CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

National Policy

ORDER
8200.48
CHG 1

Effective Date:
04/02/2025

SUBJ: Flight Inspection Equipment Standards

1. Purpose. This change transmits revisions to FAA Order 8200.48, Flight Inspection Equipment Standards, dated September 18, 2024.

2. Who this change affects. Air Traffic Organization Technical Operations Eastern, Central, and Western Service Areas; Flight Operations Teams and crewmembers in the Aircraft Operations Directorate (AJF-1000); Flight Standards, Flight Technologies and Procedures Division; NAS Implementation Centers, and special military addressees.

3. Disposition of Transmittal Paragraph. Retain this transmittal sheet until this Directive is canceled by a new Directive.

4. Explanation of Policy Changes. The changes to this order clarify that the appendices represent guidance from the International Civil Aviation Organization (ICAO) and add procedural notes to a few tables within Appendix A, Very High Frequency Omnirange (VOR) Flight Inspection Standards; Appendix B, Distance Measuring Equipment (DME) Flight Inspection Standards; Appendix C, Instrument Landing System (ILS) Flight Inspection Standards; and Appendix O, RFI Detection and Location Standards.

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Randa Hayes

Randa A. Hayes
Vice President, Flight Program Operations
Flight Program Executive

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Initiated By: AJF-0

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National Policy

ORDER 8200.48

Effective Date: 09/18/2024

SUBJ: Flight Inspection Equipment Standards

1. Purpose of This Order. This order establishes the standards for equipment used by Flight Program Operations to conduct flight inspection of air navigation services. It applies to all types of flight inspection as defined in FAA Order 8200.1, United States Standard Flight Inspection Manual (latest edition). This order demonstrates how Flight Program Operations meets the equipment and measurement standards of International Civil Aviation Organization (ICAO) Annex 10 – Aeronautical Telecommunications Volume I – Radio Navigation Aids, 2.2, which provides the international standard on the ground and flight testing of radio navigation aids.

2. Audience. The primary audience for this order is Flight Program Operations personnel involved in the flight inspection of air navigation services. Flight Program Operations is a service unit within the Air Traffic Organization (ATO) responsible for flight inspection. Flight inspection ensures the integrity of instrument approaches and airway procedures that constitute the national airspace system infrastructure and FAA international commitments. Flight Program Operations accomplishes this mission through the airborne inspection of all space- and ground-based instrument flight procedures and the validation of electronic signals in space transmitted from ground navigation systems.

3. Where Can I Find This Order. You can find this order on the FAA website at http://www.faa.gov/regulations_policies/orders_notices and anywhere else that you may put your orders for your audience.

4. Explanation of Policy Changes. This order contains flight inspection equipment calibration standards previously contained in Order VN 8200.8, Flight Inspection Program Standards.

5. Aircraft Standards. All aircraft used by Flight Program Operations to conduct flight inspection are consistent with the guidance specified in ICAO Doc 8071, Volume I – Manual on Testing Radio Navigation Aids, Attachment A to Chapter 1, Section 1 including:

a. FAA aircraft contain sufficient environmental controls to ensure cabin temperatures have no negative effect on measuring equipment.

b. Flight Program Operations has evaluated the aircraft for optimal antenna performance and has installed antennas in accordance with the original equipment manufacturer (OEM) recommendations and supplemental type certificate instructions.

c. Flight Program Operations twin turbo-prop aircraft have been evaluated to ensure the propellers do not negatively impact the performance of the flight inspection system navigation receivers.

6. Aircraft Instrumentation Standards. Instrumentation used by Flight Program Operations to conduct flight inspection is consistent with the guidance specified in ICAO Doc 8071, Attachment A to Chapter 1, Section 2. Flight Program Operations aircraft are equipped with suitable antenna, avionics, and position reference information for all types of flight inspection as necessary to determine the accuracy of the navigation signal. Depending on the aeronautical facility being inspected, the position information is obtained by a variety of methods such as visual observations (e.g., ground reference points), optical tracking (e.g., theodolite), or onboard autonomous systems (e.g., Flight Inspection Airborne Processor Application (FIAPA)). Flight Program Operations provides certainty testing and other methods to ensure that:

a. Flight inspection measuring equipment doesn't interfere with the operation or accuracy of the aircraft's normal navigation and general avionics equipment.

b. The measurement equipment is adequately protected against the electromagnetic environment both internal and external to the aircraft.

c. All parameters of the navigational aid meet the standards specified in ICAO Annex 10 and FAA Order 8200.1, and the equipment installed in the aircraft is capable of measuring these parameters accurately.

