DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 121, 125, 129, 135

[Docket No. 28109; Amendment No. 121–266, 125–30, 129–27, 135–69]

RIN 2120–AF76

Revisions to Digital Flight Data Recorder Rules

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: This document revises and updates the Federal Aviation Regulations to require that certain airplanes be equipped to accommodate additional digital flight data recorder (DFDR) parameters. These revisions follow a series of safety recommendations issued by the National Transportation Safety Board (NTSB), and the Federal Aviation Administration's (FAA) decision that the DFDR rules should be revised to upgrade recorder capabilities in most transport airplanes. These revisions will require additional information to be collected to enable more thorough accident or incident investigation and to enable industry to predict certain trends and make necessary modifications before an accident or incident occurs.

DATES: *Effective date:* August 18, 1997. Comments on the Paperwork Reduction Act issues presented in this document must be received by September 15, 1997.

ADDRESSES: Comments on this notice should be mailed, in triplicate to: Federal Aviation Administration, Office of Chief Counsel, Attention: Rules Docket (AGC–200), Docket No. 28109, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. 28109. Comments may also be submitted electronically to the following Internet address: 9–nprm–cmts@faa.dot.gov. Comments may be examined in Room 915G weekdays, except on Federal holidays, between 8:30 a.m. and 5 p.m.

FOR FURTHER INFORMATION CONTACT:

Gary E. Davis, Air Carrier Operations Branch (AFS–220), Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591, telephone (202) 267–8096.

SUPPLEMENTARY INFORMATION:

Background

Statement of the Problem

The NTSB submitted recommendations to the FAA to require the recordation of additional parameters on certain fight data recorders. These recommendations were submitted in response to accidents involving two Boeing 737 aircraft that were operated by two different air carriers. Both airplanes were equipped with flight data recorders (FDR's), but in neither case did the FDR provide sufficient information about airplane motion and flight control surface positions during the accident sequence to enable the NTSB to determine a probable cause for either accident.

The history of aircraft accidents and the lack of information that has inhibited proper investigation of their causes is much broader than recent experience with the Boeing 737. Historical records of airplane incidents suggest that additional, reliable data for the entire fleet of transport category airplanes is necessary to identify causes of these incidents before accidents occur. This rule will expand the data collection requirements to include all parameters that can cost-effectively be collected.

History of This Regulatory Action

NTSB Recommendations

On February 22, 1995, the NTSB submitted to the FAA recommendations A–95–25, A–95–26, and A–95–27, which recommended that the FAA require upgrades of the flight data recorders installed on certain airplanes to record certain additional parameters not required by the current regulations.

The following recommendations were submitted by the NTSB to the Federal Aviation Administration:

I. Require that each Boeing 737 airplane operated under 14 CFR part 121 or 125 be equipped, by December 31, 1995, with a flight data recorder system that records, as a minimum, the parameters required by current regulations applicable to that airplane plus the following parameters: lateral acceleration, flight control inputs for pitch, roll, and yaw, and primary flight control surface positions for pitch, roll, and yaw. (Classified as Class I, Urgent Action) (Recommendation No. A–95–25)

II. Amend, by December 31, 1995, 14 CFR §§ 121.343, 125.225, and 135.152 to require that Boeing 727 airplanes, Lockheed L–1011 airplanes, and all transport category airplanes operated under 14 CFR parts 121, 125, or 135 whose type certificates apply to airplanes still in production, be equipped to record on a flight data recorder system, as a minimum, the parameters listed in ''Proposed Minimum FDR Parameter Requirements for Airplanes in Service'' plus any other parameters required by current regulations applicable to each individual airplane. Specify that the airplanes be so equipped by January 1, 1998, or by the later date when they meet Stage 3 noise requirements but, regardless of Stage 3 compliance status, no later than December 31, 1999. (Classified as Class II, Priority Action) (Recommendation No. A–95–26)

III. Amend, by December 31, 1995, 14 CFR 121.343, 125.225, and 135.152 to require that all airplanes operated under 14 CFR parts 121, 125, or 135, having 10 or more seats and for which an original airworthiness certificate is received after December 31, 1996, record the parameters listed in ''Proposed FDR Enhancements for Newly Manufactured Airplanes'' on a flight data recorder having at least a 25-hour recording capacity. (Classified as Class II, Priority Action) (Recommendation No. A–95–27).

FAA Response to the NTSB Recommendations

On March 14, 1995, the FAA published in the **Federal Register** a notice of a public hearing, and solicited public comment concerning the NTSB recommendations. On April 20, 1995, the public hearing was held in Washington D.C. Eight speakers from the aviation community made presentations. Copies of the presentations have been placed in the docket for this rulemaking.

After considering the information obtained through the public forum, the FAA responded to the NTSB recommendations. A summary of that response was published in Notice No. 96–7, and is summarized here:

In response to Safety Recommendation A–95–25, the FAA stated that it agrees that Boeing 737 airplanes that operate under 14 CFR part 121 or 125 should be equipped with flight data recorders that include, as a minimum, the parameters referenced in this safety recommendation. This proposed rule would require all Boeing 737 airplanes as well as certain other airplanes operated under 14 CFR parts 121, 125, or 135 having 10 or more seats to be equipped to record the parameters that were specified by the NTSB.

The FAA received enough valid information from the public to determine that the schedule for retrofit completion by December 31, 1995,

could not be met. The proposed date would have imposed an extremely aggressive retrofit schedule that, if it were physically possible, would have resulted in substantial airplane groundings and very high associated costs. Furthermore, if operators had been required to retrofit all Boeing 737 airplanes before the end of 1995, each of these airplanes might have had to undergo a second retrofit to meet the expanded requirements that were proposed in response to NTSB Recommendations A–95–26 and –27

In response to NTSB recommendation A–95–26, the FAA agrees that airplanes still in production should be required to be equipped with DFDR's that record, as a minimum, the parameters listed in the NTSB recommendation.

In response to NTSB recommendation A–95–27, the FAA agrees that airplanes operated under parts 121, 125, or 135 having 10 or more seats for which an original airworthiness certificate is received after December 31, 1996, should record the parameters listed in ''proposed FDR Enhancements for Newly Manufactured Airplanes'' on a flight data recorder having at least a 25-hour recording capacity.

Aviation Rulemaking Advisory Committee Participation

After reviewing the comments submitted pursuant to the NTSB recommendations and listening to the presentations, the FAA determined that it would be beneficial to have aviation industry personnel assist in any related rulemaking efforts. On June 27, 1995, the FAA published a notice in the **Federal Register** that the Aviation Rulemaking Advisory Committee (ARAC) established the Flight Data Recorder Working Group (60 FR 33247), which included members representing the Air Transport Association, Aerospace Industries Association of America, General Aviation Manufacturers Association, Regional Airline Association, Air Line Pilots Association, and the FAA. The NTSB was invited to participate in working group efforts in an advisory capacity. The working group's task was to recommend to ARAC rulemaking proposals or other alternatives that would satisfactorily address the NTSB recommendations. The ARAC could then make one or more recommendations to the FAA, and the FAA would determine whether to issue a proposal based on the ARAC recommendation.

