

APPENDIX E TO PART 125—AIRPLANE FLIGHT RECORDER SPECIFICATIONS

The recorded values must meet the designated range, resolution and accuracy requirements during static and dynamic conditions. Dynamic condition means the parameter is experiencing change at the maximum rate attainable, including the maximum rate of reversal. All data recorded must be correlated in time to within one second.

| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|--|--|---|--|---------------------|---|
| 1. Time or Relative Times Counts. ¹ | 24 Hrs, 0 to 4095. | ±0.125% Per Hour. | 4 | 1 sec | UTC time preferred when available. Count increments each 4 seconds of system operation. |
| 2. Pressure Altitude. | – 1000 ft to max certificated altitude of aircraft, +5000 ft. | ±100 to ±700 ft (see table, TSO C124a or TSO C51a). | 1 | 5' to 35' | Data should be obtained from the air data computer when practicable. |
| 3. Indicated air-speed or Calibrated airspeed. | 50 KIAS or minimum value to Max V _{soi} , to 1.2 V _D . | ±5% and ±3% | 1 | 1 kt | Data should be obtained from the air data computer when practicable. |
| 4. Heading (Primary flight crew reference). | 0–360° and Discrete “true” or “mag”. | ±2° | 1 | 0.5° | When true or magnetic heading can be selected as the primary heading reference, a discrete indicating selection must be recorded. |
| 5. Normal Acceleration (Vertical) ⁹ . | –3g to +6g | ±1% of max range excluding datum error of ±5%. | 0.125 | 0.004g. | |
| 6. Pitch Attitude .. | ±75° | ±2° | 1 or 0.25 for airplanes operated under § 125.226(f). | 0.5° | A sampling rate of 0.25 is recommended. |
| 7. Roll Attitude ² .. | ±180° | ±2° | 1 or 0.5 for airplanes operated under § 121.344(f). | 0.5° | A sampling rate of 0.5 is recommended. |
| 8. Manual Radio Transmitter Keying or CVR/DFDR synchronization reference | On-Off (Discrete) None. | ..... | 1 ..... | ..... | Preferably each crew member but one discrete acceptable for all transmission provided the CVR/FDR system complies with TSO C124a CVR synchronization requirements (paragraph 4.2.1 ED–55). |
| 9. Thrust/Power on each engine—primary flight crew reference. | Full Range Forward. | ±2% | 1 (per engine) ... | 0.3% of full range. | Sufficient parameters (e.g., EPR, N1 or Torque, NP) as appropriate to the particular engine being recorded to determine power in forward and reverse thrust, including potential overspeed condition. |
| 10. Autopilot Engagement. | Discrete “on” or “off”. | ..... | 1. | | |
| 11. Longitudinal Acceleration. | ±1g | ±1.5% max. range excluding datum error of ±5%. | 0.25 | 0.004g. | |
| 12a. Pitch control(s) position (nonfly-by-wire systems) ¹⁸ . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 or 0.25 for airplanes operated under § 125.226(f). | 0.5% of full range. | For airplanes that have a flight control breakaway capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5 or 0.25, as applicable. |
| 12b. Pitch control(s) position (fly-by-wire systems) ^{3 18} . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 or 0.25 for airplanes operated under § 125.226(f). | 0.2% of full range. | |

Federal Aviation Administration, DOT

Pt. 125, App. E

The recorded values must meet the designated range, resolution and accuracy requirements during static and dynamic conditions. Dynamic condition means the parameter is experiencing change at the maximum rate attainable, including the maximum rate of reversal. All data recorded must be correlated in time to within one second.

| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|---|------------------|--|--|---------------------|--|
| 13a. Lateral control position(s) (nonfly-by-wire) ¹⁸ . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 or 0.25 for airplanes operated under § 125.226(f). | 0.2% of full range. | For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5 or 0.25, as applicable. |
| 13b. Lateral control position(s) (fly-by-wire) ^{4 18} . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 or 0.25 for airplanes operated under § 125.226(f). | 0.2% of full range. | |
| 14a. Yaw control position(s) (nonfly-by-wire) ^{5 18} . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 | 0.3% of full range. | For airplanes that have a flight control breakaway capability that allows either pilot to operate the controls independently, record both control inputs. The control inputs may be sampled alternately once per second to produce the sampling interval of 0.5. |
| 14b. Yaw control position(s) (fly-by-wire) ¹⁸ . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 | 0.2% of full range. | |
| 15. Pitch control surface(s) position ^{6 18} . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 or 0.25 for airplanes operated under § 125.226(f). | 0.3% of full range. | For airplanes fitted with multiple or split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25, as applicable. |
| 16. Lateral control surface(s) position ^{7 18} . | Full Range | ±2° unless higher accuracy uniquely required. | 0.5 or 0.25 for airplanes operated under § 125.226(f). | 0.2% of full range. | A suitable combination of surface position sensors is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25, as applicable. |
| 17. Yaw control surface(s) position ^{8 18} . | Full range | ±2° unless higher accuracy uniquely required. | 0.5 | 0.2% of full range. | For airplanes fitted with multiple or split surfaces, a suitable combination of surface position sensors is acceptable in lieu of recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5. |
| 18. Lateral Acceleration. | ±1g | ±1.5% max. range excluding datum error of ±5%. | 0.25 | 0.004g. | |
| 19. Pitch Trim Surface Position. | Full Range | ±3° Unless Higher Accuracy Uniquely Required. | 1 | 0.6% of full range | |

Pt. 125, App. E

14 CFR Ch. I (1–1–14 Edition)

The recorded values must meet the designated range, resolution and accuracy requirements during static and dynamic conditions. Dynamic condition means the parameter is experiencing change at the maximum rate attainable, including the maximum rate of reversal. All data recorded must be correlated in time to within one second.

| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|--|---|---|---|------------------------|--|
| 20. Trailing Edge Flap or Cockpit Control Selection. ¹⁰ . | Full Range or Each Position (discrete). | ±3° or as Pilot's indicator. | 2 | 0.5% of full range. | Flap position and cockpit control may each be sampled at 4 second intervals, to give a data point every 2 seconds. |
| 21. Leading Edge Flap or Cockpit Control Selection. ¹¹ . | Full Range or Each Discrete Position. | ±3° or as Pilot's indicator and sufficient to determine each discrete position. | 2 | 0.5% of full range. | Left and right sides, or flap position and cockpit control may each be sampled at 4 second intervals, so as to give a data point every 2 seconds. |
| 22. Each Thrust Reverser Position (or equivalent for propeller airplane). | Stowed, In Transit, and Reverse (Discrete). | ..... | 1 (per engine). .. | ..... | Turbo-jet—2 discretely enable the 3 states to be determined. Turbo-prop—1 discrete. |
| 23. Ground Spoiler Position or Speed Brake Selection ¹² . | Full Range or Each Position (discrete). | ±2° Unless higher accuracy uniquely required. | 1 or 0.5 for airplanes operated under § 125.226(f). | 0.2% of full range. | |
| 24. Outside Air Temperature or Total Air Temperature. ¹³ . | −50 °C to +90 °C. | ±2 °C | 2 | 0.3 °C.. | |
| 25. Autopilot/ Autothrottle/ AFCS Mode and Engagement Status. | A suitable combination of discretely. | ..... | 1 ..... | ..... | Discretely should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft. |
| 26. Radio Altitude ¹⁴ . | −20 ft to 2,500 ft. | ±2 ft or ±3% Whichever is Greater Below 500 ft and ±5% above 500 ft. | 1 | 1 ft +5% Above 500 ft. | For autoland/category 3 operations. Each radio altimeter should be recorded, but arranged so that at least one is recorded each second. |
| 27. Localizer Deviation, MLS Azimuth, or GPS Lateral Deviation. | ±400 Microamps or available sensor range as installed ±62°. | As installed. ±3% recommended ... | 1 | 0.3% of full range. | For autoland/category 3 operations. each system should be recorded but arranged so that at least one is recorded each second. It is not necessary to record ILS and MLS at the same time, only the approach aid in use need be recorded. |
| 28. Glideslope Deviation, MLS Elevation, or GPS Vertical Deviation. | ±400 Microamps or available sensor range as installed. 0.9 to + 30° | As installed ±3% recommended ... | 1 | 0.3% of full range. | For autoland/category 3 operations. each system should be recorded but arranged so that at least one is recorded each second. It is not necessary to record ILS and MLS at the same time, only the approach aid in use need be recorded. |
| 29. Marker Beacon Passage. | Discrete "on" or "off". | ..... | 1 ..... | ..... | A single discrete is acceptable for all markers. |
| 30. Master Warning. | Discrete ..... | ..... | 1 ..... | ..... | Record the master warning and record each 'red' warning that cannot be determined from other parameters or from the cockpit voice recorder. |
| 31. Air/ground sensor (primary airplane system reference nose or main gear). | Discrete "air" or "ground". | | 1 (0.25 recommended). | | |