7. Antenna Standards. Antennas used by Flight Program Operations to conduct flight inspection are consistent with the guidance specified in ICAO Doc 8071, Attachment A to Chapter 1, Section 3. Careful consideration must be given to the selection and placement of aircraft antennas to optimize the performance of the airborne receiving system used for flight inspection. To the extent feasible, the flight inspection equipment and its associated antennas must be totally independent from the aircraft's operational avionics. In addition:

a. The antennas must not be obscured from the signal during any normal inspection flight profiles.

b. Multiple measuring receivers may use a common antenna.

c. Tracked structure measurements must account for the location of the avionics antennas with respect to the tracking reference on the aircraft. This error, if not corrected by using aircraft altitude information, must be included in measurement uncertainty calculations. Alternatively, the errors may be corrected using information from the aircraft's attitude sensors.

d. Calibration of the antenna system gain is required for antennas used to measure field strength. Antenna system gain characteristics (including all feed cables, switches, and power splitters) must be determined in order to measure relative and absolute field strength within the specified uncertainties. The characteristics must be measured over the range of frequencies and at the aircraft orientations experienced during the measurement procedures to be used. These antenna gain characteristics must then be applied either real-time as data is input and displayed, or post-processed to generate the final report data.

e. The achieved antenna patterns for structure measurements must be measured and documented.

8. Receivers and Radio Communication Equipment Standards. Receivers and Radio Communication Equipment used by Flight Program Operations to conduct flight inspection are consistent with the guidance specified in ICAO Doc 8071 Chapter 1 and its appendices.

a. Position Accuracy. The position fixing system and the flight inspection antennas and receivers contribute to the overall error budget. ICAO Doc 8071, Chapter 1, Appendix A, Section 2.10 reads, "Flight inspection receivers provide both navigation information as in standard aircraft equipment and flight inspection information. Special care has to be taken concerning the location of antennas of the flight inspection receivers in order to avoid interference problems and to minimize the error contribution of the test equipment."

b. Measurement Accuracy. Appendices A through P of this order contain tables that define measurement tolerances and the allowed uncertainty for flight inspection measurements of aeronautical facilities. In general, the tolerances are used in the international community. When a defined measurement tolerance does not exist, the uncertainties are based on engineering judgement and knowledge of the current measurement methodology.

(1) Flight Program Operations must document the accuracies achieved by its measurements, showing that the uncertainties in the appendices are not exceeded. Compliance with the standards in the appendices may be accomplished by analysis or demonstration. The method of calculation and any assumptions made must be clearly shown. The documentation must be approved and maintained by the Flight Program Operations Director of Operations.

(2) Many measurements are a combination of receiver output and aircraft position, and in these cases, the figure required is the sum of all the errors involved in the measurement, including aircraft position. Where several measurements are combined to produce a single result, the errors must be computed using the root-sum-squared (RSS) method to give the overall expected measurement uncertainty. For measurements that can only be derived from recordings, the accuracy and resolution of the recording equipment must be included in calculating the expected measurement uncertainty.

(3) Once initial documentation of measurement uncertainty has been accomplished, any subsequent change to measurement conditions (e.g., software algorithm change, avionics replacement) must be shown to continue to meet the standards in the appendices.

c. Temperature Stability. The uncertainties stated above must be maintained under the specified environmental conditions for a flight inspection measurement.

(1) Allowable environmental conditions (e.g., temperature range, humidity range) must be defined and subsequently maintained during measurements.

(2) Documentation of measurement uncertainty with respect to temperature must be available for all the measuring equipment. This may be in the form of test results made by the organization or OEM specifications. If OEM specifications are used, the OEM test results must be available as evidence.

d. Calibration Standards. Flight Program Operations ensures all equipment meets OEM specifications and is traceable to National Institute of Standards and Technology (NIST) standards. This applies to all devices mentioned in each appendix under the heading of "Required Equipment."

(1) Regular calibration of the flight inspection receivers and position fixing system, as well as ground equipment used to maintain and calibrate them, must be performed. Calibration must meet OEM specifications, be capable of reading the field calibration requirements, and be traceable to NIST standards. The calibration may be performed either onboard the flight inspection aircraft or in a laboratory. Calibration intervals must be included in the calibration records and be made available for inspection.

(2) Clearly defined calibration procedures must be maintained and used for all equipment involved in flight inspection measurements. Any changes to the defined calibration procedures or tolerances must be accepted by the Flight Program Operations Director of Maintenance prior to implementation.

(3) When any equipment used is advertised as self-calibrating, the internal processes involved must be clearly defined. This involves showing how the equipment's internal standard is applied to each of the parameters that it can measure or generate. The internal standard must be traceable to NIST standards.

