NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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National Policy

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SUBJ: Wide Area Multilateration (WAM)

1. Purpose of This Notice. This Notice details the flight inspection procedures, requirements, and analysis for the evaluation of Wide Area Multilateration (WAM) systems. It is interim guidance for FAA Order 8200.1, United States Standard Flight Inspection Manual (USSFIM).

2. Audience. The audience for this notice is the Air Traffic Technical Operations Eastern, Central, and Western Service Areas; Aviation System Standards Flight Inspection Operations Group offices and crewmembers, Air Force Flight Standards Agency (AFFSA), and the 1st Air Force Reserves Unit; Flight Standards Flight Technologies and Procedures Division; and users of FAA Order 8200.1.

3. Where Can I Find This Notice? Go to the Directives Management System (DMS) website: https://employees.faa.gov/tools_resources/orders_notices/ or the Aviations System Standards website: http://www.avn.faa.gov/index.asp?xml=fioo/notices

4. Background. Wide Area Multilateration (WAM) is a surveillance system that uses multiple sensors to detect, identify, display, and track targets. WAM uses a constellation of ground stations, or Remote Units (RU), to provide surveillance coverage within a defined region. WAM makes use of signals transmitted from Air Traffic Control Beacon System (ATCRBS) aircraft transponders, including Mode A, Mode C, and Mode S, to calculate an aircraft's position. The WAM system also processes signals from ADS-B Mode S to calculate an aircraft's position. The WAM system also processes signals from ADS-B Mode-S extended squitter transponders. When an ADS-B message is received at three or more remote units, a Multilateration report can be generated. WAM can be configured as a Virtual radar, feeding data to an automation system (e.g., micro en route automated radar tracking system (MEARTS)) for display to air traffic controllers.

5. Guidance. The guidance in this notice will be incorporated into the next change to FAA Order 8200.1C, United States Standard Flight Inspection Manual. It applies to Chapters 4 and 14. Chapter 4, Paragraph 4.25, Table 4-1 of FAA Order 8200.1 will include "or WAM system" after "ASR" in the "Facility" column. Chapter 14 will include the following information.

a. Wide Area Multilateration Flight Inspection Procedures

(1) General. Like surveillance radar inspections, Wide Area Multilateraion inspections may vary from a single (special inspection requirement, such as coverage, over a new air traffic "fix") to a complete system commissioning inspection. In very general terms, planning activity and engineering support involvement is similar to a traditional radar inspection.

(2) Commissioning Inspections. The objective of the commissioning inspection is to evaluate system performance, determine and document the site coverage, and provide a baseline for the detection of deterioration in equipment performance. Data obtained during this inspection will be used for daily comparison of facility performance, as well as future inspections. The commissioning is the most thorough inspection and requires a correspondingly detailed plan and report.

(3) Periodic Inspections. WAM systems require a periodic flight inspection with a periodic interval of 540 days.

(4) Special Inspections. Special inspections are conducted to fulfill a particular need and may be very limited in scope. The limited inspection may not require a formal written plan and only a short inspection report. If equipment changes or modifications to commissioned facilities change the coverage pattern, document the changes in the inspection report. The new coverage pattern then becomes the basis for comparison during subsequent inspections. Coordination with appropriate military personnel is vital at joint-use sites. Special inspections include the following:

(a) Engineering Support. Engineering support is performed to help engineering and Air Traffic personnel determine if the system meets equipment certification and operational requirements. This data may be used for commissioning purposes, provided no equipment modifications are made prior to the commissioning inspection.

(b) Major Modifications. This inspection plan, inspection, and report should be confined to the parameters necessary to confirm facility performance. The system engineer must determine the extent of a special inspection during preparation and coordination of the plan. Depending upon the extent of the modification, an inspection using software tools and targets-of-opportunity may satisfy the inspection requirements.

(c) Near Midair-Collision Inspections. These inspections are conducted at the request of the AT manager of the facility involved. The inspection determines the coverage in the area where the incident occurred. The flight inspection must be conducted as soon as possible following the near-midair-collision, duplicating the maneuvers, altitude, and direction of flight of the incident aircraft. The WAM system must be operated in the same configuration, to the extent practicable, as it was at the time of the incident. Near-midair flight inspection reports must be submitted in the same manner as after-accident reports (see Order 8240.36, Flight Inspection Report Processing System (FIRPS)).

b. Wide Area Multilateration Checklist. The checks requiring a flight inspection aircraft are identified in the checklist and appropriate "detailed procedure" paragraphs. The procedures presented here may be used singly when a special inspection may be satisfied with one or more of the individual tests. The checklist items identified by an "X" are mandatory. Facilities Maintenance personnel must evaluate the data obtained using targets-of-opportunity to determine if further evaluation by a flight inspection aircraft is required. The flight inspector must consult with the system engineer prior to departing the area to ensure that checklist requirements have been completed. The following checklist items must be completed as indicated.