The DFDR Working Group met over the course of several months. While many of the issues concerning flight data recorder upgrades were settled, no formal recommendation was forwarded to the FAA by the ARAC. A full discussion of the issues considered by the working group was included in Notice 96–7.

NPRM No. 96–7

On July 16, 1996, the FAA published an NPRM addressing revisions to digital flight data recorder rules and solicited public comment to the proposed amendments. The proposals were based on meetings attended by FAA, ARAC, and NTSB personnel. Twenty-six commenters responded, each addressing multiple issues. Their comments have been placed in the docket. Although numbered comments in the docket indicate 28 commenters responded, several submittals were duplicates. Comments to the NPRM are discussed in detail in the ''Discussion of Comments to the NPRM'' section of this document.

Supplemental Notice of Proposed Rulemaking, SNPRM No. 96–7A

As a result of some comments received and further analysis within the FAA, the FAA determined that some issues not included in the NPRM, but related to the proposal, should have been included. These issues included: (1) Applicability of the requirements to airplanes placed on the operations specifications of a U.S. operator after a certain date; (2) a compliance date for certain aircraft that must be retrofitted with DFDR equipment as a result of a change in policy announced in notice 96–7; (3) information regarding airplanes that should be exempted from the requirements proposed in notice 96–7; and (4) a requirement to use a 25-hour recorder, which is the industry standard, rather than the 8-hour recorder currently required. Because three of the issues were not included in the initial proposal, and because the FAA needed more information to make a determination regarding all four of the issues, the agency published a supplemental proposal on December 10, 1996 (61 FR 65142), and solicited public comment. Six comments were received; they are discussed in detail in the ''Discussion of Comments to the SNPRM'' section in this document. After analysis of all comments received, the FAA has adopted final rule language that includes items proposed in the SNPRM.

Discussion of Comments to the NPRM

Flight Systems Engineering, Inc., comments on the requirement for recordation of lateral acceleration on airplanes with one or two engines. It states that to the best of its knowledge, the ''trade-in'' program to upgrade from dual to tri-axial accelerometers was considered, but is not currently available and it doubts it will ever be. The commenter estimates the cost of the tri-axial accelerometer to be $3,000 per aircraft plus associated engineering and installation costs. The commenter believes that the accelerometer information can be obtained through analysis of other available data. In addition, the commenter states that to require a sampling rate of twice per second (rather than the current once per second) as proposed for certain parameters may generate costs to industry that the commenter does not consider to be cost beneficial.

FAA Response: The FAA acknowledges that this rule will place some economic burdens on operators. According to information received by the FAA, however, the $3,000 per aircraft for a tri-axial accelerometer is a maximum cost for a new unit, which, in practice, the FAA maintains will not be installed in all cases. Rather, modified units will be used wherever possible. The FAA does not agree that the commenter's proposed method of obtaining the information through analysis is a reasonable alternative that would satisfy the NTSB recommendation. No changes have been made as a result of this comment.

Patriot Sensors and Controls Corporation (Patriot) comments that it would cost approximately $2000 in 1997/1998 dollars to upgrade the lateral acceleration sensor from a dual axis to a tri-axial configuration. Patriot emphasizes that to accomplish the upgrade in a timely manner, upgrades of its units should be scheduled as soon as possible after issuance of the final rule. It emphasizes that it can not guarantee timely accomplishment for any order received later than 18 months prior to the final date of compliance.

FAA Response: The FAA appreciates the comment from Patriot; the FAA notes that the costs for modification of existing units presented by the commenter are approximately one third less than those presented by the operators for new units. Further discussion of other comments concerning the economic impact of this rule are contained in the Regulatory Evaluation section of this preamble.

AVRO International Aerospace comments that the proposed list of parameters appears to have been developed to address a specific type of airplane that has experienced a small number of accidents, and that the proposed list of parameters may not be the most appropriate for general application. AVRO also states that the

European codes have been formalized for adoption through JAR Ops and that it considers the FAA's action to extend requirements beyond the EUROCAE ED–55 standards (ED–55) without a full consultation with JAA authorities to be contrary to the spirit of the JAR/FAR Harmonization program.

FAA Response: The FAA acknowledges that the requirements proposed in the NPRM could appear to have been developed to address a specific type of airplane, and expanded to merely include all airplanes. However, the parameters proposed to be recorded involve functions of all airplanes, and may provide data over a wide range of incidents and accidents. Accordingly, in response to the NTSB recommendation, the FAA has included all transport category airplanes in this rulemaking action. The FAA disagrees that extended U.S. requirements require full consultation with JAA authorities. The ARAC working group considered current international standards where they exist, and realized that restricting the upgrades to ED–55 standards would not satisfy the NTSB recommendation. The standards proposed are harmonized with the current JAR-Ops, which are based on the ED–55 standards; the additional U.S. requirements have no JAR counterpart with which to harmonize. No changes were made as a result of this comment.

Aerospace Industries Association (AIA) submits technical comments and editorial comments regarding typographical errors. For parameter 88, all cockpit flight control input forces (control wheel, control column, rudder pedal), AIA comments that the force sensor accuracy in the appendix should be changed from ''+/−5%'' to ''+/−5% or +/−15% of actual, whichever is greater or as installed.'' AIA also comments that the accuracy values in the appendix for the Force Sensor Range for Wheel, Column, and Pedal ranges of parameter 88 should be changed to include the words ''or as installed'' after the numerical values. Also for parameter 88, AIA suggests the following language be added to the remarks column: ''Force Sensor Range requirements are based on FAR 25.143(c).'' Finally, AIA suggests that the Force Sensor requirements in the Accuracy column for parameter 88 should be moved from the Accuracy column to the Range Column.

FAA Response: During ARAC working group meetings, NTSB representatives made it clear that the NTSB needs the full range control forces to be recorded as outlined in the NPRM with no exceptions. Force Sensor Range requirements in this rule are not based on the requirements in § 25.143(c) because slightly stricter requirements are needed to yield the desired information for accident and incident investigation.

The FAA agrees that the Force Sensor requirements for parameter 88 should be moved from the Accuracy column to the Range Column in the appendices; the change is reflected in this final rule.

AIA also commented that the following should be added to the Remarks column in the appendices for parameters 82, Cockpit trim control input position—pitch, 83, Cockpit trim control input position—roll, and 84, Cockpit trim control input position—yaw: ''Where mechanical means for control inputs are not available, Cockpit Display Trim Positions should be recorded.'' Its rationale for the change is that modern transport aircraft do not always use mechanical trim controls.

FAA Response: The FAA concurs and the language in the Remarks column in the appendices for parameters 82, 83, and 84 has been revised.

Finally, AIA comments that the language in the Remarks column in the appendices for parameter 32, Angle of attack (if measured directly), is incomplete and should be changed to read as follows: ''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 seconds as required.''

FAA Response: The FAA concurs and the language in the Remarks column in the appendices for parameter 32 has been changed. Also, all typographical errors noted in AIA's comments have been corrected in this final rule.