(4) Flight Program Operations maintains calibration interval requirements and updates those requirements as necessary, based on calibration data collection and analysis.

e. Build State and Modification Control. The build state of all equipment, including test equipment, must be recorded and the records updated whenever modifications or changes are made. All modifications must be accurately documented and cross-referenced to modification labels or numbers on the equipment. After making any modification, tests and analysis must ensure that the modification fulfills its intended purpose and that it has no undesired side effects.

f. Flight Inspection Software. All software (i.e., procedures, formulas, algorithms) used in flight inspection measurements and in trajectory control of the aircraft during flight inspection maneuvers must meet high safety and quality assurance standards. All avionics used for these purposes must be certified to airworthiness standards.

(1) Industry-standard procedures, such as the use of the Society of Automotive Engineers (S.A.E.) Aerospace Recommended Practice (ARP) 4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, and S.A.E. 4754, Guidance for Development, Validation, and Verification of Aircraft Systems, or

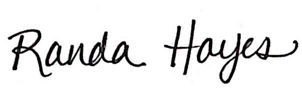
equivalent, must be used to assess the flight inspection hardware (avionics) and software architecture, to determine the potential safety risk from failures of flight inspection software.

(2) Based on the resulting safety risk, industry standard software quality assurance standards, such as Radio Technical Commission for Aeronautics (RTCA) DO-178B, Software Considerations in Airborne Systems and Equipment Certification or equivalent, must be used to assign an assurance level to each module of software.

(3) Each software module must be produced using procedures and methodology appropriate to its assigned assurance level.

(4) Documentation substantiating the safety risk analyses, the software assurance levels, and the procedures and methodology used to produce the software must be available.

g. Recording Equipment. The flight inspection system must include equipment that electronically records the measured parameters of the aeronautical aid being inspected. Recorded data must be marked to correlate with the aircraft's position at the time of the measurement.



Randa A. Hayes
Vice President, Flight Program Operations
Flight Program Executive

Appendix A. Very High Frequency Omnirange Range (VOR) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for VOR facilities consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 2, Very High Frequency Omnidirectional Radio Range (VOR).

2. Required Equipment. The aircraft should be fitted with a typical VOR receiver and antenna system. The power level into the receiver is used as the normal reference parameter for the determination of field strength. The power level into the receiver can be converted to absolute field strength if the antenna factor and cable losses are known. Refer to ICAO Doc 8071, Chapter 1, Attachment A, for guidance on determining antenna performance.

3. Measurements. ICAO guidelines for measuring VOR accuracy are shown in the table below. The power level into the receiver is used as the normal reference parameter for the determination of field strength. The power level into the receiver can be converted to absolute field strength if the antenna factor and cable losses are known.

a. Coverage (Field Strength) Maximum Uncertainty is defined at the OEM receiver capability level. Periodic calibration verification ensures OEM calibration status.

b. Calibration check validity ensures continued compliance with OEM and NIST values.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Azimuth Accuracy Alignment Bends Roughness & Scalloping	Deviation	 ± 2.0° ± 3.5° ± 3.0°	 0.6° 0.6° 0.3° Subjective
Coverage	Field Strength	90 µV/m	3 dB absolute 1 dB
Modulation With Voice Without Voice	Modulation Depth Up to 5º elevation	25 to 35% 20 to 35% 20 to 55%	1%
Bearing Monitor	Deviation	± 1.0°	0.3°

Appendix B. Distance Measuring Equipment (DME) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for DME facilities consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 3, Distance Measuring Equipment (DME).

2. Required Equipment. DME interrogator, antenna system, oscilloscope, and (optional) Spectrum Analyzer. The flight inspection DME interrogator should be maintained in accordance with the manufacturer's instructions and should conform to Annex 10 Standards and Recommended Practices.

3. Measurements.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Coverage Power density or field strength	Power density	Signal strength such that field density ≥ -89 dBW/m² (690 μV/m) at limits or operational requirements	5 dB
Accuracy	Distance	≤ 150 m ≤ 75 for DME associated with landing aids	50 m
Pulse shape (1)	Time, Amplitude	Rise time ≤ 3 μs Duration 3.5 μs, ±0.5 μs Decay time ≤ 3.5 μs Amplitude, between 95% rise / fall amplitudes, ≥ 95% of maximum amplitude	0.1 μs 1%
Pulse spacing	Time, Amplitude	X channel: 12 ±0.25 μsY channel: 30 ± 0.25 μs	0.05 μs
Identification	Identification	Correct, clear, properly synchronized	N/A
Reply efficiency	Change in efficiency, position	Note areas where this changes significantly	N/A
Unlocks	Unlocking, position	Note where unlocking occurs	N/A
Standby equipment	Suitability	Same as primary transmitter	N/A
Standby power	Suitability	Should not affect transponder parameters	N/A

NOTE: (1) Pulse shape and spacing analysis is currently not implemented. Flight Program Operations uses oscilloscope and spectrum analysis when needed for tolerance.