Federal Aviation Administration, DOT

Pt. 125, App. E

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| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|--|--|----------------------------------|---|--------------------------|---|
| 32. Angle of Attack (If measured directly). | As installed | As Installed | 2 or 0.5 for airplanes operated under § 125.226(f). | 0.3% of full range. | If left and right sensors are available, each may be recorded at 4 or 1 second intervals, as appropriate, so as to give a data point at 2 seconds or 0.5 second, as required. |
| 33. Hydraulic Pressure Low, Each System. | Discrete or available sensor range, "low" or "normal". | ±5% | 2 | 0.5% of full range. | |
| 34. Groundspeed | As Installed | Most Accurate Systems Installed. | 1 | 0.2% of full range. | |
| 35. GPWS (ground proximity warning system). | Discrete "warning" or "off". | ..... | 1 ..... | ..... | A suitable combination of discretes unless recorder capacity is limited in which case a single discrete for all modes is acceptable. |
| 36. Landing Gear Position or Landing gear cockpit control selection. | Discrete ..... | ..... | 4 ..... | ..... | A suitable combination of discretes should be recorded. |
| 37. Drift Angle. ¹⁵ | As installed | As installed | 4 | 0.1% | |
| 38. Wind Speed and Direction. | As installed | As installed | 4 | 1 knot, and 1.0°. | |
| 39. Latitude and Longitude. | As installed | As installed | 4 | 0.002°, or as installed. | Provided by the Primary Navigation System Reference. Where capacity permits Latitude/longitude resolution should be 0.0002°. |
| 40. Stick shaker and pusher activation. | Discrete(s) "on" or "off". | ..... | 1 ..... | ..... | A suitable combination of discretes to determine activation. |
| 41. Windshear Detection. | Discrete "warning" or "off". | ..... | 1 | | |
| 42. Throttle/power lever position. ¹⁶ | Full Range | ±2% | 1 for each lever | 2% of full range | For airplanes with non-mechanically linked cockpit engine controls. |
| 43. Additional Engine Parameters. | As installed | As installed | Each engine each second. | 2% of full range | Where capacity permits, the preferred priority is indicated vibration level, N2, EGT, Fuel Flow, Fuel Cut-off lever position and N3, unless engine manufacturer recommends otherwise. |
| 44. Traffic Alert and Collision Avoidance System (TCAS). | Discretes | As installed | 1 ..... | ..... | A suitable combination of discretes should be recorded to determine the status of-Combined Control, Vertical Control, Up Advisory, and Down Advisory. (ref. ARINC Characteristic 735 Attachment 6E, TCAS VERTICAL RA DATA OUTPUT WORD.) |
| 45. DME 1 and 2 Distance. | 0-200 NM | As installed | 4 | 1 NM | 1 mile. |
| 46. Nav 1 and 2 Selected Frequency. | Full range | As installed | 4 ..... | ..... | Sufficient to determine selected frequency |
| 47. Selected barometric setting. | Full range | ±5% | (1 per 64 sec.) .. | 0.2% of full range. | |
| 48. Selected Altitude. | Full range | ±5% | 1 | 100 ft. | |