Embraer comments on the technical aspects of several proposed items; the commenter states that airplanes fitted with conventional mechanical flight controls should be allowed to record either the flight control input or the control surface position. The commenter further states that derived information for control input and control movement can be demonstrated for its aircraft. Embraer also comments that due to technical constraints such as sensor reliability, low level signal treatment, and aircraft installation, plus cost restraints and the low priority given to cockpit flight controls forces (as evidenced by their location in the order of the parameter list), it considers the recording of these parameters unnecessary. Embraer also comments that to be able to accommodate 88 parameters, it will be necessary to replace existing recorders that record 64 to 128 words per second (wps) with a new one capable of recording 256 wps, which is not presently available on the market. Embraer also submits cost figures for updating its software and hardware.

FAA Response: The NTSB recommendations on which this rulemaking action is based indicate that both control input and surface position are necessary for both conventional mechanical flight controls and fly-by wire controls. Past accident investigations support the need for this data. Further, although the NTSB has used derived information in support of some findings in accident investigation, the NTSB has noted that derived information may include too many variables to support the determination of probable cause of an accident.

The FAA acknowledges that some technical constraints regarding force sensors may currently exist. The recordation of the associated parameter, however, is not required until 5 years from the effective date of the final rule, and the FAA anticipates that within the next 5 years, these technical constraints will be overcome. Also, with regard to the ability to record 256 wps, the FAA maintains that there are recorders available today that include this technology, and expects them to be more readily available within 5 years, when newly manufactured airplanes must have recorders capable of recording all 88 parameters.

The FAA acknowledges that the DFDR enhancements proposed by this rule are expensive and that a recognized safety return may not immediately be recognized. However, the FAA maintains that the information collected will aid in accident and incident investigations and will help detect trends so that corrective measures can be taken before an accident occurs, and that collection of this data is in the public interest.

The FAA notes that the additional cost information submitted by Embraer is consistent with information submitted by ARAC working group members during development of the NPRM. Further discussion of other comments concerning economic issues can be found in this preamble under the section ''Regulatory Evaluation.'' No changes were made to the proposal as a result of Embraer's comment.

Sheehan Consultants comments that the acceleration resolutions need to be upgraded in the final rule from 0.01g to 0.004g's to be consistent with the requirements in ED–55. It states that the change would have no impact on current recorders because they already meet the ED–55 requirements. The commenter states that accident investigators need very fine resolution to observe an airplane bouncing on the

joints of a runway during taxi, takeoff, and landing, as well as other quick flight path changes, structural breakup, and explosions.

FAA Response: The FAA agrees that the resolution for all three acceleration parameters in parts 121, 125, and 135 should be changed to harmonize with the EUROCAE document ED–55. The final rule reflects the change in the resolution column of the appendices for parameters 5, 11, and 18 to read 0.004g's.

Aerospatiale and Alenia (ATR), manufacturers of ATR airplanes, comment that compliance with the primary flight control and master warning recording requirements would involve significant software modification and hardware modification of the flight data acquisition units (FDAU's), plus additional wiring. The two manufacturers state that the design changes would cost $100,000 per aircraft for U.S. operators for parts and labor, in addition to down time associated with completing the modifications. ATR requests that some flexibility be introduced into the requirements that would take into account certain design features such as flight control characteristics or aircraft weight. In addition, ATR states that harmonization with the EUROCAE ED–55 requirements should be considered for the retrofit requirements.

FAA Response: The FAA acknowledges that there may be alternatives to obtaining data other than direct recordation. However, the proposed sampling rates, resolution readouts, and parameter list in the NPRM represent contributions from all members of the ARAC working group. The ARAC working group made every effort to match the requirements in the proposal to both the requirements in ED–55 and the NTSB recommendations, and the FAA has determined that the differences are insignificant for U.S. operators. No changes were made as a result of this comment.

Airbus Industrie agrees with the statement in the preamble of Notice 96–7 that more flight data yields better results when investigative authorities are trying to determine the cause of an accident or incident. It suggests, however, that requirements for recording stick shaker/stick pusher, yaw or sideslip angle, and hydraulic pressure are not necessary because the information can be derived from other data, or because the information is not relevant to the understanding of system operation. Airbus Industrie also suggests that the rule should retain the current language that would allow the proposed terms ''record'' and ''recorded'' to be replaced respectively with the terms ''determine'' and ''able to be determined.'' In addition, Airbus Industrie comments that it has always installed advanced recording systems on its aircraft, but that aircraft already equipped to record 88 or more parameters may not be recording all of those proposed in the NPRM. Airbus Industrie suggests that the FAA require recordation of only those parameters included in EUROCAE ED–55, and states that anything else would constitute disharmony with European regulations. The commenter does not oppose the recordation of additional data, but would like to see more international involvement to determine what addition data should be included, and suggests that the effort be addressed within the ICAO and within the FAA/JAA Harmonization Work Program under the ARAC process before additional parameters beyond ED–55 are added.

Airbus Industrie also suggests that proposed §§ 121.344 and 125.226 be revised so that current FDR's that already record the necessary parameters, but not at the specific sampling or resolution readouts listed in Appendix K (corrected to read Appendix M), not be required to incur retrofit costs simply to meet those Appendix M values. Airbus Industrie believes that the introduction of this flexibility would result in significant cost savings to industry without jeopardizing the capability of investigating events.

FAA Response: The FAA acknowledges that there may be alternatives to obtain data other than direct recordation. However, the proposed sampling rates, resolution readouts, and parameter list in the NPRM represent contributions from industry representatives, the FAA, and the NTSB. During ARAC working group meetings, the NTSB argued that information gathered from interpretation was not as reliable as direct recordations, as discussed above. Some industry representatives did not agree. After further discussion, the working group decided that, to respond to the NTSB recommendations on which this rulemaking is based, the rule would be written with a requirement for direct recordation of the parameters listed. Although Airbus Industrie presents an alternative to obtaining information directly from a flight data recorder, the FAA has determined that justification provided by Airbus Industrie is not sufficient to overcome the NTSB's arguments that information gathered from interpretation is not as reliable as direct recordation. Accordingly, there was no change to the proposal as a result of this comment.

As previously stated, the FAA disagrees that international disharmony occurs as a result of this final rule. The ARAC working group made every effort to make the proposal identical, where applicable, to the requirements of ED–55. However, the FAA has determined that those requirements alone are insufficient for U.S. operators or U.S.-registered airplanes, and in fact would not satisfy the intent of the NTSB recommendations. Accordingly, the FAA proposed the additional requirements. The FAA disagrees with the suggestion that more international involvement is needed to develop U.S. regulations that govern U.S. operators and U.S.-registered airplanes. No changes were made as a result of this comment.

Fairchild Aircraft, Inc. (Fairchild), opposes the requirement for newly manufactured 10–19 seat airplanes to record 57 parameters effective 3 years after the effective date of the rule, and 88 parameters effective 5 years after the effective date of the rule. As proposed, the rule would require that these airplanes include a flight data acquisition unit (FDAU), plus the sensory devices and associated wiring for each (additional) parameter. Fairchild states that compliance with current § 135.152 and implementation of the proposed § 121.344a(a) is more than adequate for the size and complexity of any airplane in the 10–19 seat category. It is the commenter's understanding that the goal of this rule-making is to provide information regarding accidents and incidents as they occur, and it notes that 10–19 seat aircraft have no history of accidents of undetermined cause.