				FI Transponder Settings		
	Para Ref	**C**	**P**	**Lo-Pwr Select**	**Flt Insp Select**	**Transponder Type (6)**
Vertical Transition Handoff	5c(2)	X		As Requested		Either
Modes/Codes	5c(8)	X		Not Applicable		Either
General Coverage	5c(3)	X		(3)	(3)	(3)
Perimeter Coverage	5c(4)	X (1)		(4)	(4)	(4)
Airways/ Route Coverage	5c(5)	X (1)		(3)	(3)	(3)
Fix /Map Accuracy	5c(6)	X		OFF	ON	Either
Communications	5c(9)	X	X	Not Applicable		Either
Standby Equip	5c(10)	X		As Requested		Either
Standby Power	5c(11)	X		Not Applicable		Either
MSAW (2)	5c(12)	X	X (1)	OFF	OFF	Either
Degraded System Configuration (5)	5c(13)	X (1)		(4)	(4)	(4)

FOOTNOTES: C = Commissioning P = Periodic

X Denotes mandatory check; see text for approved procedure. All other checks are at engineering/ maintenance/ controller request.

(1) Requires flight inspection aircraft for final evaluation.

(2) Check existing GTM and APM features during commissioning. If either of these is not available during commissioning, they do not require a flight inspection prior to use. Only the GTM must be checked during a periodic inspection. APM checks are accomplished by request (e.g., a maintenance or ATC request).

(3) Check with either type of transponder when using targets of opportunity; flight inspection aircraft should use an ATCRBS-only transponder set at low sensitivity and low power unless otherwise directed by engineering.

(4) Flight inspection aircraft should use an ATCRBS-only transponder set at low sensitivity and low power unless otherwise directed by engineering.

(5) WAM System configured per engineering instructions.

(6) Two basic types of aircraft transponders are referred to: Mode-S and ATCRBS-only. Some checks require a flight inspection aircraft equipped with an ATCRBS-only (without Mode-S) transponder with the capability to reduce receiver sensitivity to approximately -66 dB. Checks marked with "Either" can use either a Mode-S flight transponder or an ATCRBS-only transponder.

c. Wide Area Multilateration Detailed Procedures

(1) General. Facilities Maintenance personnel must use operational displays for target grading and guidance information. Data from the operational displays and automation diagnostic and analysis programs will determine if the system supports operational requirements. When using targets-of-opportunity, multiple target returns are required to ensure accuracy. Verify questionable accuracy with a flight inspection aircraft. The system should be configured for use in the day-to-day standard operating configuration (Normal), except during the Degraded Configuration System checks. During these checks, Facilities Maintenance personnel will configure the WAM system in its lowest usable configuration(s). WAM processes Mode-S and ATCRBS aircraft transponders differently; therefore, some checks are designed to evaluate performance using a specific type of transponder.

(2) Vertical Transition Handoff

(a) Purpose. To verify when aircraft transition vertically from the volume of airspace covered by the WAM system to the overlying airspace covered by a conventional radar (ATCRBS), or vice versa, that the transition is seamless with no loss of coverage.

(b) Vertical Transition Area. Choose a ground track between one or more waypoints that transitions through areas of the WAM coverage area where the vertical handoff is to be evaluated.

(c) Approved Procedures. Targets-of-opportunity may be used to check the vertical handoff between WAM and other radars. Verify questionable results with flight inspection aircraft. The flight inspection aircraft should fly the provided ground track and climb and descend through the transition boundary altitude (by at least 1,000 feet) several times.

(d) Evaluation. There should be no loss of coverage when transitioning through the transition boundary altitude.

(3) General Coverage

(a) Purpose. To verify designed coverage

(b) Approved Procedures. Targets-of-opportunity will be the primary method of determining system coverage. Use flight inspection aircraft when there is a lack of data or suspected problem areas. Fly the altitudes and distances requested by engineering personnel.

(c) Evaluation. Facilities Maintenance personnel must determine if the coverage supports operational requirements.

