered.

12. Attach Azimuth Bubble Level Assembly to the shaft using the same mounting hardware that fastened the antenna hub.

13. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

14. Observe Bubble Level in the Roll axis and verify it is within 1 arc minute of level. If it is out of tolerance, proceed with Step 15. If it is within tolerance, record and proceed with Step 23.

---

NOTE: Each Bubble Level division represents 1 arc minute.

15. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

16. Remove platform Roll gear box cover and loosen the clamps of the fine (36X) synchro 3A1A2B2.

17. At Unit 3, set circuit breaker 3A4A4CB1 to ON.

18. Observe Bubble Level in Roll axis, rotate Roll fine (36X) synchro 3A1A2B2 until Bubble Level indicates within 1 arc minute of level.

CAUTION: 115V is present on terminals of the synchro.

NOTE: If platform starts to oscillate, this indicates the course synchro is not properly aligned with the fine synchro.

19. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

20. Tighten fine (36X) synchro 3A1A2B2 clamps.

21. At Unit 3, set circuit breaker 3A4A4CB1 to ON.

22. Verify Bubble Level still indicates within 1 arc minute of level and record.

---

23. Remove Bubble Level Assembly.

24. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT and the Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^{0}$.

25. Monitor the voltage across terminals R1 and R2 of course (2X) synchro 3A1A2B1. The voltage should be less than 45 mV. If the voltage is out of tolerance, proceed with Step 26. If voltage is within tolerance, record and proceed to Step 30.

---

CAUTION: 115V is present on terminals of the synchros.

26. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

27. Loosen course (2X) synchro 3A1A2B1 clamps.

28. At Unit 3, set circuit breaker 3A4A4CB1 to ON.

29. Monitor voltage across terminals R1 and R2 of course (2X) synchro 3A1A2B1. Rotate synchro until minimum voltage is achieved and record. This voltage should be less than 45 mV.

---

30. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

31. Tighten course (2X) synchro 3A1A2B1 clamps and replace Roll gear box cover.

32. Remove shaft locking set screw.

33. Reinstall antenna hub 3MP28 and rotary joint 3W1 and reconnect waveguide 3W2.

34. Remove card 3A4A1A1 and extender card, and reinsert card 3A4A1A1 directly into Unit 3A4.

35. At Unit 3, set circuit breaker 3A4A4CB1 to ON and Operate/Test Deflect switch 3A1A4S3 to OPERATE.

36. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 13 - AZIMUTH YAW STABILIZATION ALIGNMENT.

NOTE:

(1) Before proceeding with this test, ensure Tests 5a (Azimuth AOP Alignment) and 12 (Azimuth Roll Stabilization Alignment) have been completed satisfactorily.

(2) Ensure SINS is connected to the system and it is in the NAVIGATE mode.

(3) One of the following tests will be used to align the azimuth yaw stabilization. The test used will be left to the discretion of the certifying personnel in order to achieve ±0.05° accuracy with respect to angle deck centerline.

## TEST 13a - AZIMUTH ALIGNMENT (WITHOUT RADOME).

NOTE: Appendix A (Azimuth Drop Pulse Alignment) may be substituted for Step 1 and Steps 30 through 34.

1. Install calibrated AN/ARA-63 receiver and decoder in the Azimuth RF Monitor (Unit 5) and Pulse Decoder, KY-651/ARA-63 (Unit 3A4A2).

2. Remove the azimuth radome.

3. Extend azimuth monitor boom and lock in place.

4. Set up a theodolite on centerline. Ensure the theodolite is level and site in centerline as far forward as possible.

5. Transfer this reference aft of the fantail.

6. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

7. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to OPERATE.

8. At the Azimuth Transmitter Group (Unit 3), set circuit breaker 3A4A4CB1 to OFF.

9. Extend Antenna Control drawer (Unit 3A4A1) and remove Line Driver card 3A4A1A1.

10. Insert extender card 9E1 or 9E2 and reinsert card 3A4A1A1 on the extender card.

11. Connect logic probe tip to pin 31 (Azimuth Zero), +5V lead to pin 34, and ground lead to pin 1 of the extender card.

12. Remove antenna hub 3MP28 from shaft by removing six screws which are located on the antenna hub; also remove four screws which mount waveguide 3W2 to rotary joint 3W1. Remove four screws which mount rotary joint 3W1 to clamp 3MP27.

13. Remove antenna 3E1 from hub 3MP28.

14. Install shaft locking set screw on the antenna shaft and adjust to light hand pressure.

15. At Unit 3, set circuit breaker 3A4A4CB1 to ON, Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT and Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^0$.

16. By slight rotation of the antenna shaft the Azimuth Zero pulse should trigger the logic probe. Tighten the shaft locking set screw at the point where the logic probe is triggered.