Fairchild believes that the money needed to comply with the proposed regulations could be better spent improving overall operations. It states that an FDR will not increase the level of safety in the 19-seat airplane, and will probably diminish the level of safety, because funds will be diverted to comply with something of no value versus something of positive value. Fairchild also states that, if adopted, the proposal would have a significant negative impact on the competitiveness of current operators and airplanes made in the United States that are sold on the international market. Fairchild believes the proposed changes would increase operating costs and thus negatively affect future sales in both the United States and foreign markets, particularly to customers in developing nations. Finally, Fairchild submits some cost

information, as well as the following technical comments:

Fairchild recommends deletion of § 121.344a (b) and (c), which would require newly manufactured airplanes with 10 to 19 seats to install enhanced DFDR's. Fairchild also notes that in § 121.344a(a)(1)(iv), a typographical error occurs; the second reference to Appendix B should instead be a reference to Appendix M.

Fairchild points out that the FH227 listed in parts 121 and 125 does not belong to Fairchild Aircraft, Inc., as stated in the proposal.

Fairchild requests that the following airplane types be added to the list of airplanes that need not comply with the requirements in § 121.344a, but continue to comply with the requirements in § 135.152: SA227–AC, SA227–TT, SA227–AT, and SA227–BC. As justification, Fairchild submits that these airplanes were manufactured prior to October 11, 1991, and are not commuter category airplanes.

FAA Response: As stated in the NPRM, when the NTSB made its recommendations in February 1995, the FAA has not yet issued its rule that requires most airplanes that have 10–19 seats that were formerly operated under part 135 to operate pursuant to the requirements of part 121 beginning in March 1997. Because the purpose of that rulemaking action was to establish ''one level of safety,'' the NPRM associated with this final rule, and all rules developed from this point forward, reflect that agency policy. Recognizing the differences between larger airplanes operating under part 121 and those designed to carry 10–19 passengers, the FAA developed a special section in the NPRM to specifically address the flight data recorder requirements for these airplanes. The ARAC working group discussed and decided that the intent of the NTSB recommendations was to capture all airplanes regularly used in commercial service, including those that began operating under part 121 beginning in March 1997.

The FAA disagrees with the suggestion to delete § 121.344a (b) and (c) for newly manufactured airplanes. The suggestion is inconsistent with the NTSB recommendations, and no alternative to satisfy the recommendation was suggested. No change was made as a result of this comment.

The FAA agrees that the second reference to Appendix B in § 121.344a(a)(1)(iv) is an error; ''Appendix B'' should read ''Appendix M.'' The rule has been revised accordingly.

The FAA finds that insufficient information was submitted to justify the addition of the following planes to the list of airplanes that need not comply with the requirements in § 121.344a, but continue to comply with the requirements in § 135.152: SA227–AC, SA227.TT, SA227–AT, and SA227–BC. The fact that airplanes were manufactured before October 11, 1991, is not considered sufficient to justify their exclusion. No change was made as a result of this comment.

The FAA agrees that the FH227 does not belong to Fairchild Aircraft, Inc., and the final rule has been revised to reflect the aircraft is a product of Fairchild Industries.

All typographical errors noted by the commenter have been corrected in this final rule.

Southwest Airlines (SWA) comments that the language proposed in § 121.344(b)(3) be changed to remove reference to installation no later than the next heavy maintenance check that occurs after two years after the effective date of the final rule. The commenter believes the final rule should only require compliance by the final date of the rule and should not include any milestones or restrictions. In addition, SWA comments that the sampling rates given in Appendix M have been increased from the rates initially proposed by ARAC working group members, and that the higher sampling rates may require additional modifications and expense.

FAA Response: The issue addressing the earliest possible compliance time was discussed in the preamble to the NPRM. In that document, the FAA stated that that ''heavy maintenance check'' provision was added to prevent operators from waiting until the last minute to install upgrades, causing a logjam in scheduling and equipment availability. The proposed sampling rates reflect those needed by the NTSB to aid in accident and incident investigations. No changes were made as a result of this comment.

Airborne Express comments that lateral acceleration cannot be recorded at the specified recording intervals using the Loral F800 flight data recorder. Airborne Express states that 70% of its fleet is fitted with the Loral F800, and to replace these recorders would constitute an undue burden. The commenter suggests that language be changed to reflect that, except for the Boeing 737, lateral acceleration should not be required to be recorded unless sufficient capacity is available on the existing recorder to record that parameter and that the recording ranges, accuracies, and recording intervals be limited to those specified in current Appendix B to part 121. In addition, Airborne Express asks for clarification of the term ''capacity'' as it is used in proposed § 121.344(b)(1)(i) so it can determine whether it can comply with the proposed rule language.

FAA Response: According to Loral, the manufacturer of the F800 recorder, lateral acceleration can be recorded for the Airborne Express installation if a nonrequired parameter is removed from the input to the recorder, and the existing spare channels are used. The term ''capacity'' refers to the design of a recorder to be able to record a certain number of parameters and store them for 25 hours. For example, a recorder may have a capacity to record 32 wps for 25 hours, 64 wps for 25 hours, 128 wps for 25 hours, etc. No changes to the rule were made as a result of this comment.

Piedmont Airlines (Piedmont) comments that although it agrees with the NTSB in the importance of information retrieved from FDR's, it believes ''the one size fits all'' approach to rulemaking is not an efficient or cost effective method. Piedmont believes the primary reason for the rule is two unresolved accidents that were due to loss of control. However, they do not agree that those accidents justify the proposal to obtain directly recorded data as opposed to obtaining information through alternative methods. Piedmont submits examples of two airplanes that will have to undergo some retrofit to comply with the rule as proposed. Piedmont believes that those airplanes are clear examples that existing recorded data is adequate for accident prevention and investigation, and that the proposed requirement will result in a costly retrofit for the purpose of a data-gathering exercise that is not justified by any benefit/cost comparison. Piedmont believes it would be cost beneficial to require recording up to 17 parameters but it disagrees that, other than for powered flight controls, both the control surface and the input need be recorded.

FAA Response: The FAA realizes that this rulemaking action may appear to be intended for certain airplanes that have been involved in accidents, the cause of which has not been determined. As stated in the NPRM, the FAA has determined that since the cause of these accidents is unknown, it is possible that similar incidents may occur on other airplane types. Therefore, the FAA finds that the need to record additional flight data is applicable to all airplanes covered by the final rule. The FAA recognizes that DFDR's do not in and of themselves prevent accidents; they are

used as an investigative tool when accidents or incidents occur. However, the FAA does not agree that continuing the current level of data collection is acceptable for future accident investigation. The FAA recognized in the NPRM that additional flight data can be collected cost-effectively, particularly in light of the NTSB recommendations. No changes were made as a result of these comments.