Appendix C. Instrument Landing System (ILS) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement standards for ILS facilities consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 4, Instrument Landing System (ILS).

2. Required Equipment. To minimize the errors due to implementation, antennas should be installed according to recommendations listed in ICAO 8071 Volume 1, Attachment A to Chapter 1, Section 3. For example, when the aircraft is over the runway threshold, a vertical displacement of 6 cm (2.5 inches) is equal to approximately 0.01° in elevation angle, observed from the glide path tracking site.

a. The receivers used should measure at a minimum the difference in the depth of modulation (DDM), sum of modulation depths (SDM), signal input level, and modulations depths. For integrity and technical comfort, the simultaneous use of two receivers is strongly recommended. This redundancy offers a protection against errors that might occur during flight inspection because of unexpected short-term changes in a receiver's performance. A divergence of their output signals can therefore be noted immediately.

b. Equipment constituting the acquisition and processing subsystem should have such performance that it does not degrade the acquired parameters. It is necessary that signal acquisition occurs synchronously with the positioning determination of the plane, to compare measurements that correspond in time. It will be possible to convert, by the use of calibration tables, the radio electrical signals into usual physical units with a convenient resolution, and to take into account the actual functioning of the receiver in its operational environment. The graphic display and record should be such that they will allow the flight inspector to evaluate fluctuations of signals against the required tolerances.

3. Measurements. ICAO guidelines for measuring ILS accuracy are shown in the table below.

LOCALIZER SUBSYSTEM

Parameter	Measurand	Tolerance	Maximum Uncertainty
Alignment	DDM	CAT I: 10.5m CAT II: 7.5m CAT III: 3.0m	2 m 1 m 0.7 m
Displacement Sensitivity	DDM	CAT I: Within 17% CAT II: Within 17% CAT III: Within 10%	±3 µA ±3 µA ±2 µA For nominal 150 µA input
Off Course Clearance	DDM	On either side of course line, linear increase to 175 µA, then maintenance of 175 µA to 10°. Between 10° and 35°, minimum 150 µA. Where coverage required outside of ±35°, minimum of 150 µA except in back course sector.	±5 µA For nominal 150 µA input
Course Structure	DDM	Outer limit of coverage to Point A: 30 µA all categories Point A to Point B: CAT I: Linear decrease to 15µA CAT II: Linear decrease to 5 µA CAT III: Linear decrease to 5 µA Beyond Point B: CAT I: 15 µA to Point C CAT II: 5 µA to Reference datum CAT III: 5 µA to Point D, then linear increase to 10 µA at Point E.	From Point A to B 3 µA, Decreasing to 1 µA From Point B to E 1 µA
Coverage	Flag status, DDM	-114 dBW/m2 (40 µV/m) in all parts of operational coverage volume from 25 NM, when	±3 dB

Parameter	Measurand	Tolerance	Maximum Uncertainty
	Power density	within the LOC course sector and on GP: CAT I: -107 dBW/m2 (90 µV/m) on ILS from 10 NM to 30 m height CAT II: -106 dBW/m2 (100 µV/m) on ILS from 10 NM, increasing to -100 dBW/m2 (200 µV/m) at 15 m height above THR CAT III: -106 dBW/m2 (100 µV/m) on ILS from 10 NM, increasing to -100 dBW/m2 (200 µV/m) at 6 m height above THR, -106 dBW/m2 (100 µV/m) along the length of the runway	
Modulation Balance Depth	DDM, Modulation, Depth SDM	0.002 DDM 18% to 22% <60% SDM within ±35° azimuth or actual coverage sector for systems installed post January 2000	0.001 DDM ±0.5%
Monitor Alignment	DDM. Distance	Monitor must alarm for a shift in the main course line from the runway centre line equivalent to or more than the following distances at the ILS reference datum. CAT I: 10.5 m (35 ft) CAT II: 7.5 m (25 ft) CAT III: 6.0 m (20 ft)	 2 m 1 m 0.7 m
Displacement Sensitivity	DDM, Distance	CAT I: Within 17% CAT II: Within 17% CAT III: Within 10%	±4% ±4% ±2%

Parameter	Measurand	Tolerance	Maximum Uncertainty
Off Course Clearance	DDM	Required only for certain types of localizer. Monitor must alarm when the off-course clearance crosspointer deflection falls below 150 µA anywhere in the off-course coverage area.	±5 µA ±1 dB relative
Power	Power field strength	Monitor must alarm either for a power reduction of 3 dB, or when the coverage falls below the requirement for the facility, whichever is the smaller change. For two-frequency localizers, the monitor must alarm for a change of ±1 dB in either carrier, unless tests have proved that use of the wider limits above will not cause unacceptable signal degradation (>150 µA in clearance sector)	± 5 µA

NOTE: Localizer modulation for next-generation automated flight inspection systems (NAFIS) must be maintained according to OEM calibration standards, which comply with National Institute of Standards and Technology (NIST) requirements. These standards ensure that equipment meets or exceeds the specified values during ramp calibration intervals.