17. Attach the Boresight Assembly to the shaft using the same mounting hardware that fastened the antenna hub.

18. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

19. Sight through the theodolite to a predominant landmark or anything that can be accurately used with the boresight.

20. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

21. Remove platform Yaw gear box access plates and loosen the clamps of the fine (36X) synchro 3A1A3B2.

22. At Unit 3, set circuit breaker 3A4A4CB1 to ON.

23. Sight through the Boresight Assembly, rotate Yaw fine (36X) synchro 3A1A3B2 until crosshairs of Boresight Assembly are directly in line with alignment point determined with the theodolite.

> CAUTION: 115V is present on terminals of the synchros.
>
> NOTE: If platform starts to oscillate rapidly, this indicates the course synchro is not properly aligned with the fine synchro.

24. Adjust azimuth monitor boom until feedhorn is directly in line with crosshairs of boresight and the alignment point. Lock the azimuth monitor boom in place.

25. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

26. Remove Boresight Assembly and shaft locking set screw.

27. Reinstall antenna hub 3MP28, antenna 3E1, and rotary joint 3W1, and reconnect waveguide 3W2.

28. Remove card 3A4A1A1 and the extender card, and reinsert card 3A4A1A1 directly into Unit 3A4.

29. Reinstall the azimuth radome.

30. At Unit 3, set Azimuth Monitor Power switch to ON and circuit breaker 3A4A4CB1 to ON.

31. At Unit 1, connect a voltmeter as follows: common to negative terminal of 1A1M1 (Azimuth Monitor Meter); positive to the side of 1A1R24 NOT connected to positive terminal of 1A1M1.

32. At Unit 1, set Local Function switch to OFF and then to ANTENNA DRIVE.

33. After approximately two minutes observe the XMTR READY indicator illuminates at Unit 1 and set Local Function switch to RADIATE.

34. Observe meter for a deviation reading of ±10 mV of calibrated AN/ARA-63 offset bias reading. If aligned correctly, record and proceed to Step 39. If reading is greater than 10 mV, an alignment error exists. Proceed with Step 35.

NOTE: Calibrated AN/ARA-63 offset bias reading is located on Pulse Decoder KY-651/ARA-63.

---

35. Remove platform Yaw gear box access plates and loosen the clamps of the fine (36X) synchro 3A1A3B2.

36. Observe meter and rotate Yaw fine (36X) synchro 3A1A3B2 until deviation reading is ±10 mV of the calibrated AN/ARA-63 offset bias reading.

37. Tighten fine (36X) synchro 3A1A3B2 clamps.

38. Verify deviation reading is ±10 mV of the calibrated AN/ARA-63 offset bias reading and record.

---

39. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT and the Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^0$.

40. Monitor the voltage across terminals R1 and R2 of course (1X) synchro 3A1A3B1. The voltage should be less than 45 mV. If the voltage is out of tolerance, proceed with Step 41. If the voltage is within tolerance, record and proceed to Step 44.

41. Loosen course (1X) synchro 3A1A3B1 clamps.

CAUTION: 115V is present on terminals of the synchros.

42. Monitor voltage across terminals R1 and R2 of course (1X) synchro 3A1A3B1. Rotate synchro until minimum voltage is achieved and record. This voltage should be less than 45 mV.

43. Tighten course (1X) synchro 3A1A3B1 clamps, replace Yaw gear box access plates, and set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

44. At Unit 1, set Local Function switch to OFF.

45. Return Unit 5 and monitor boom to normal operating configuration.

46. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

TEST 13b - AZIMUTH ALIGNMENT (WITH RADOME).

NOTE: Appendix A (Azimuth Drop Pulse Alignment) may be substituted for Step 1 and Steps 7 through 11.

1. Install calibrated AN/ARA-63 receiver and decoder in the Azimuth RF Monitor (Unit 5) and Pulse Decoder KY-651/ARA-63 (Unit 3A4A2).

2. Extend azimuth monitor boom and lock in place.

3. Set up a theodolite on centerline. Ensure the theodolite is level. Then site the ship's angle deck centerline as far forward as possible.

4. Transfer this reference aft of the fantail to site in an azimuth monitor feedhorn.

5. Adjust azimuth monitor boom until feedhorn is directly in line with crosshairs of the theodolite. Lock the azimuth monitor boom in place.

6. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

7. At the Azimuth Transmitter Group (Unit 3), set Azimuth Monitor Power switch to ON.

8. At Unit 1, connect a voltmeter as follows: common to negative terminal of 1A1M1 (Azimuth Monitor Meter); positive to the side of 1A1R24 NOT connected to positive terminal of 1A1M1.

9. At Unit 1, set Local Function switch to ANTENNA DRIVE and Platform Control switch to OPERATE.

10. After approximately two minutes observe the XMTR READY indicator illuminates at Unit 1 and set Local Function switch to RADIATE.

11. Observe meter for a deviation reading of ±10 mV of the calibrated AN/ARA-63 offset bias reading. If aligned correctly, record and proceed to Step 15. If reading is greater than 10 mV, an alignment error exists. Proceed with Step 12.