Twin Otter International, Ltd. (TOIL) and its affiliate by ownership, Grand Canyon Airlines, Inc. (GCA) comments that its members use deHavilland DHC–6–300 airplanes in their operations. This airplane type went out of production before October 11, 1991. TOIL claims that the DHC–6–300 was not designed to accommodate flight data recorders, and that installation would require extensive redesign and would be prohibitively expensive. In addition, the manufacturer is not interested in participating in the cost of certifying and retrofitting the airplanes for flight data recorder installation and no other airworthiness authority worldwide requires a DFDR in the DHC–6–300. TOIL states that no DHC–6–300 has ever been equipped with a DFDR.

The commenter states that the reversal of the policy determination addressed in Notice 96–7 would create a regulatory inconsistency because 12 of its DHC–6–300 airplanes would be required to be retrofitted, while 26 others owned by the companies would not. It states that the same airplane type brought onto the register after October 11, 1991, is no less safe than one brought on before that date, and recommends that in lieu of reversing the policy determination, the FAA should revise proposed § 121.344a to read ''manufactured after October 11, 1991,'' in lieu of ''brought onto the U.S. register after * * *'' that date. Further, the commenter points out, airplanes of foreign registration (not required to comply with U.S. DFDR requirements) may be allowed to be operated in the United States by a U.S. air carrier without being on the register, and would have an economic advantage over U.S.-registered airplanes.

FAA Response: Twin Otter International, Ltd. presented significant evidence why the DHC–6 airplane (Twin Otter) should be exempted from the flight data recorder upgrade requirements proposed in the NPRM, and the final rule includes an exemption for the DHC–6, whether the airplanes are operated under part 121 or part 135.

The FAA fully considered the popularity of this aircraft model in the sightseeing industry, and determined that the exemption is still appropriate. The FAA does not agree with TOIL's characterization of the effect of the policy change announced in notice 96–7, nor that the policy announced in Flight Standards Information Bulletin 92–09 should be codified. The revised policy states that airplanes previously registered in the United States that were removed and brought back on the register after October 11, 1991 are not ''grandfathered'' and must install flight data recorders. This interpretation is consistent with both the language and the intent of the current rule. While the FAA acknowledges that the October 11, 1991 date creates two classes of airplanes that are otherwise the same, any other method of distinguishing airplanes that must be retrofitted would have an equally bifurcated effect. TOIL's proposed solution to use October 11, 1991 as a date of manufacture to distinguish those airplanes to be retrofitted is a solution only for aircraft out of production; airplanes in production would continue to be separated into two classes by the date regardless of how identical two airplanes were when they came off the production line. The 1991 ''brought on the U.S. register'' date was adopted in 1988, and a well-defined class of airplanes was established. The FAA has no reason to now disrupt the applicability of the flight data recorder requirements by changing from one date to another when it would not solve the problem described by the commenter. Nor does the FAA agree with the commenter that, as a class, airplanes that are no longer being produced should be categorically exempted from the DFDR requirements.

In a comment to the NPRM, Twin Otter International, Ltd. (TOIL) comments that two classes of airplanes are created by the ''brought on the U.S. register'' language because foreign registered airplanes may be operated in the United States. This issue was raised by the FAA in the SNPRM to this rule, and the agency proposed that the applicability of the regulation be changed to include airplanes brought onto the U.S. register or airplanes that are foreign registered and added to an operator's U.S. operations specification after October 11, 1991. As explained in the preamble to the SNPRM, the original language was adopted to minimize costs and to deter the importation of older, non-DFDR equipped airplanes. The fact that the language created a separate standard for non-U.S. registered airplanes was unintentional; the FAA always intended to cover all of the airplanes operating domestically. TOIL did not comment on the change proposed in the SNPRM. Based on the comment of TOIL, the final rule language includes an exemption for the Twin Otter. No other changes were made based on this comment.

The Regional Airlines Association (RAA) comments that it supports the enhancement of FDR recording parameters where the benefits can be shown to justify the costs, and suggests that the compliance period be extended to 6 years. RAA supports the proposed rule as it applies to newly manufactured aircraft. However, RAA states that many of the proposed requirements to retrofit new recording parameters into existing airplanes have not been shown to provide a direct safety improvement or to be cost effective, and that requiring installation will impose a severe economic burden on affected operators, resulting in increased costs of travel to the public, and thus should be eliminated.

FAA Response: The FAA recognizes that the DFDR enhancements proposed by this rule may be costly and may not provide immediately recognized benefits. However, cost alone cannot justify ignoring the potential safety gain represented by the improvements required by this rule. The FAA has determined that this final rule should be promulgated as in the public interest, and RAA has not submitted sufficient justification to show that it is not in the public interest. No changes were made as a result of this comment.

The Air Line Pilots Association (ALPA) agrees with the proposal except for the proposed compliance period, and suggests that the FAA contact FDR and FDAU manufacturers directly to validate the economic information supplied in the NPRM. The commenter believes that the four year compliance period outlined in the proposed rule for the retrofit of FDR's is too long, and that three years is more appropriate.

FAA Response: The FAA relied heavily on the industry members of the ARAC working group to supply accurate economic information, including costs of parts, labor, and aircraft down time. The information was provided in aggregate form based on major cost components, not in detail. Therefore, contacting the manufacturers of specific parts such as the FDR's and FDAU's would not yield useful additional economic information. During development of the proposal, the ARAC working group discussed extensively the most appropriate compliance period—one that would be practical both technologically and economically. Manufacturers and operators argued that four years is necessary to redesign any

affected areas, and to incorporate any needed retrofits into a regular maintenance schedule in order to minimize the down time required for installation of DFDR enhancements. The FAA also notes that the required upgrades may be accomplished sooner than the prescribed four years; the final rule requires the installation of the DFDR no later than the next heavy maintenance check, or equivalent, after two years after the effective date of the final rule. No changes were made as a result of this comment.

General Aviation Manufacturers Association (GAMA) comments that the FAA has gone beyond the scope of the NTSB recommendations by including 10 to 19 passenger airplanes in the NPRM. GAMA also states that it considers the requirements proposed not to be cost beneficial, and thus a final rule should not be published. GAMA indicates that requiring enhanced DFDR's would not support the theory of eventual zero unexplained accidents per year simply by increasing the number of parameters being monitored. The commenter states that a regulatory analysis is not provided for newly manufactured airplanes and feels this is necessary by law and is essential. GAMA also disagrees with the FAA's conclusion that the cost of developing a 256 word per second recorder is insignificant. It cites the requirement to develop standards through committees, and the issue of possible import design and data correlation as additional cost burdens. GAMA comments that the FAA highlights the benefits of the NPRM and downplays costs, and that the proposal does not adequately quantify the benefits. The FAA should be required to conduct a full and complete cost analysis of the total NPRM impact prior to issuing a final rule. GAMA further maintains that although the FAA states that no disharmony is created in the proposal, it disagrees, and lists areas of possible conflict as parameters 40, 41, 42, and 44.

GAMA also comments that the NPRM should include rule language that would exclude retrofit requirements for existing airplanes operated under part 135 for on-demand service, and would exclude those newly manufactured airplanes to be operated under part 135 for on-demand service. Likewise, the commenter states that the proposed amendments should include language that the amendments would not apply to any airplane type certificated for nine or fewer passenger seats or any rotorcraft.