GLIDE SLOPE SUBSYSTEM

Parameter	Measurand	Tolerance	Maximum Uncertainty
Alignment	DDM, Angle	CAT I: within 7.5% of nominal angle CAT II: within 7.5% of nominal angle CAT III: within 4% of nominal angle	0.75% 0.75% 0.3%[2] of nominal angle
Displacement Sensitivity Symmetry	DDM, Angle	CAT I: Between 0.07θ and 0.14θ above and below path CAT I*: 0.12θ above and below path, within ±0.02θ CAT II: 0.12θ above path, within +0.02θ and -0.05θ CAT II: 0.12θ below path, within ±0.02θ CAT III: 0.12θ above and below path, within ±0.02θ * Recommendation	CAT I: 2.5% CAT II: 2.0% CAT III: 1.5%
Value		CAT I: Within ±25% of nominal displacement sensitivity CAT II: Within ±20% of nominal displacement sensitivity CAT III: Within ±15% of nominal displacement sensitivity	
Clearance Below path	DDM, Angle	Not less than 190 µA at an angle above the horizontal of not less than 0.3θ. If 190 µA is realized at an angle greater than 0.45θ, a minimum of 190 µA must be maintained at least down to 0.45θ.	±6 µA for a Nominal 190 µA input

Parameter	Measurand	Tolerance	Maximum Uncertainty
Above path		Must attain at least 150 µA and not fall below 150 µA until 1.75θ is reached.	
Glide path structure	DDM	CAT I: From coverage limit to Point C: 30 µA. CAT II and III: From coverage limit to Point A: 30 µA From Point A to Point B: linear decrease from 30 µA to 20 µA. From Point B to reference datum: 20 µA.	CAT I: 6 µA CAT II: 4 µA CAT III: 4 µA
Coverage Power density or field strength	Power Density	-95 dBW/m² (400 µV/m)	±3 dB
Modulation Balance Depth	Modulation Depth	0.002 DDM 37.5% to 42.5% for each tone.	0.001 DDM 0.5 %
Monitor Angle	DDM, Angle	Monitor must alarm for a change in angle of -7.5/+10% of the promulgated angle	±4 µA
Displacement Sensitivity	DDM, Angle	CAT I: Monitor must alarm for a change in the angle between the glide path and the line below the glide path at which 75 µA is obtained, by more than 0.037θ. CAT II: Monitor must alarm for a change in displacement sensitivity by more than 25%. CAT III: Monitor must alarm for a change in displacement sensitivity by more than 25%.	±4 µA ±1 dB
Power	Power	Monitor must alarm either for a power reduction of 3 dB, or when the coverage falls below the requirement for the facility, whichever is the smaller change.	±0.5 dB

Parameter	Measurand	Tolerance	Maximum Uncertainty
		For two-frequency glide paths, the monitor must alarm for a change of ±1 dB in either carrier, unless tests have proved that use of the wider limits above will not cause unacceptable signal degradation.	

ILS MARKER BEACON SUBSYSTEM

Parameter	Measurand	Tolerance	Maximum Uncertainty
Coverage	Distance	OM: 600 m ±200 m (2 000 ft ±650 ft) MM: 300 m ±100 m (1 000 ft ±325 ft) IM: 150 m ±50 m (500 ft ±160 ft) On a normal approach, there should be a well-defined separation between the indications from the middle and inner markers. *	OM: ±40m MM: ±20m IM: ±10m ±3dbm
Monitor System	Field Strength	3 dB reduction	1 dB relative

NOTE: Measurement should use the Low Sensitivity setting on receiver. (Refer to Annex 10 for specific field strength requirements.) Alternatively, this can be checked by analyzing the field strength recording.

Appendix D. Non-Directional Beacon (NDB) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for NDB facilities consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 5, Non-directional beacon (NDB).

a. NDB coverage is determined by field strength measurements (rated coverage) or by a quality assessment (effective coverage) of factors such as signal strength, voice and identification, and cross-pointer activity. The use of either or both methods depend upon operational and engineering standards.

b. Flight Program Operations does not use continuous recording of the data derived from flight check, recordings of both field strength and the quality of the bearing information or recording compass outputs for NDB parameters. As an alternative, a pilot quality assessment (effective coverage) of factors such as signal strength, voice and identification, and cross-pointer activity is used to determine compliance via visual observation.

c. Flight Program Operations uses automatic direction finder antennas that meet omnidirectional sense antenna and rotatable loop (or a fixed loop and goniometer performing the same function) guidelines.