NOTE: Calibrated AN/ARA-63 offset bias reading is located on Pulse Decoder KY-651/ARA-63.

---

12. Remove platform Yaw gear box access plates and loosen the clamps of the fine (36X) synchro 3A1A3B2.

CAUTION: 115V is present on terminals of the synchros.

NOTE: If platform starts to oscillate rapidly, this indicates the course synchro 3A1A3B1 is not properly aligned with the fine synchro.

13. Observe meter and rotate Yaw fine (36X) synchro 3A1A3B2 until deviation reading is ±10 mV of the calibrated AN/ARA-63 offset bias reading.

14. Tighten fine (36X) synchro 3A1A3B2 clamps.

15. Verify deviation reading is ±10 mV of the calibrated AN/ARA-63 offset bias reading and record.

---

16. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT and the Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^0$.

17. Monitor the voltage across terminals R1 and R2 of course (1X) synchro 3A1A3B1. The voltage should be less than 45 mV. If the voltage is out of tolerance, proceed with Step 18. If the voltage is within tolerance, record and proceed to Step 21.

---

18. Loosen course (1X) synchro 3A1A3B1 clamps.

CAUTION: 115V is present on terminals of the synchros.

19. Monitor voltage across terminals R1 and R2 of course (1X) synchro 3A1A3B1. Rotate synchro until minimum voltage is achieved and record. This voltage should be less than 45 mV.

20. Tighten course (1X) synchro 3A1A3B1 clamps, replace Yaw gear box access plates, and set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

21. At Unit 1, set Local Function Switch to OFF.

22. Return Unit 5 and monitor boom to normal operating configuration.

23. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

TEST 13c - AZIMUTH ALIGNMENT (USING BENCHMARK).

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to CAGED.

3. At the Azimuth Transmitter Group (Unit 3), set circuit breaker 3A4A4CB1 to OFF.

4. Extend Antenna Control drawer (Unit 3A4A1) and remove Line Driver card 3A4A1A1.

5. Insert extender card 9E1 or 9E2 and reinsert card 3A4A1A1 on the extender card.

6. Connect logic probe tip to pin 31 (Azimuth Zero), +5V lead to pin 34, and ground lead to pin 1 of the extender card.

7. Remove antenna hub 3MP28 from shaft by removing six screws which are located on the antenna hub, and four screws which mount waveguide 3W2 to rotary joint 3W1. Remove four screws which mount rotary joint 3W1 to clamp 3MP27.

8. Remove antenna 3E1 from hub 3MP28.

9. Install shaft locking set screw on the antenna shaft and adjust to light hand pressure.

10. At Unit 3, set circuit breaker 3A4A4CB1 to ON, Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT, and Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to 0°.

11. By slight rotation of the antenna shaft the Azimuth Zero pulse should trigger the logic probe. Tighten the shaft locking set screw at the point where the logic probe is triggered.

12. Attach the Boresight Assembly to the shaft using the same mounting hardware that fastened the antenna hub. Ensure boresight is mounted to sight through radome door.

13. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

14. Sight through the boresight and locate the azimuth benchmark on the bulkhead.

15. Verify crosshairs on Boresight Assembly and benchmark are directly in line; record and proceed to Step 20. If they are not directly in line, proceed with Step 16.

---

16. Remove platform Yaw gear box access plates and loosen the clamps of the fine (36X) synchro 3A1A3B2.

CAUTION: 115V is present on terminals of the synchros.

NOTE: If platform starts to oscillate rapidly, this indicates the course synchro 3A1A3B1 is not properly aligned with the fine synchro.

17. Rotate Yaw fine (36X) synchro 3A1A3B2 until crosshairs on Boresight Assembly and benchmark are directly in line and record.

---

18. Tighten Yaw fine (36X) synchro 3A1A3B2 clamps.

19. Verify crosshairs on Boresight Assembly and benchmark are directly in line.

---

20. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT and the Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^{\circ}$.

21. Monitor the voltage across terminals R1 and R2 of course (1X) synchro 3A1A3B1. The voltage should be less than 45 mV. If the voltage is out of tolerance, proceed with Step 22. If the voltage is within tolerance, record and proceed to Step 25.

---

22. Loosen course (1X) synchro 3A1A3B1 clamps.

23. Monitor voltage across terminals R1 and R2 of course (1X) synchro 3A1A3B1. Rotate synchro until minimum voltage is achieved and record. This voltage should be less than 45 mV.

24. Tighten course (1X) synchro 3A1A3B1 clamps, replace Yaw gear box access plates, and set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

25. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

26. Remove Boresight Assembly and shaft locking set screw.

27. Reinstall antenna hub 3MP28, antenna 3E1, and rotary joint 3W1, and reconnect waveguide 3W2.

28. Remove card 3A4A1A1 and extender card, and reinsert card 3A4A1A1 directly into Unit 3A4.

29. At Unit 3, set circuit breaker 3A4A4CB1 to ON.

30. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 14 - AZIMUTH DIAL ALIGNMENT.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to OPERATE.