Pt. 125, App. E

14 CFR Ch. I (1–14 Edition)

The recorded values must meet the designated range, resolution and accuracy requirements during static and dynamic conditions. Dynamic condition means the parameter is experiencing change at the maximum rate attainable, including the maximum rate of reversal. All data recorded must be correlated in time to within one second.

| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|---|---|---|-------------------------------|----------------------|--|
| 49. Selected speed. | Full range | ±5% | 1 | 1 knot. | |
| 50. Selected Mach. | Full range | ±5% | 1 | .01. | |
| 51. Selected vertical speed. | Full range | ±5% | 1 | 100 ft/min. | |
| 52. Selected heading. | Full range | ±5% | 1 | 1°. | |
| 53. Selected flight path. | Full range | ±5% | 1 | 1°. | |
| 54. Selected decision height. | Full range | ±5% | 64 | 1 ft. | |
| 55. EFIS display format. | Discrete(s) ..... | ..... | 4 ..... | ..... | Discretes should show the display system status (e.g., off, normal, fail, composite, sector, plan, nav aids, weather radar, range, copy). |
| 56. Multi-function/ Engine Alerts Display format. | Discrete(s) ..... | ..... | 4 ..... | ..... | Discretes should show the display system status (e.g., off, normal, fail, and the identity of display pages for emergency procedures, need not be recorded). |
| 57. Thrust command. ¹⁷ | Full Range | ±2% | 2 | 2% of full range | |
| 58. Thrust target | Full range | ±2% | 4 | 2% of full range. | |
| 59. Fuel quantity in CG trim tank. | Full range | ±5% | (1 per 64 sec.) .. | 1% of full range. | |
| 60. Primary Navigation System Reference. | Discrete GPS, INS, VOR/ DME, MLS, Loran C, Omega, Localizer Glideslope. | ..... | 4 ..... | ..... | A suitable combination of discrete to determine the Primary Navigation System reference. |
| 61. Ice Detection | Discrete "ice" or "no ice". | ..... | 4 ..... | ..... |  |
| 62. Engine warning each engine vibration. | Discrete ..... | ..... | 1 ..... | ..... |  |
| 63. Engine warning each engine over temp. | Discrete ..... | ..... | 1 ..... | ..... |  |
| 64. Engine warning each engine oil pressure low. | Discrete ..... | ..... | 1 ..... | ..... |  |
| 65. Engine warning each engine over speed. | Discrete ..... | ..... | 1 ..... | ..... |  |
| 66. Yaw Trim Surface Position. | Full Range | ±3% Unless Higher Accuracy Uniquely Required. | 2 | 0.3% of full range.. | |
| 67. Roll Trim Surface Position. | Full Range | ±3% Unless Higher Accuracy Uniquely Required. | 2 | 0.3% of full range.. | |
| 68. Brake Pressure (left and right). | As installed | ±5% | 1 ..... | ..... | To determine braking effort applied by pilots or by autobrakes. |
| 69. Brake Pedal Application (left and right). | Discrete or Analog "applied" or "off". | ±5% (Analog) | 1 ..... | ..... | To determine braking applied by pilots. |
| 70. Yaw or sideslip angle. | Full Range | ±5% | 1 | 0,5° | |
| 71. Engine bleed valve position. | Discrete "open" or "closed". | ..... | 4 ..... | ..... |  |
| 72. De-icing or anti-icing system selection. | Discrete "on" or "off". | | 4 | | |