2. Required Equipment. Front-end aircraft NDB system. No specific equipment requirements.

3. Measurements. See paragraph 1.b above.

Appendix E. En route Very High Frequency (VHF) Marker Beacons (MB) (75 MHz) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for enroute MB facilities consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 6, En-route VHF marker beacons (75 MHz).

2. Required Equipment. The airborne equipment used for flight inspection of marker beacons is usually a marker receiver and antenna, that allows field strength to be continuously recorded. Alternatively, a suitable general-purpose field strength meter covering the 75 MHz band could be used. The signal level used for calibration of the airborne marker receiver or field strength meter depends on the type of aircraft antenna used.

Airborne marker beacon systems consist of antenna, receiver, and indicator subsystems. The antenna may be a standard open wire or a flush mounted type and is mounted on the underside of the aircraft. The receiver's detected modulation is monitored by headset or speaker and is also passed through an appropriate filter.

This lamp is usually one of a three-lamp installation, the other two responding to ILS marker beacon signals. The sensitivity of the receiver and antenna combination is adjusted so that the indicator lamp illuminates when the signal level reaches a specified level.

3. Measurements. ICAO guidelines for measuring Enroute MB accuracy are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Coverage	Time	Indication centered over beacon	1 s
	Field Strength	25%	10 μV

Appendix F. Precision Approach Radar (PAR) Flight Inspection Standards

1. **Purpose.** This appendix lists the minimum measurement guidelines for PAR facilities consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 7, Precision approach radar (PAR).

2. **Required Equipment.** Suitable Position Reference System.

3. **Measurements.** ICAO guidelines for measuring PAR accuracy are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Coverage	Distance Azimuth Elevation	≥ 9 nm 20° 7°	0.1 nm 1° 0.1 °
Accuracy Azimuth	Azimuth	Greater of 0.6% of distance to PAR antenna + 10% of deviation from on-course line, or 9m	3 m
Elevation	Elevation	Greater of 0.4% of distance to PAR antenna + 10% of actual linear displacement from the chosen descent path, or 6m	3 m
Distance	Distance	30m + 3% of distance to touchdown	3 m

Appendix G. Tactical Air Navigation (TACAN) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for TACAN facilities.

2. Required Equipment. An oscilloscope, TACAN test set, or equivalent computational and display ability is required to observe individual pulse characteristics such as pair spacing and rise/fall times, and to count TACAN pulses and pulse pairs.

3. Measurements. ICAO guidelines for measuring TACAN accuracy are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Azimuth Accuracy Alignment Bends Roughness & Scalloping	Deviation	 ± 2.0° ± 3.5° ± 3.0°	 0.6° 0.6° 0.3°
Distance Accuracy	Distance; Range	± 0.2 nm	0.05 nm
Coverage	Signal Strength	-80 dBm	3 dB absolute 1 dB repeatability
Modulation	Modulation Depth, 15 and 135 Hz	10 to 30%	2%
Bearing Monitor	Deviation	± 1.0°	0.3°
Reference Group Size Main Ref Group Aux Ref Group	Pulse Pair Count	± 1 pair ± 1 pair	Individual pulse detection

Appendix H. Performance-Based Navigation (PBN) Instrument Flight Procedures Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for PBN consistent with the guidance in ICAO Doc 8071, Volume I, Chapter 8, Performance-Based Navigation (PBN).

2. Required Equipment. No specific equipment is required beyond that listed for individual facilities in appendices A through H.

3. Measurements. None other than those in appendices A through P. Tolerances are defined in FAA Order 8200.1.

Appendix I. Space-Based Augmentation System (SBAS) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for SBAS facilities consistent with the guidance in ICAO Doc 8071, Volume II, Chapter 3, Satellite-based augmentation systems (SBAS).

2. Required Equipment. Suitable SBAS receivers to acquire the ranging and correction data and apply these data to determine the integrity and improve the accuracy of the derived position.

3. Measurements. SBAS parameters are based on survey data that is compiled and validated by ATO Mission Support. For use in flight inspection roles, ICAO guidelines for measuring SBAS accuracy are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Final Approach Segment (FAS) Survey data accuracy	WGS-84 Coordinates, converted to linear	N/A	N/A
Horizontal	N/A	N/A	< 1 m
Vertical	N/A	N/A	< 0.25 m

Appendix J. Ground-Based Augmentation System (GBAS) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement standards for GBAS facilities consistent with the guidance in ICAO Doc 8071, Volume II, Chapter 4, Ground-based augmentation systems (GBAS).