GAMA also comments that several of the parameters' names or corresponding remarks are ambiguous and need to be further clarified. It further comments that the rule language should be changed to include in the rule text the appendix remarks concerning flight control breakaway capability; suggests that the dual coverage requirement for conventional axes be deleted; and suggests that the requirement for recordation apply to only aircraft axes that are augmented.

For newly manufactured airplanes, GAMA believes there are differences between parameters that some operators have chosen to record and proposed parameters 58–88. GAMA asks whether operators must cease recording parameters of choice or those required in the JAR-Ops and/or ED–55, and instead record the proposed extended parameters. GAMA believes clarification is needed regarding these issues.

FAA Response: As explained in the NPRM, when the NTSB made its recommendations in February 1995, the FAA had not yet issued its rule that requires most airplanes that have 10–19 seats that formerly operated under part 135 to comply with the requirements of part 121 beginning in March 1997. Because the purpose of that rulemaking action was to establish ''one level of safety,'' the NPRM associated with this final rule, and all rules developed from this point forward, reflect that agency policy. Recognizing the differences between larger airplanes operating under part 121 and those designed to carry 10–19 passengers, the FAA developed a special section in the NPRM to specifically address the flight data recorder requirements for these airplanes. The ARAC working group discussed and decided that the intent of the NTSB recommendations was to capture all airplanes regularly used in commercial service, including those 10–19 seat airplanes that began operating under part 121 in March 1997.

The FAA recognizes that increasing the number of recorded parameters may not realize an immediate safety return, but maintains that the information collected will aid in accident and incident investigations, and will help detect trends so corrective measures can be taken before an accident occurs. The FAA also maintains that as more information is recorded, the occurrence of unexplained accidents and incidents will decrease.

Regarding the commenters statements addressing the cost/benefit analysis, an analysis for newly manufactured airplanes, costs associated with developing a 256 word per second recorder, and other cost burdens: these and other comments concerning economic impact are discussed further in the Regulatory Evaluation section of this preamble.

The FAA disagrees that disharmony is created in the proposal, and notes that harmonization does not mean identicality. The final rule is as similar as practicable with international standards, where they exist, and goes beyond international standards only to accommodate the NTSB recommendation, which is the original basis for this rulemaking action.

The FAA disagrees that the proposed rule language should be changed to exclude retrofit requirements for existing airplanes operated under part 135 for on-demand service. As proposed, the rule is not applicable to these airplanes. Only those part 135 airplanes that operate scheduled, commuter operations that have transferred to part 121 as of March 1997 will be subject to retrofit requirements in this rule. The FAA also disagrees that the proposed rule language should be changed to exclude newly manufactured airplanes that will be operated in on-demand service. For reasons stated in the preamble to the NPRM, the FAA finds that all airplanes affected should comply with the new regulations, regardless of the nature of their operation. The FAA disagrees with the commenter's suggestion that language be added to exclude airplanes certificated for nine or fewer passenger seats and all rotorcraft. Section 135.152 does not apply to airplanes with nine or fewer passenger seats, and the proposed language in § 135.152(f) applies only to airplanes that would be required to be equipped in accordance with §§ 135.152 (a) or (b), as appropriate.

With respect to the commenter that some of the parameter name and corresponding remarks are ambiguous, the FAA notes that the names and remarks have evolved over time and are generally accepted by industry. The names and remarks were discussed during the ARAC working group meetings in which GAMA participated. No technical concerns over the names of the parameters were raised by the commenter at the time or subsequently by any other commenter. The nature of the commenter's questions concerning specific parameter names will be considered in preparation of the Advisory Circular already under development.

The FAA disagrees that the text contained in the appendix ''Remarks'' column should be incorporated into the rule language for flight control breakaway capability parameter. The FAA has determined that this addition would be confusing for a single parameter and that the text should

remain in the ''Remarks'' column of the appendix.

The FAA disagrees that the dual coverage requirement for conventional axes should be deleted and that the requirement for recordation should apply to only aircraft axes that are augmented. The FAA finds that both of these requirements are needed to meet the NTSB recommendations.

Regarding the issue of recording required parameters rather than recording parameters of choice (or those required in the JAR-Ops and/or ED–55), the final rule states the parameters that must be recorded in each appropriate section. An operator may choose to record parameters beyond those required, but must record the required parameters. The FAA acknowledges that some operators may have to change the parameters currently being recorded, unless an operator chooses to replace its equipment for that with greater capacity.

The National Air Transportation Association (NATA) comments that proposed § 135.152 should be revised in the final rule to differentiate the applicability of the new requirements by ''kind of operation'' in which a 10 to 30 seat airplane is used. It also comments that the final rule language should be clarified concerning its applicability to 10 to 30 seat airplanes used in part 135 on-demand operations. The FAA is unable to understand clearly NATA's comment regarding proposed regulations for airplanes brought onto the U.S. register on or before October 11, 1991. The FAA concludes that NATA is suggesting that affected commuter airplanes operated under § 121.344a that are brought onto the U.S. register after October 11, 1991, should be required to meet only existing part 135 requirements. NATA appears to believe that there is no justification in requiring two sets of regulations for the same airplane type simply because of registration date, and suggests that the October 11, 1991, date be deleted and that the date of manufacture be used instead. NATA agrees with the exclusion of rotorcraft and airplanes certificated with nine or fewer passenger seats from the regulations, but feels that the term ''multiengine,'' which is included in current § 135.152 (a) and (b), should be included in proposed §§ 135.152 (i) and (j).

FAA Response: The FAA appreciates the NATA comment but it does not agree that applicability is an issue for this final rule. The FAA recently promulgated new part 119, which determines the type of operation that is applicable to an on-demand or commuter operation. When using the definitions of part 119, it is clear that § 135.152 applies to on-demand operators of the 10–30 seat airplanes, and that § 121.344a applies to scheduled commuter operators. The FAA acknowledges that DFDR's do not in and of themselves prevent accidents; they are used as an investigative tool when accidents or incidents occur. However, it does not agree that continuing to obtain the current level of information required to be recorded by § 135.152 without obtaining any new information is acceptable for future accident investigation. Similarly, the FAA does not agree with NATA that the term ''multiengine'' should be included in the new §§ 135.152 (i) and (j) for certain newly manufactured airplanes. In its deliberations, the FAA decided that a new, single-engine, turbine-powered airplane capable of carrying 10 to 30 passengers should meet the same standard as the multiengine airplane carrying the same number of passengers. Since NATA has not submitted any additional justification that would warrant different treatment of these airplanes, no changes were made as a result of this comment.

The Air Transport Association (ATA) generally supports the proposed rule, but expresses disagreement in the following areas. ATA comments that because the FAA proposes more parameters than are included in the JAR-Ops, harmonization is not achieved, and suggests that the FAA should restrict its list of parameters to those required by European standards, even if it means keeping the number of newly manufactured airplane DFDR parameters at 57. ATA also comments that increasing sampling rates in newer generation aircraft is not cost effective and recommends that several parameters be recorded at a sampling rate of once per second rather than twice per second as proposed. (The specific parameters will be addressed in the FAA reply.) In addition, ATA requests clarification regarding those aircrafts that fall under the requirements of Appendix B and have the flight control breakaway capability that allows either pilot to operate the controls independently.