Federal Aviation Administration, DOT

Pt. 125, App. E

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| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|--|------------------------------|-------------------------|-------------------------------|---------------------|--|
| 73. Computed center of gravity. | Full Range | ±5% | (1 per 64 sec.) .. | 1% of full range. | |
| 74. AC electrical bus status. | Discrete "power" or "off". | ..... | 4 ..... | ..... | Each bus. |
| 75. DC electrical bus status. | Discrete "power" or "off". | ..... | 4 ..... | ..... | Each bus. |
| 76. APU bleed valve position. | Discrete "open" or "closed". | ..... | 4 ..... | ..... |  |
| 77. Hydraulic Pressure (each system). | Full range | ±5% | 2 | 100 psi. | |
| 78. Loss of cabin pressure. | Discrete "loss" or "normal". | ..... | 1 ..... | ..... |  |
| 79. Computer failure (critical flight and engine control systems). | Discrete "fail" or "normal". | ..... | 4 ..... | ..... |  |
| 80. Heads-up display (when an information source is installed). | Discrete(s) "on" or "off". | ..... | 4 ..... | ..... |  |
| 81. Para-visual display (when an information source is installed). | Discrete(s) "on" or "off". | ..... | 1 ..... | ..... |  |
| 82. Cockpit trim control input position—pitch. | Full Range | ±5% | 1 | 0.2% of full range. | Where mechanical means for control inputs are not available, cockpit display trim positions should be recorded. |
| 83. Cockpit trim control input position—roll. | Full Range | ±5% | 1 | 0.7% of full range. | Where mechanical means for control inputs are not available, cockpit display trim position should be recorded. |
| 84. Cockpit trim control input position—yaw. | Full Range | ±5% | 1 | 0.3% of full range. | Where mechanical means for control input are not available, cockpit display trim positions should be recorded. |
| 85. Trailing edge flap and cockpit flap control position. | Full Range | ±5% | 2 | 0.5% of full range. | Trailing edge flaps and cockpit flap control position may each be sampled alternately at 4 second intervals to provide a sample each 0.5 second. |
| 86. Leading edge flap and cockpit flap control position. | Full Range or Discrete. | ±5% | 1 | 0.5% of full range. | |
| 87. Ground spoiler position and speed brake selection. | Full Range or Discrete. | ±5% | 0.5 | 0.3% of full range | |

Pt. 125, App. E

14 CFR Ch. I (1–1–14 Edition)

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| Parameters | Range | Accuracy (sensor input) | Seconds per sampling interval | Resolution | Remarks |
|--|--|-------------------------|-------------------------------|---------------------|---|
| 88. All cockpit flight control input forces (control wheel, control column, rudder pedal) ^{18 19} . | Full range Control wheel ±70 lbs. Control column ±85 lbs. Rudder pedal ±165 lbs. | ±5% | 1 | 0.3% of full range. | For fly-by-wire flight control systems, where flight control surface position is a function of the displacement of the control input device only, it is not necessary to record this parameter. For airplanes that have a flight control break away capability that allows either pilot to operate the control independently, record both control force inputs. The control force inputs may be sampled alternately once per 2 seconds to produce the sampling interval of 1. |
| 89. Yaw damper status. | Discrete (on/off) | 0.5 | | | |
| 90. Yaw damper command. | Full range | As installed | 0.5 | 1% of full range. | |
| 91. Standby rudder valve status. | Discrete | 0.5 | | | |