2. Required Equipment.

a. The airborne GBAS equipment used for the flight test should meet the applicable standards required for the procedure being tested. There are situations that may require modifications to the flight test receiver that could invalidate the certification. An example is the need to override the broadcast "test" mode and maximum range value of the GBAS facility. This may require special consideration or certification for instrument flight conditions use. In some cases, it may be desirable to acknowledge and suppress GBAS alerts, warnings, and flags for the purposes of completing required checks.

b. The receiver should have the capability of outputting and recording parameters required in the table below. It is helpful to be able to observe and optionally record during flight-testing additional parameters beyond those listed in the below table, such as Horizontal Protection Level/Vertical Protection Level (HPL)/VPL, satellites tracked, geostationary satellite Signal-to-Noise Ratio (SNR), and GBAS sensor status. These parameters may provide an indication of marginal performance and are a baseline for further analysis of any observed anomalies.

3. Measurements. ICAO guidelines for measuring GBAS accuracy are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Waypoint and Procedure design correlation (all segments) Course/track to next WP Distance to next WP WP Data FAS Data	 Degrees Meters (nm) Coordinates FAS Path	 0.5° 185m (0.1 nm) Entered to 0.01 minute[1] Consistent with FAS Design[2]	 N/A 106m N/A N/A
Resistance to Interference (ranging signal)	Interference signal level	< Interference mask definitions	3 dB absolute
VDB Coverage GBAS/H field strength GBAS/E field strength Horizontal Vertical	Field Strength	 >-99 dBW/m^2 to -35 dBW/m^2 >-99 dBW/m^2 to -35 dBW/m^2 -103 dBW/m^2 to -39 $dBW/^2$	3 dB absolute
Position Domain Accuracy	Position	4m vertical 16m lateral	1m

NOTE 1: FAA Order 8200.1 requires entry precision to 0.001 minute.
NOTE 2: The FAS design defines the course, glide path, and threshold crossing height, each of which must meet the relevant (e.g., CAT 1) requirements.

Appendix K. Lighting System Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for lighting systems.

2. Required Equipment. Although it is not necessary to use a special aircraft for the flight testing of lighting systems, it is highly desirable that the aircraft used be specially designated for this work. If a special aircraft is not used, a theodolite suitably modified to read accurately the displacement in azimuth and elevation of the flight test aircraft from the desired approach path may be required.

3. Required Equipment. ICAO guidelines for measuring lighting system accuracy are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Visual glidepath angle	Elevation degrees	± 0.2 °	0.05 °
Coverage	Azimuth, degrees from approach angle	> ± 10 °	0.5 °

Appendix L. Communications System Flight Inspection Standards (Including Direction Finder (DF) Systems)

1. Purpose. This appendix lists the minimum measurement guidelines for communications systems. This service not currently provided by Flight Program Operations for U.S. operations.

2. Required Equipment.

a. Aircraft without on-board position-fixing systems may perform DF checks if accurately plotted ground checkpoints are selected over which the aircraft can safely maneuver, or if a theodolite is used.

b. Aircraft without on-board position-fixing systems may perform DF checks if accurately plotted ground checkpoints are selected over which the aircraft can safely maneuver, or if a theodolite is used.

c. For voice communications facilities, it is highly desirable to have the ability to measure frequency and received very high frequency/ultra high frequency (VHF/UHF) signal strength, and to record received audio on tape or other suitable media for subsequent engineering analysis.

3. Measurements. There are no measurement guidelines for air-ground voice communications facilities. Inspection requirements consist entirely of observations and subjective judgments.

Appendix M. Area Navigation (RNAV) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement standards for RNAV flight inspection.

2. Required Equipment. The flight management system used for flight inspection of RNAV procedures must have the following characteristics:

a. Capability to handle and display all Aeronautical Radio Incorporated 424 path and terminations.

b. Capacity for navigation database resolution to 0.01 second of latitude and longitude.

c. Waypoint entry resolution to 0.001 minute of latitude and longitude.

d. Vertical navigation capability for barometric aided and global navigation satellite system operations.

e. Required navigation performance (RNP) capability (display of RNP or equivalent level of performance).

f. Capability to enter ground track route for flight inspection.

g. Capability to display true track versus magnetic track.

h. Display of navigation sensor status.

Appendix N. Microwave Landing System (MLS) Flight Inspection Standards

1. Purpose. This appendix lists the minimum measurement guidelines for MLS. This service is not currently provided by Flight Program Operations for U.S. operations. There are no MLS in the U.S. and the FAA Flight Program aircraft are not equipped to inspect them.

2. Required Equipment. The minimum MLS flight inspection equipment standards are:

a. MLS test receiver with path following error (PFE) and control motion noise (CMN) filters.

b. Selectable forward looking and side looking antennas.

c. Recording and display equipment (preferably digital) with the following outputs: raw angle, PFE, CMN, and aircraft position in azimuth angle, elevation angle, and distance.

d. A means of decoding and displaying the contents of all basic and auxiliary data words.

e. An oscilloscope for monitoring log video signals.