ATA comments that the Lockheed Aircraft Corporation Electra L–188 should be included on the list of airplanes that would not have to comply with the new proposal. The L–188 is out of production but remains in service. ATA also comments that the Loral 800 FDR does not have the capacity to record lateral acceleration at the rate of 4 words per second, as proposed. A two-engine airplane equipped with the Loral F800 is only capable of recording this parameter at a rate of 1 wps. ATA recommends that Appendix B be revised to allow a recording rate of 1 wps for lateral acceleration for airplanes equipped with 32 wps recorders.

Also, ATA comments that the NPRM does not take into account aircraft with specialized data acquisition that may be capable, for example, of recording primary axis controls, either by pilot inputs or by surface position, but is not capable of recording both. ATA maintains that software to support this unique system is not available, which would result in the need to install extensive rewiring and expensive hardware.

ATA also comments that some of the accuracies listed in the NPRM for certain parameter sources differ from the accuracy as defined by the aircraft manufacturer, and suggests that when this happens, the manufacturer's accuracy should apply over the affected range.

ATA comments that some operators have established their DFDR Maintenance Programs using the current Appendix B parameter numbers for tracking and compliance purposes. ATA recommends that the final rule allow those operators that have a parameter-number-based FDR maintenance program to add the new parameters (numbers) to the original list, their maintenance manuals, and word cards.

ATA states that the FAA's time frame for compliance is more reasonable than that proposed in the NTSB recommendations, but still maintains there will be a tremendous burden on manufacturers, operators, and suppliers, as well as the FAA. Although FAA rejected ATA's earlier recommendation to establish a phased compliance schedule, ATA now suggests the FAA should survey operators annually after the effective date of the rule to determine the status of operator retrofit programs.

ATA states that with a few exceptions, its cost estimates generally agree with the data presented by the FAA in the proposed rule. It states, however, that some costs were not addressed in the NPRM, and consequently, ATA feels the FAA's cost estimates underestimate the total program costs.

FAA Response: The FAA disagrees that disharmony occurs as a result of this final rule. The ARAC working group made every effort to make the proposal identical, where applicable, to the requirements of ED–55. However, the FAA has determined that those requirements are insufficient to satisfy NTSB recommendations for U.S. operators, and has thus provided some

additional requirements. The FAA recognizes that there may be other alternatives to obtain data, but no comprehensive alternative that would meet the NTSB recommendations has been presented, nor cost data submitted for comparison. The proposed sampling rates, resolution readouts, and parameter list in the NPRM were developed with input from industry representatives, the FAA, and the NTSB. The FAA has determined that justification provided by ATA is not sufficient to change the proposal.

The FAA agrees that the Lockheed Aircraft Corporation Electra L–188 should be included in the list of airplanes that need not comply with these amendments, and the applicable sections have been revised in the final rule.

The FAA does not agree that the Loral F800 is incapable of recording 4 samples per second (the FAA assumes ATA misquoted the NPRM when it said 4 words per second), as proposed. According to the manufacturer of the F800 recorder, lateral acceleration can be recorded at 4 samples per second if a nonrequired parameter is removed from the input to the recorder, and the existing spare channels are used.

Regarding specialized equipment configurations, the FAA requested for specific comment from TWA and other operators that may find themselves in unique circumstances. Although the ATA comment points out a unique problem with specialized FDAU's, the limitations are of recording system capacity caused by out-of-date software. The FAA is not inclined to revise the proposed rule in such a way to encourage the continued use of old, insufficient software. The FAA does acknowledge that extenuating circumstances may occur, and so may consider exemptions requesting relief from the recordation of specific parameters if an operator can show that all efforts to rearrange nonrequired parameters and software ''fix'' solutions have been exhausted, and that the only solution would be an expensive equipment upgrade.

The FAA acknowledges that some of the accuracies listed are not the same as those listed by the manufacturers, but maintains that to achieve the minimum level of safety prescribed by the rule, and to maintain the continuity of recorded data, the FAA must establish the standards, not the individual manufacturers.

The comment concerning operator maintenance programs is not a flight data recorder issue, and is beyond the scope of this rulemaking action. The current rule does not prohibit, and the NPRM did not propose to prohibit those operators with a parameter-number-based FDR maintenance program from adding new parameters (by number) to the original list, their maintenance manuals, or word cards.

Regarding the commenter's suggestion to survey operators annually after the effective date of the rule to determine the status of operator retrofit programs, the FAA finds that the exercise would serve no useful purpose and would require additional resources and paperwork. Operators may submit their DFDR retrofit status at any time on a voluntary basis. During working group discussions, it was decided that a phased-in compliance schedule would not be necessary because affected airplanes could be retrofitted with any newly required equipment at the time of a heavy maintenance check. A separate DFDR retrofit schedule could conflict with other established maintenance schedules and increase costs.

Discussion of economic comments can be found in the Regulatory Evaluation section of this preamble. Except where noted above, no changes were made as a result of this comment.

The National Transportation Safety Board disagrees with the FAA's proposed compliance dates for newly manufactured and existing aircraft, and with the minimum parameter requirements for existing aircraft. It also disagrees with the FAA's decision not to require more expeditious flight control parameter upgrades for Boeing 737 airplanes, as required by the Board in its Recommendation A–95–25, and now suggests a December 1997 compliance date for retrofit of these airplanes.

In addition, for newly manufactured airplanes, the NTSB comments that most of the 88 parameters included in the FAA's proposal are currently being recorded, or are capable of being recorded with little cost, by existing FDR systems. Therefore, the NTSB believes that there does not appear to be a justifiable technical or economic reason for not requiring a full 88-parameter installation on newly manufactured aircraft by 3 years after the date of the final rule.

The NTSB also comments that the parameter ''Overspeed Warning'' should be added to the parameter list for newly manufactured airplanes, and that the final date should explain in greater detail the significance of the Appendices Header, which reads ''The recorded values must meet the designated range, resolution and accuracy requirements during dynamic and static conditions. All data recorded must correlate in time to within one second.'' The NPRM does not make it clear that this statement may have a significant impact on some existing airplanes with FDR parameters that do not reflect the actual condition of the aircraft during certain dynamic conditions. Certain data may not be recorded accurately due to filtering that takes place prior to recording.

The NTSB would like the FAA to change the proposed language to require non-FDAU equipped aircraft to be equipped with FDAU's and believes that the benefit would justify the additional $50,000 per aircraft cost of this retrofit. Adding a FDAU enables the recording of all the FDR parameters recommended by the Board in Recommendation 95–26. It would also provide reserve capacity for future FDR parameter needs that may become necessary in the future as a result of accident investigations and/or technology advancements.

In addition to the 1997 compliance date for Boeing 73 retrofits and the 3-year compliance date for newly manufactured airplanes, the NTSB suggests that industry should be able to retrofit the affected existing fleet within 2 years from the issuance of the final rule, rather than the 4 years proposed in Notice 96–7.