(4) Perimeter Coverage

(a) Purpose. To verify coverage and performance at maximum altitudes and distances

(b) Approved Procedures. During this check the flight inspection aircraft should utilize the ATCRBS-only transponder operating in the low sensitivity and low power modes (approximately -66 dB and 90 watts). This lower than normal sensitivity approximates the operational limit for a reduction in transmission power from the WAM system ground stations. Engineering may ask to repeat some of this check using the Mode-S transponder (FI Insp Select ON; Lo-Pwr Select ON at or below 15,000'MSL). Fly the perimeter of the constellation adjusting altitude to follow the highest adapted altitude. Fly 100' below the adapted altitude to prevent unnecessary coverage dropouts due to momentarily exceeding the top altitude. If the terrain elevation becomes a factor while flying the perimeter, adjust the ground track towards the inside of the coverage area while maintaining the desired MSL altitude. Repeat for each constellation if there is more than one. Record time-stamped positioning data for post-flight analysis by engineering personnel.

(c) Evaluation. Facilities Maintenance personnel must determine if the coverage supports operational requirements.

(5) Airway/ Route Coverage

(a) Purpose: To document coverage along routes and airways, required by Air Traffic. Facilities Maintenance personnel must determine the extent of these evaluations which determine the overall WAM facility coverage. Areas of poor target returns or other potential problems identified in the inspection plan may be further evaluated to determine actual facility coverage. This check must be accomplished using targets-of-opportunity with the final commissioning check accomplished with a flight inspection aircraft.

(b) Approved Procedures

1 Inspecting Routes and Airways. During this check the flight inspection aircraft should utilize the ATCRBS-only transponder operating in the low sensitivity and low power modes (approximately -66 dB and 90 watts). This lower than normal sensitivity approximates the tolerance limit for a reduction in transmission power from the WAM system ground stations. Engineering may ask to repeat some of this check using the Mode-S transponder (FI Insp Select ON; Lo-Pwr Select ON at or below 15,000'MSL). The altitudes at which satisfactory coverage exists will be determined by flying the minimum altitude (not lower than minimum obstruction clearance altitude (MOCA)) on airway centerline. The terminal arrival and departure routes and other areas of interest identified in the inspection plan will be flown at MOCA. Maintain course guidance by reference to Automated Flight Inspection System (AFIS), ground checkpoints, NAVAID signals, or radar vectors. Be prepared to provide time-stamped positioning data for post-flight analysis if requested.

2 **Targets-of-Opportunity.** Targets may consist of one or an assortment of aircraft returns on a particular airway, route or terminal radial. Targets must show altitude. Scoring may be accomplished by either software tools or manually. Software analysis tools may be used to evaluate the track information of a selected (beacon code) target.

(c) Evaluation. Facilities Maintenance personnel must determine if the facility coverage meets operational requirements.

(6) Fix/ Map Accuracy

(a) Purpose. To verify all airways, routes, fixes, and runway centerlines on the video map display. Replacement map overlays, video maps, or digitally-generated maps do not require a flight inspection if Facilities Maintenance personnel can determine, using targets-of-opportunity, that the new map is accurate.

(b) Approved Procedure. If requested, fly the minimum altitude where satisfactory coverage exists along the airway, route, or fix. The procedure is the same whether using a flight inspection aircraft or targets-of-opportunity; Facilities Maintenance personnel compare reported aircraft position relative to the airway, route, or fix with the video map presentation. Similarly, verify runway centerline to video map alignment by observing landing and departing aircraft.

(c) Evaluation. Compute the distance between the airway, route or fix, and the aircraft position, and apply the appropriate tolerance.

(d) Radar Overlays. Flight inspection of radar map overlays used as a backup for a video map need not be accomplished, provided the overlay contains data which is identical to a video map display which has been satisfactorily inspected. Any data on an overlay that differs from the video map display must be inspected before use. This applies to new or replacement map overlays.

(7) Surveillance Approaches. WAM does not provide approach service at this time.

(8) Modes and Codes

(a) Purpose: To verify the proper decoding of ATCRBS reply pulses and altitude readout. Codes 7500, 7600, and 7700 should not be used due to the possibility of alarming other facilities.

(b) Approved Procedure. Facilities Maintenance personnel must monitor the flight inspection aircraft transponder replies or targets-of-opportunity throughout the vertical coverage, airway, route, and terminal checks to verify correct altitude readout. During these tests, Facilities Maintenance personnel should request the flight inspection aircraft use different modes or codes to sample various modes and code trains. When targets-of-opportunity are used, ensure that the sample contains all modes interrogated and a sufficiently large sample of codes to ensure correct decoding of beacon replies.