3. At the Azimuth Transmitter Group (Unit 3), set Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT and Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^0$.

4. Verify Roll platform dial indicator reads $0^0$ $\pm 0.01^0$. If incorrect, proceed with Step 5. If correct, record and proceed to Step 8. _____

5. Remove four screws holding the plexiglass cover and loosen three screws clamping the dial.

6. Adjust dial to read $0^0$ $\pm 0.01^0$ and record. _____

7. Tighten three screws clamping the dial and replace the plexiglass cover and four mounting screws.

8. Verify Yaw platform dial indicator reads $0^0$ $\pm 0.01^0$. If incorrect, proceed with Step 9. If correct, record and proceed to Step 12. _____

9. Remove four screws holding the plexiglass cover and loosen three screws clamping the dial.

10. Adjust dial to read $0^0$ $\pm 0.01^0$ and record. _____

11. Tighten three screws clamping the dial and replace the plexiglass cover and four mounting screws.

12. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

13. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 15 - ELEVATION ROLL AND PITCH STABILIZATION ALIGNMENT.

NOTE: Before proceeding with this test, ensure Test 5b (Elevation ADP Alignment) has been completed satisfactorily.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

NOTE: Ensure SINS is connected to the system and it is in the NAVIGATE mode.

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to OPERATE.

3. At the Elevation Transmitter Group (Unit 2), set circuit breaker 2A4A4CB1 to OFF.

4. Extend Antenna Control drawer (Unit 2A4A1) and remove Line Driver card 2A4A1A1.

5. Insert extender card 9E1 or 9E2 and reinsert card 2A4A1A1 on the extender card.

6. Connect logic probe tip to pin 31 (Elevation Zero), +5V lead to pin 34, and ground lead to pin 1 of the extender card.

7. Remove antenna 2E1 from hub by removing six allen screws securing it to antenna hub 2MP30.

8. Install shaft locking set screw on the antenna shaft and adjust to light hand pressure.

9. At Unit 2, set circuit breaker 2A4A4CB1 to ON, Platform Control switch 2A1A4S3 to TEST DEFLECT, and Roll and Pitch test deflect switches, 2A1A4S1 and 2A1A4S2 to $0^0$.

10. By slight rotation of the antenna shaft the Azimuth Zero pulse should trigger the logic probe. Tighten the shaft locking set screw at the point where the logic probe is triggered.

11. Attach Elevation Bubble Level Assembly to the shaft using the same mounting hardware that fastened the antenna hub.

12. At Unit 2, set Platform Control switch 2A1A4S3 to OPERATE.

13. Observe Bubble Level in the Roll axis and verify it is within 1 arc minute of level. If it is out of tolerance, proceed with Step 14. If it is within tolerance, record and proceed to Step 22.

NOTE: Each Bubble Level division represents 1 arc minute.

14. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

15. Remove platform Roll gear box cover and loosen the clamps of the fine (36X) synchro 2A1A2B2.

16. At Unit 2, set circuit breaker 2A4A4CB1 to ON.

17. Observe Bubble Level in Roll axis, rotate Roll fine (36X) synchro 2A1A2B2 until Bubble Level indicates within 1 arc minute of level.

CAUTION: 115V is present on terminals of the synchros.

NOTE: If platform starts to oscillate, the course synchro is not properly aligned with the fine synchro.

18. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

19. Tighten fine (36X) synchro 2A1A2B2 clamps.

20. At Unit 2, set circuit breaker 2A4A4CB1 to ON.

21. Verify Bubble Level still indicates within 1 arc minute of level and record.

---

22. Observe Bubble Level in the Pitch axis and verify it is within 1 arc minute of level. If it is out of tolerance, proceed with Step 23. If it is within tolerance, record and proceed to Step 31.

NOTE: Each Bubble Level division represents 1 arc minute.

---

23. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

24. Remove platform Pitch gear box access plates and loosen the clamps of the fine (36X) synchro 2A1A3B2.

25. At Unit 2, set circuit breaker 2A4A4CB1 to ON.

26. Observe Bubble Level in Pitch axis, rotate Pitch fine (36X) synchro 2A1A3B2 until Bubble Level indicates within 1 arc minute of level.

CAUTION: 115V is present on terminals of the synchro.

NOTE: If platform starts to oscillate, this indicates the course synchro is not properly aligned with the fine synchro.

27. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

28. Tighten fine (36X) synchro 2A1A3B2 clamps.

29. At Unit 2, set circuit breaker 2A4ACB1 to ON.

30. Verify Bubble Level indicates within 1 arc minute of level and record.

---

31. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

32. Remove Bubble Level Assembly and shaft locking set screw.

33. Reinstall antenna 2E1.

34. Remove card 2A4A1A1 and extender card and reinsert card 2A4A1A1 directly into Unit 2A4.

35. At Unit 2, set circuit breaker 2A4A4CB1 to ON, Platform Control switch 2A1A4S3 to TEST DEFLECT, and the Roll and Pitch test deflect switches, 2A1A4S1 and 2A1A4S2, to $0^{o}$.

36. Monitor the voltage across terminals R1 and R2 of Roll course (2X) synchro 2A1A2B1. The voltage should be less than 45 mV. If the voltage is out of tolerance, proceed with Step 37. If the voltage is within tolerance, record and proceed to Step 41.

---

CAUTION: 115V is present on terminals of the synchro.

37. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

38. Loosen Roll course (2X) synchro 2A1A2B1 clamps.

39. At Unit 2, set circuit breaker 2A4A4CB1 to ON.

40. Monitor voltage across terminals R1 and R2 of Roll course (2X) synchro 2A1A2B1. Rotate synchro until minimum voltage is achieved and record. This voltage should be less than 45 mV.

---

41. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

42. Tighten Roll course (2X) synchro 2A1A2B1 clamps and replace Roll gear box cover.

43. At Unit 2, set circuit breaker 2A4A4CB1 to ON.

44. Monitor the voltage across terminals R1 and R2 of Pitch course (2X) synchro 2A1A3B1. The voltage should be less than 45 mV. If the voltage is out of tolerance, proceed with Step 45. If the voltage is within tolerance, record and proceed to Step 49.

---

CAUTION: *115V is present on terminals of the synchros.*

45. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

46. Loosen Pitch course (2X) synchro 2A1A3B1 clamps.

47. At Unit 2, set circuit breaker 2A4A4CB1 to ON.

48. Monitor voltage across terminals R1 and R2 of Pitch course (2X) synchro 2A1A3B1. Rotate synchro until minimum voltage is achieved and record. This voltage should be less than 45 mV.

---

49. At Unit 2, set circuit breaker 2A4A4CB1 to OFF.

50. Tighten Pitch course (2X) synchro 2A1A3B1 clamps and replace Pitch gear box access plates.

51. At Unit 2, set circuit breaker 2A4A4CB1 to ON and Platform Control switch 2A1A4S3 to OPERATE.

52. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 16 - ELEVATION DIAL ALIGNMENT.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to OPERATE.

3. At the Elevation Transmitter Group (Unit 2), set Platform Control switch 2A1A4S3 to TEST DEFLECT and Roll and Pitch test deflect switches, 2A1A4S1 and 2A1A4S2, to $0^0$.

4. Verify Roll platform dial indicator reads $0^0 \pm 0.01^0$. If incorrect, proceed with Step 5. If correct, record and proceed to Step 8.

_____

5. Remove four screws holding the plexiglass cover and loosen three screws clamping the dial.

6. Adjust dial to read $0^0 \pm 0.01^0$ and record.

_____

7. Tighten three screws clamping the dial and replace the plexiglass cover and four mounting screws.

8. Verify Pitch platform dial indicator reads $0^0 \pm 0.01^0$. If incorrect, proceed with Step 9. If correct, record and proceed to Step 12.

_____

9. Remove four screws holding the plexiglass cover and loosen three screws clamping the dial.

10. Adjust dial to read $0^0 \pm 0.01^0$ and record.

_____

11. Tighten three screws clamping the dial and replace the plexiglass cover and four mounting screws.

12. At Unit 2, set Platform Control switch 2A1A4S3 to OPERATE.

13. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 17 - AZIMUTH BENCHMARK ALIGNMENT.

NOTE: Before proceeding with this test, ensure all preceding alignments have been completed satisfactorily.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches on Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to LOGIC TEST and Platform Control switch to CAGED.

3. At the Azimuth Transmitter Group (Unit 3), set circuit breaker 3A4A4CB1 to OFF.

4. Extend Antenna Control drawer (Unit 3A4A1) and remove Line Driver card 3A4A1A1.

5. Insert extender card 9E1 or 9E2 and reinsert card 3A4A1A1 on the extender card.

6. Connect logic probe tip to pin 31 (Azimuth Zero), +5V lead to pin 34, and ground lead to pin 1 of the extender card.

7. Remove antenna hub 3MP28 from shaft by removing six screws which are located on the antenna hub; also remove four screws which mount waveguide 3W2 to rotary joint 3W1. Remove four screws which mount rotary joint 3W1 to clamp 3MP27.

8. Remove antenna 3E1 from hub 3MP28.

9. Install shaft locking set screw on the antenna shaft and adjust to light hand pressure.

10. At Unit 3, set circuit breaker 3A4A4CB1 to ON, Operate/Test Deflect switch 3A1A4S3 to TEST DEFLECT, and Roll and Yaw test deflect switches, 3A1A4S1 and 3A1A4S2, to $0^{0}$.