¹ For A300 B2/B4 airplanes, resolution = 6 seconds.
² For A330/A340 series airplanes, resolution = 0.703°.
³ For A318/A319/A320/A321 series airplanes, resolution = 0.275% (0.088°>0.064°)
⁴ For A330/A340 series airplanes, resolution = 2.20% (0.703°>0.064°)
⁵ For A318/A319/A320/A321 series airplanes, resolution = 0.22% (0.088°>0.080°)
⁶ For A330/A340 series airplanes, resolution = 1.76% (0.703°>0.080°)
⁷ For A330/A340 series airplanes, resolution = 1.18% (0.703°>0.120°).
⁸ For A330/A340 series airplanes, seconds per sampling interval = 1.
⁹ For A330/A340 series airplanes, resolution = 0.783% (0.352°>0.090°)
¹⁰ For A330/A340 series airplanes, aileron resolution = 0.704% (0.352°>0.100°). For A330/A340 series airplanes, spoiler resolution = 1.406% (0.703°>0.100°).
¹¹ For A330/A340 series airplanes, resolution = 0.30% (0.176°>0.12°)
¹² For A330/A340 series airplanes, seconds per sampling interval = 1
¹³ For B-717 series airplanes, resolution = .005g. For Dassault F900C/F900EX airplanes, resolution = .007g.
¹⁴ For A330/A340 series airplanes, resolution = 1.05% (0.250°>0.120°)
¹⁵ For A330/A340 series airplanes, resolution = 1.05% (0.250°>0.120°). For A330 B2/B4 series airplanes, resolution = 0.92% (0.230°>0.125°).
¹⁶ For A330/A340 series airplanes, spoiler resolution = 1.406% (0.703°>0.100°).
¹⁷ For A330/A340 series airplanes, resolution = 0.5°C.
¹⁸ For Dassault F900C/F900EX airplanes, Radio Altitude resolution = 1.25 ft.
¹⁹ For A330/A340 series airplanes, resolution = 0.352 degrees.
²⁰ For A318/A319/A320/A321 series airplanes, resolution = 4.32%. For A330/A340 series airplanes, resolution is 3.27% of full range for throttle lever angle (TLA); for reverse thrust, reverse throttle lever angle (RLA) resolution is nonlinear over the active reverse thrust range, which is 51.54 degrees to 96.14 degrees. The resolved element is 2.8 degrees uniformly over the entire active reverse thrust range, or 2.9% of the full range value of 96.14 degrees.
²¹ For A318/A319/A320/A321 series airplanes, with IAE engines, resolution = 2.58%.
²² For all aircraft manufactured on or after December 6, 2010, the seconds per sampling interval is 0.125. Each input must be recorded at this rate. Alternately sampling inputs (interleaving) to meet this sampling interval is prohibited.
²³ For all 737 model airplanes manufactured between August 19, 2000, and April 6, 2010: The seconds per sampling interval is 0.5 per control input; the remarks regarding the sampling rate do not apply; a single control wheel force transducer installed on the left cable control is acceptable provided the left and right control wheel positions also are recorded.

[Doc. No. 28109, 62 FR 38390, July 17, 1997; 62 FR 48135, Sept. 12, 1997, as amended by Amdt. 125-32, 64 FR 46121, Aug. 24, 1999; 65 FR 2295, Jan. 14, 2000; Amdt. 125-32, 65 FR 2295, Jan. 14, 2000; Amdt. 125-34, 65 FR 51745, Aug. 24, 2000; 65 FR 81735, Dec. 27, 2000; Amdt. 125-39, 67 FR 54323, Aug. 21, 2002; Amdt. 125-42, 68 FR 42937, July 18, 2003; 68 FR 50069, Aug. 20, 2003; 68 FR 53877, Sept. 15, 2003; Amdt. 125-54, 73 FR 12568, Mar. 7, 2008; Amdt. 125-56, 73 FR 73180, Dec. 2, 2008; Amdt. 125-60, 75 FR 17046, Apr. 5, 2010; Amdt. 125-59, 75 FR 7357, Feb. 19, 2010; Amdt. 125-62, 78 FR 39971, July 3, 2013]

PART 129—OPERATIONS: FOREIGN AIR CARRIERS AND FOREIGN OPERATORS OF U.S.-REGISTERED AIRCRAFT ENGAGED IN COMMON CARRIAGE

Sec.