(c) Evaluation. Facilities Maintenance personnel must ensure the displayed transponder reading agrees with the aircraft transponder setting and altitude.

(9) Communications. The purpose of this check is to evaluate very high frequency (VHF)/ ultra high frequency (UHF) communications capability within the coverage area. When flight inspection aircraft are not equipped for UHF communications, the inspection can be completed using VHF only. UHF coverage may be confirmed by the appropriate air traffic facility via targets of opportunity. The flight inspector must check communications in accordance with Chapter 8 of FAA Order 8200.1, concurrent with the WAM inspection.

(10) Standby Equipment. The purpose of this check is to evaluate the performance of standby equipment and may be accomplished during pre-inspection testing using targets-of-opportunity. A WAM system normally has two Target Processors (TP1 and TP2). Attempt to document the performance of both during the commissioning flight inspection.

(11) Standby Power. The purpose of this check is to evaluate system performance on standby (engine generator) power and must be conducted during pre-inspection testing.

(12) Minimum Safe Altitude Warning (MSAW). Follow guidance in Chapter 14 of Order 8200.1.

(13) Degraded System Configuration

(a) Purpose: To verify that the system performs in an acceptable manner, with adequate coverage and position accuracy, in the allowable degraded states.

(b) Approved Procedure.

1 During each of these checks, the flight inspection aircraft will record time-stamped positioning data for post-flight analysis by engineering personnel. Unless otherwise requested by engineering, the flight inspection aircraft should utilize the ATCRBS-only flight inspection transponder, (i.e., without Mode S), operating in the low sensitivity and low power mode (approximately -66 dB and 90 watts).

2 N-1 State Check. A WAM system is normally designed to operate in a “N-1” state, with one of the Receive Only (RO) or Receive/Transmit (RT) Remote Units (RU(s)) out of service.

> **NOTE:** Some WAM systems may not be designed to operate in an N-1 configuration, and some may be designed to operate in an even more (e.g., N-2) degraded configuration. Adapt this check accordingly to the given situation.

Prior to the flight inspection, engineering personnel will determine, using software analysis tools, which RU(s), when disabled, result in possible marginal coverage, and/or marginal performance (positional accuracy). In addition, a specific routing (ground track and altitudes) will be identified in the inspection plan to be flown with each marginal "N-1" state. Also fly an instrument procedure final segment and missed approach segment (if available) to any runways within the area identified as an area of possible marginal coverage/ performance. This does not require flying every published approach and missed approach procedure to every runway within the possible marginal area. Choosing a representative approach and missed approach will suffice. If warranted and circling is authorized for any instrument approach procedure at the airport, consideration should be given to circling around the airport in question at the minimum circling altitude. If more than one inoperative RU ("N-1") state is identified, configure the system in each "N-1" state in turn, and fly the associated routing/ approaches with each.

3 Horizontal Transitions. Conduct this check at the request of Engineering Services only. Configure the WAM system per engineering direction. Fly any airway or air traffic control (ATC) routing from outside the WAM system coverage area, through the WAM area, and back out of coverage, all at 100 feet below the maximum altitude(s). Maximum altitude in this case is defined as the highest altitude within a given sort box at which WAM coverage will be utilized by Air Traffic. Flying 100 feet below the designed altitude should prevent unnecessary coverage drop-outs due to momentarily exceeding the software controlled cut-off altitude. Note that this check will require configuring the automation display to include neighboring radars, as well as the WAM coverage area.

(c) Evaluation. In addition to real-time assessment of system performance and coverage, conduct a post-flight analysis of the flight inspection positioning data to determine system accuracy. Facilities Maintenance personnel must determine if the facility performance meets operational requirements.

d. Tolerances

Parameter	Reference Paragraph	Tolerance/ Limit
Coverage		
Vertical Transition Handoff	5c(2)	No loss of coverage during transition
General Coverage	5c(3)	Meets operational requirements
Perimeter Coverage	5c(4)	Meets operational requirements
Approaches, airways, arrival and departure routes, and fixes route/ procedure	5c(5)	A usable target must be maintained.
Fix/ map Accuracy	5c(6)	500' for WAM systems, regardless of aircraft position
Altitude Readout	5c(8)	± 125' of altitude displayed in the cockpit relative to 29.92 in Hg.
Standby Equipment	5c(10)	Meets same tolerances as main equipment

For additional information, please contact Don McGough, Flight Inspection Policy, 405-954-3050.

/s/

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