11. By slight rotation of the antenna shaft, the Azimuth Zero pulse should trigger the logic probe. Tighten the shaft locking set screw at the point where the logic probe is triggered.

12. Attach the Boresight Assembly to the shaft using the same mounting hardware that fastened the antenna hub. Ensure boresight is mounted to sight through radome door.

13. At Unit 3, set Operate/Test Deflect switch 3A1A4S3 to OPERATE.

14. Sight through the boresight and locate a point on the bulkhead directly in line with the boresight crosshairs.

15. Center benchmark plate at point located through boresight and attach to bulkhead.

16. Verify crosshairs on Boresight Assembly and benchmark are diretly in line and record.

---

17. At Unit 3, set circuit breaker 3A4A4CB1 to OFF.

18. Remove Boresight Assembly and shaft locking set screw.

19. Reinstall antenna hub 3MP28, antenna 3E1, and rotary joint 3W1; reconnect waveguide 3W2.

20. Remove card 3A4A1A1 and extender card and reinsert card 3A4A1A1 directly into Unit 3A4.

21. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 18 - RF MONITOR ALIGNMENT.

NOTE: Before proceeding with this test, ensure all preceding alignments have been conducted satisfactorily.

1. Conduct Appendix A (Azimuth Drop Pulse Alignment).

2. If an alignment error exists, adjust the azimuth monitor boom for a single blanking pulse in the center of the main lobe. Record alignment results.

_____

3. Conduct Appendix B (Elevation Drop Pulse Alignment).

4. If an alignment error exists, adjust the elevation monitor boom for a single blanking pulse in the center of the main lobe. Record alignment results.

_____

5. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

6. At Unit 1, set Local Function switch to OFF, Platform Control switch to CAGED, and Glideslope Select switch to $3.00^0$ (or to the setting normally used for the Elevation monitor).

7. Extend both Elevation and Azimuth RF monitors.

8. At the Elevation Transmitter Group (Unit 2) and the Azimuth Transmitter Group (Unit 3), set AN/ARA-63 receiver control switches as follows: Power to ON and Channel to SHIP'S OPERATING CHANNEL.

9. At Unit 1, set Local Function switch to RADIATE and allow two minutes warm-up time.

NOTE: On starboard side Elevation installations, set Platform Control switch 2A1A4S3 to TEST DEFLECT and Pitch switch 2A1A4S2 to $-5^0$; then set Platform Control switch 2A1A4S3 to OPERATE.

10. At Unit 1, observe Azimuth and Elevation monitor meter readings and check that they indicate correct angular displacement. Record alignment results.

AZIMUTH _____

ELEVATION _____

11. If Drop Pulse alignment has been done satisfactorily on both the Azimuth and Elevation sites, then zero Azimuth and Elevation monitor meters by adjusting meter movement adjust screw. Record results.

AZIMUTH _____

ELEVATION _____

12. At Units 2 and 3, set AN/ARA-63 receiver Power switch to OFF.

NOTE: On starboard side Elevation installations, set Platform Control switch 2A1A4S3 to TEST DEFLECT and Pitch switch 2A1A4S2 to 0°; then set Platform Control switch 2A1A4S3 to OPERATE.

13. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## TEST 19 - AN/SPN-41 SURVEY.

1. The following survey information will be recorded by the surveying activity. This survey should be conducted whenever the antenna pedestals are replaced.

2. The Pitch and Roll axis alignment will be conducted using the primary alignment point of the ship to ensure proper leveling of the base plates. The Yaw axis alignment of the azimuth and elevation base plates will be conducted in such a manner as to ensure that the base plates will be aligned to the centerline in the keel axis. The base plate alignment tolerance is ±1.5 minutes in the pitch, roll, and yaw axes.

3. The offsets will be measured to the radiation origin which is the intersecting point of the center of antenna rotation and the antenna feedhorn. All offsets will be measured to within 0.01 feet.

### AN/SPN-41 BASE PLATE ALIGNMENT ERROR

| PITCH AXIS | ROLL AXIS | YAW AXIS |
|---|---|---|
| Azimuth _____ | Azimuth _____ | Azimuth _____ |
| Elevation _____ | Elevation _____ | Elevation _____ |

### AN/SPN-41 OFFSET

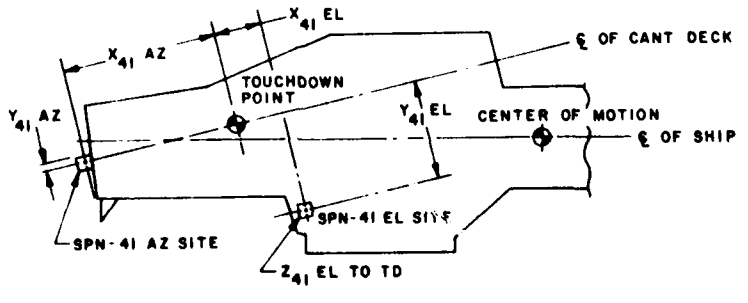
$X_{41}AZ$ = _____

$X_{41}EL$ = _____

$Y_{41}AZ$ = _____

$Y_{41}EL$ = _____

$Z_{41}EL$ = _____



## APPENDIX A

## AZIMUTH DROP PULSE ALIGNMENT

NOTE: Before proceeding with this test, ensure Tests 5a (Azimuth ADP Alignment) and 6a (Azimuth Antenna Scan Frequency Adjust) have been completed satisfactorily.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to OFF and Platform Control switch to CAGED.