3. Measurements. ICAO guidelines for measuring MLS accuracy are shown in the table below.

Azimuth Subsystem

Parameter	Measurand	Tolerance	Maximum Uncertainty
Alignment	Angle	0.02°	0.01°
PFE	Distance and Angle	20’ and <0.25°	3’ 0.01°
PFN	Distance and Angle	11.5’ and <0.15°	3’ 0.01°
CMN	Distance and Angle	10.5’ and <0.10°	3’ 0.01°
Coverage Angle Signals, 1° BW Angle Signals, 2° BW Angle Signals, 3° BW	Power Density	 -85.7 dBW/m -79.7 dBW/m -76.2 dBW/m	 3 dB absolute 1 dB repeatability

Elevation Subsystem

Parameter	Measurand	Tolerance	Maximum Uncertainty
Alignment	Angle	0.02°	0.01°
PFE	Distance and Angle	2’ and <0.2°	0.5’ 0.01°
PFN	Distance and Angle	1.3’ and <0.2°	0.5’ 0.01°
CMN	Distance and Angle	1’ and <0.1°	0.5’ 0.01°
Coverage Angle Signals, 1° BW Angle Signals, 2° BW Angle Signals, 3° BW	Power Density	 -85.7 dBW/m -79.7 dBW/m -76.2 dBW/m	 3 dB absolute 1 dB repeatability

Appendix O. RFI Detection and Location Standards

1. Purpose. This appendix lists the minimum measurement guidelines for Radio Frequency Interference (RFI) detection and location.

2. Required Equipment. Sufficiently capable receivers based on the types of interference expected to be analyzed.

a. An on-board spectrum analyzer should be provided, with capability to observe signals as low as -110 dBm at its input. Its input should be configurable to any of the antennas within the required frequency ranges. It should have either a zero-span (oscilloscope) function, or a separate oscilloscope for observation of pulse shapes, waveforms, etc., may be provided.

b. A real-time audio recording capability should be provided for demodulated Nav/Comm receiver and spectrum analyzer outputs. The media may be magnetic tape, computer-based files such as Moving Picture Experts Group Audio Layer 3 (MP3), or other suitable formats readily available for use by spectrum management personnel.

3. Measurements. ICAO guidelines for RFI detection and location are shown in the table below.

Parameter	Measurand	Tolerance	Maximum Uncertainty
Frequency of source	Frequency	None	1 kHz
Azimuth to source (within 108-137 MHz and 225-400 MHz bands, and within 100 MHz of GPS frequencies)	Angle	None	5°

Appendix P. Surveillance Radar Standards

1. Purpose. This appendix lists the minimum measurement guidelines for surveillance radar consistent with the guidance in ICAO Doc 8071, Volume III, Appendix A, Flight Testing Methods.

2. Required Equipment. Flight inspection will use small aircraft (the Beech King Air 300 series and Challenger 600 series and other aircraft of similar size are also regarded as small aircraft for the purpose of radar flight checks) equipped with a calibrated transponder for secondary surveillance radar power optimization and gain time control curve establishment for all radar flight inspection.

3. Measurements. Flight inspection aircraft offer the pilot the choice of either of the following two combinations of power and sensitivity for the altitude test to be conducted:

Parameter	Measurand	Tolerance
Transponder equipment for aircraft not permitted to fly above 15 000 feet. (Measurements at the antenna end of the cable)	18.5 dB –71 dbm 18.5 dB –69	+1dB/–0dB above 1 W power output ± 1 dBm sensitivity (low/normal) +1dB/–0dB above 1 W power output + 1 dBm/–0 dBm sensitivity (low/low)
Transponder equipment for aircraft permitted to fly above15 000 feet. (Measurements at the antenna end of the cable) **Note:** Currently, only normal/normal and low/low are provided by Flight Program Operations.	21 dB –71 21 dB –69	+1dB/–0 dB above 1 W RF power output ± –1 dBm sensitivity (low/normal) +1dB/–0 dB above 1 W power output + 1 dBm/–0 dBm sensitivity (low/low).

Appendix Q. Directive Feedback Information

Please submit any written comments or recommendation for improving this directive or suggest new items or subjects to be added to it. Also, if you find an error, please tell us about it.

Subject: Order 8200.48, Flight Inspection Equipment Standards

To: Directive Management Officer, 9-AJF-PolicyandCommunications@faa.gov.

(Please mark all appropriate line items)

☐ An error (procedural or typographical) has been noted in paragraph _______ on page _______.

☐ Recommend paragraph _______ on page _______ be changed as follows:
(attach separate sheet if necessary)

☐ In a future change to this order, please include coverage on the following subject:
(briefly describe what you want added.)

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by: ___________________________________ Date: ___________________

Telephone Numb/er: ___________________ Routing Symbol: _________________

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