SPECIAL FEDERAL AVIATION REGULATION NO. 97 [NOTE]

Subpart A—General

- 129.1 Applicability and definitions.
- 129.5 Operations specifications.
- 129.7 Application, issuance, or denial of operations specifications.
- 129.9 Contents of operations specifications.
- 129.11 Amendment, suspension and termination of operations specifications.
- 129.13 Airworthiness and registration certificates.
- 129.14 Maintenance program and minimum equipment list requirements for U.S.-registered aircraft.
- 129.15 Flightcrew member certificates.
- 129.17 Aircraft communication and navigation equipment for operations under IFR or over the top.
- 129.18 Collision Avoidance System.
- 129.19 Air traffic rules and procedures.
- 129.20 Digital flight data recorders.
- 129.21 Control of traffic.
- 129.22 Communication and navigation equipment for rotorcraft operations under VFR over routes navigated by pilotage.
- 129.23 Transport category cargo service airplanes: Increased zero fuel and landing weights.
- 129.24 Cockpit voice recorders.
- 129.25 Airplane security.
- 129.28 Flightdeck security.
- 129.29 Smoking prohibitions.

Subpart B—Continued Airworthiness and Safety Improvements

- 129.101 Purpose and definition.
- 129.103 [Reserved]
- 129.105 Aging airplane inspections and records reviews for U.S.-registered multiengine aircraft.
- 129.107 Repairs assessment for pressurized fuselages.
- 129.109 Supplemental inspections for U.S.-registered aircraft.
- 129.111 Electrical wiring interconnection systems (EWIS) maintenance program.
- 129.113 Fuel tank system maintenance program.
- 129.115 Limit of validity.
- 129.117 Flammability reduction means.

Subpart C—Special Federal Aviation Regulations

129.201 SFAR No. 111—Lavatory Oxygen Systems.

APPENDIX A TO PART 129 [RESERVED]

AUTHORITY: 49 U.S.C. 1372, 40113, 40119, 44101, 44701–44702, 44705, 44709–44711, 44713, 44716–44717, 44722, 44901–44904, 44906, 44912, 46105, Pub. L. 107–71 sec. 104.

SOURCE: Docket No. 1994, 29 FR 1720, Feb. 5, 1964, unless otherwise noted.

SPECIAL FEDERAL AVIATION REGULATION NO. 97

EDITORIAL NOTE: For the text of SFAR No. 97, see part 91 of this chapter.

Subpart A—General

§ 129.1 Applicability and definitions.

(a) *Foreign air carrier operations in the United States.* This part prescribes rules governing the operation within the United States of each foreign air carrier holding the following:

(1) A permit issued by the U.S. Department of Transportation under 49 U.S.C. 41301 through 41306, or

(2) Other appropriate economic or exemption authority issued by the U.S. Department of Transportation.

(b) *Operations of U.S.-registered aircraft solely outside the United States.* In addition to the operations specified under paragraph (a) of this section, §§ 129.5, 129.7, 129.9, 129.11, 129.14, 129.20 and 129.24, and subpart B of this part also apply to operations of U.S.-registered aircraft operated solely outside the United States in common carriage by a foreign person or foreign air carrier.

(c) *Definitions.* For the purpose of this part—

(1) *Foreign person* means any person who is not a citizen of the United States and who operates a U.S.-registered aircraft in common carriage solely outside the United States.

(2) *Years in service* means the calendar time elapsed since an aircraft was issued its first U.S. or first foreign airworthiness certificate.

[Doc. No. FAA-1999-5401, 67 FR 72762, Dec. 6, 2002, as amended by Amdt. 129-43, 72 FR 63413, Nov. 8, 2007; Amdt. 129-45, 73 FR 12570, Mar. 7, 2008; Amdt. 129-45, 74 FR 32801, July 9, 2009; Amdt. 129-49, 76 FR 7489, Feb. 10, 2011]