NOTE: When conducting this test in conjunction with Test 13a [Azimuth Alignment (without Radome)] or Test 13b [Azimuth Alignment (with Radome)], set Platform Control switch to OPERATE.

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover.

4. Remove Azimuth Data Alarm card 1A2A4.

5. Insert test card and reinsert card 1A2A4 on test card.

6. Remove ADP Simulator card 1A2A7.

7. Insert extender card 9E1 or 9E2 and reinsert card 1A2A7 on the extender card.

8. Insert a jumper from pin 39, P2 pulse, on 1A2A7 extender card to pin 39 on 1A2A4 test card.

9. Set switch S2 on test card to AN/SPN-41 Drop Pulse.

10. At Azimuth RF Monitor (Unit 5), open cover and disconnect waveguide from AN/ARA-63 receiver.

11. Connect a crystal detector type PRD 6604-54 or equivalent to waveguide.

12. Connect one of the BNC cables on Unit 5 to the crystal detector.

13. Connect the other end of the BNC cable located at the pedestal to an oscilloscope.

14. Extend Unit 5.

15. At Transmitting Set Test Set Group (Unit 9), set all Test Angle switches on Test Set Group Control (Unit 9A4) to the UP or 1 position.

NOTE: This will blank out the transmitter at $0^0$.

16. At Unit 1, set Local Function switch to RADIATE and allow system to radiate for five minutes.

17. Observe oscilloscope for an RF transmission pattern.

18. A single blanking pulse should appear at the center of the main lobe.

NOTE: If two blanking pulses appear on each side of the main lobe, then an alignment error exists.

19. At Unit 1, set Local Function switch to OFF.

20. Remove test card and reinsert card 1A2A4 directly into Unit 1A2.

21. Remove extender card and reinsert card 1A2A7 directly into Unit 1A2.

22. Return Unit 5 to normal operating configuration.

23. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## APPENDIX B

## ELEVATION DROP PULSE ALIGNMENT

NOTE: Before proceeding with this test, ensure Tests 9b (Elevation Stable Platform Test Deflection) and 10 (Elevation Transmitter Frequency Alignment) have been completed satisfactorily.

1. Ensure control at Transmitting Set Control Group (Unit 1) by setting switches at Transmitter Control (Unit 4) as follows: Control Mode to SERVICE, Function to RADIATE, Glideslope Select to SERVICE, and Platform Control to CAGED (Azimuth and Elevation).

2. At Unit 1, set Local Function switch to OFF, Platform Control switch to CAGED, and Glideslope Select switch to 3.00° (or to the setting normally used for the Elevation monitor).

3. Extend Coder Monitor drawer (Unit 1A2) and remove cover.

4. Remove Elevation Data Alarm card 1A2A16.

5. Insert test card and reinsert card 1A2A16 on test card.

6. Remove Test Angle Selector card 1A2A31.

7. Insert extender card 9E1 or 9E2 and reinsert card 1A2A31 on the extender card.

8. Insert a jumper from pin 39, P3 pulse, on 1A2A31 extender card to pin 42 on 1A2A16 test card.

9. Set switch S2 on test card to AN/SPN-41 Drop Pulse.

10. At Elevation RF Monitor (Unit 6), open cover and disconnect waveguide from AN/ARA-63 receiver.

11. Connect a crystal detector type PRD 6604-54 or equivalent to waveguide.

12. Connect one of the BNC cables on Unit 6 to the crystal detector.

13. Connect the other end of the BNC cable located at the pedestal to an oscilloscope.

14. Extend Unit 6.

15. At Transmitting Set Test Set Group (Unit 9), set Test Angle switches on Test Set Group Control (Unit 9A4) to equal 3° or to the setting normally used for the Elevation monitor.

16. At Unit 1, set Local Function switch to RADIATE and allow system to radiate for two minutes.

> NOTE: On starboard side Elevation installations, set Platform Control switch 2A1A4S3 to TEST DEFLECT and Pitch switch 2A1A4S2 to $-5^0$; then set Platform Control switch 2A1A4S3 to OPERATE.

17. Observe oscilloscope for an RF transmission pattern.

18. A single blanking pulse should appear at the center of the main lobe.

> NOTE:
>
> (1) If two blanking pulses appear on each side of the main lobe, then an alignment error exists.
>
> (2) On starboard side Elevation installations set Platform Control switch 2A1A4S3 to TEST DEFLECT and Pitch switch 2A1A4S2 to $0^0$; then set Platform Control switch 2A1A4S3 to OPERATE.

19. At Unit 1, set Local Function switch to OFF.

20. Remove test card and reinsert card 1A2A16 directly into Unit 1A2.

21. Remove extender card and reinsert card 1A2A31 directly into Unit 1A2.

22. Return Unit 6 to normal operating configuration.

23. At the control panels of Units 1 and 4, set Control Mode, Function, Glideslope Select, and Platform Control switches as desired by operating personnel.

## APPENDIX C

### MINUTES AND SECONDS TO DECIMAL PARTS OF A DEGREE

| MINUTES | DEGREE | SECONDS | DEGREE |
|---|---|---|---|
| 0 | 0.00000 | 0 | 0.00000 |
| 1 | 0.01667 | 1 | 0.00028 |
| 2 | 0.03330 | 2 | 0.00056 |
| 3 | 0.05000 | 3 | 0.00083 |
| 4 | 0.06667 | 4 | 0.00111 |
| 5 | 0.08333 | 5 | 0.00139 |
| 6 | 0.10000 | 6 | 0.00167 |
| 7 | 0.11667 | 7 | 0.00194 |
| 8 | 0.13333 | 8 | 0.00222 |
| 9 | 0.15000 | 9 | 0.00250 |
| 10 | 0.16667 | 10 | 0.00278 |
| 11 | 0.18333 | 11 | 0.00306 |
| 12 | 0.20000 | 12 | 0.00333 |
| 13 | 0.21667 | 13 | 0.00361 |
| 14 | 0.23333 | 14 | 0.00389 |
| 15 | 0.25000 | 15 | 0.00417 |
| 16 | 0.26667 | 16 | 0.00444 |
| 17 | 0.28333 | 17 | 0.00472 |
| 18 | 0.30000 | 18 | 0.00500 |
| 19 | 0.31667 | 19 | 0.00528 |
| 20 | 0.33333 | 20 | 0.00556 |
| 21 | 0.35000 | 21 | 0.00583 |

APPENDIX C (Cont'd)

| MINUTES | DEGREE | SECONDS | DEGREE |
|---|---|---|---|
| 22 | 0.36667 | 22 | 0.00611 |
| 23 | 0.38333 | 23 | 0.00639 |
| 24 | 0.40000 | 24 | 0.00667 |
| 25 | 0.41667 | 25 | 0.00694 |
| 26 | 0.43333 | 26 | 0.00722 |
| 27 | 0.45000 | 27 | 0.00750 |
| 28 | 0.46667 | 28 | 0.00778 |
| 29 | 0.48333 | 29 | 0.00806 |
| 30 | 0.50000 | 30 | 0.00833 |
| 31 | 0.51667 | 31 | 0.00861 |
| 32 | 0.53333 | 32 | 0.00889 |
| 33 | 0.55000 | 33 | 0.00917 |
| 34 | 0.56667 | 34 | 0.00944 |
| 35 | 0.58333 | 35 | 0.00972 |
| 36 | 0.60000 | 36 | 0.01000 |
| 37 | 0.61667 | 37 | 0.01028 |
| 38 | 0.63333 | 38 | 0.01056 |
| 39 | 0.65000 | 39 | 0.01083 |
| 40 | 0.66667 | 40 | 0.01111 |
| 41 | 0.68333 | 41 | 0.01139 |
| 42 | 0.70000 | 42 | 0.01167 |
| 43 | 0.71667 | 43 | 0.01194 |
| 44 | 0.73333 | 44 | 0.01222 |
| 45 | 0.75000 | 45 | 0.01250 |

APPENDIX C (Cont'd)

| MINUTES | DEGREE | SECONDS | DEGREE |
|---|---|---|---|
| 46 | 0.76667 | 46 | 0.01278 |
| 47 | 0.78333 | 47 | 0.01306 |
| 48 | 0.80000 | 48 | 0.01333 |
| 49 | 0.81667 | 49 | 0.01361 |
| 50 | 0.83333 | 50 | 0.01389 |
| 51 | 0.85000 | 51 | 0.01417 |
| 52 | 0.86667 | 52 | 0.01444 |
| 53 | 0.88333 | 53 | 0.01472 |
| 54 | 0.90000 | 54 | 0.01500 |
| 55 | 0.91667 | 55 | 0.01528 |
| 56 | 0.93333 | 56 | 0.01556 |
| 57 | 0.95000 | 57 | 0.01583 |
| 58 | 0.96667 | 58 | 0.01611 |
| 59 | 0.98333 | 59 | 0.01639 |
| 60 | 1.00000 | 60 | 0.01667 |