FAA Response: The FAA has fully explored with ARAC the NTSB recommendations concerning the Boeing 737 and a 2-year versus 4-year compliance date. During the course of the ARAC working group deliberations, the aircraft manufacturers presented and justified arguments that they would need more than 3 years to incorporate the engineering designs necessary to accommodate the proposed parameters that are beyond those listed in ED–55. The FAA published the result of those deliberations in the NPRM, which provided the rationale for these proposals and the retrofit of the existing fleet. The aviation industry provided information that indicated a 2-year retrofit schedule would be prohibitively costly, and that it may be technologically impossible to complete a fleet retrofit in less than 4 years. In addition, a mandatory 2-year retrofit schedule would have had a major effect on the traveling public due to unscheduled groundings of airplanes that would be necessary to meet the requirement. During ARAC discussions, industry and the FAA found that a 2-year retrofit would be burdensome, and discussed whether a faster retrofit would result in expenditures that would undermine separate attempts to find the cause of incidents and accidents. Finally, the FAA determined that a 4-year compliance time would permit the operators to schedule DFDR retrofits during a major maintenance check, e.g.,

a ''D'' check, while the aircraft is at a maintenance facility that has the equipment and technical capability to perform the installation and the modifications to the airframe. The NTSB has presented no new persuasive arguments that would justify changing the proposal.

Since the Pittsburgh (Aliquippa) Boeing 737 accident, Boeing has concentrated its efforts on using the available actual data and derived data to better understand the possible causes of this accident. Boeing has recently introduced changes in the Boeing 737 rudder system that it believes will prevent future rudder-induced rollover accidents. The FAA acknowledges the merits of the Boeing program and notes that such activities could be cut short if time and resources had to be directed toward meeting an accelerated DRDR retrofit schedule. At best, the recording of additional parameters may highlight where a problem exists. The rudder redesign efforts of Boeing, however, are a positive action that might prevent future accidents, and care must be taken not to inhibit such actions unnecessarily.

At the 1995 public hearing on flight data recorder upgrades, the FAA stated that it hoped that airlines would not wait for a government mandate before upgrading recorders. The FAA has received information that at least one major operator of Boeing 737 airplanes has already made a substantial commitment to upgrading its airplanes before the compliance date mandated in this rule. The FAA applauds this dedication to an important safety initiative and encourages equally aggressive compliance schedules from other operators.

The Board's suggestion to add to the parameter list of ''Overspeed Warning'' was not raised during the NTSB's participation in the ARAC working group. The FAA is not including in the final rule in an effort to maintain consistency with the proposed rule and the substantial cost analyses done by industry for the parameters already proposed. The FAA will consider adding the parameter in future rulemaking.

The NTSB requests a more detailed explanation of the Appendices Header that, as proposed, reads: ''The recorded values must meet the designated range, resolution and accuracy requirements during dynamic and static conditions. All data recorded must correlate in time to within one second:.'' The FAA added the requirement for a dynamic test condition to ensure accurate dynamic recording of aircraft performance. This requirement was necessary to preclude the presumption that information that may be obtained from filtered or modified signals. Correlation must be within one second between recorded data and actual performance. The FAA agrees that further explanation of these tests is needed, and intends to address the test procedures in an upcoming Advisory Circular to clarify the recording of dynamic and static conditions, and other acceptable means of compliance with the rule.

The original NTSB recommendations did not fully recognize the considerable constraints of DFDR retrofit of older airplanes that are out of production and are not equipped with flight data acquisition units (FDAU's), and for transport category airplanes whose type certificates apply to airplanes still in production. The NTSB did not recommend that 88-parameter recorders be installed in those airplanes. The ARAC team discussed the differences between FDAU-equipped and non-FDAU-equipped airplanes and recognized that the NTSB recommendation could not be fully accommodated without a FDAU retrofit of older airplanes. However, the costs related to redesign and retrofit were found to be excessive when compared to the benefits gained in older, less complex airplanes. Therefore, the ARAC team recommended different retrofit requirements for three different categories of airplanes, depending on their age and equipment already installed. Those categories and requirements were discussed in Notice No. 96–7, and are summarized in a chart printed in this preamble. The FAA has fully debated this issue and disagrees with the NTSB comment concerning FDAU retrofit of older airplanes, including that an additional $50,000 cost per older aircraft is justified. The FAA finds that the NTSB has submitted no new information that either was not considered by the FAA or that would justify developing a supplemental notice to incorporate this comment. No changes have been made as a result of the NTSB comment.

Several members on staff at the West Virginia University (WVU) comment that a virtual flight data recorder that they have been developing is capable of achieving the same result that an actual flight data recorder can, at much lower costs to industry. Congressman Nick J. Rahall II and Senator John D. Rockefeller IV, both of West Virginia, and the Air Transport Association (ATA) submitted comments in support of the WVU comment. The ATA states that the FAA and the NTSB should fund this technology.

FAA Response: The information presented in this comment is beyond the scope of this rulemaking action. It is ultimately the responsibility of the NTSB to determine whether this technology would be a useful accident investigation tool and provide the necessary funding for future research. The commenter's suggested methods of obtaining information from ''virtual'' flight data recorders in lieu of the proposed expanded flight data recorders, while interesting, would not satisfy the NTSB recommendations being addressed in this final rule, especially considering the NTSB's expressed need for directly recorded data. No change was made as a result of this comment.

An individual comments that the FAA does not provide a cost benefit analysis in the NPRM. In addition, the commenter believes the proposed rule is unnecessary and will not automatically improve aviation safety. He presents a number of hypothetical probable causes for accidents discussed in the preamble of the NPRM and suggests that improved inspection, maintenance, and training would better serve to prevent similar accidents. The commenter also states that it is necessary to record both pilots' inputs (force and displacement) as well as the control surface positions.

FAA Response: The NPRM contains a summary of a cost-benefit comparison. A more complete analysis is contained in the docket. The FAA disagrees that the proposed rule is unnecessary, although the immediate safety benefits may not be readily apparent. Currently, DFDR's are being used to aid accident investigation. Furthermore, the FAA is convinced that the enhanced data collection required by this rule will improve the accuracy and completeness of accident and incident investigations through the collection and analysis of more information. In addition, the FAA finds that the enhanced data collection required by this rule, and other voluntary measures being implemented by the air carriers, will provide enough data to recognize trends that may adversely affect flight operations in certain airplanes. Manufacturers and operators can analyze these trends and take corrective measures, if necessary, to avoid potential accidents or incidents.

The FAA agrees that improved inspection, maintenance, and training are important elements of preventing accidents, but that there is no acceptable substitute for the additional data that will be gathered as a result of this rule.

Regarding the comment on the requirement for recording from the pilot and the copilot both force and displacement, the FAA maintains that

the rule provides for the recording of both pilots' inputs. For clarification, the information in the ''Remarks'' column has been revised in the final rule.

An individual comments that he would like to see another item added to the NPRM in light of the recent crashes of ValuJet and TWA. Specifically, he suggests that the rule require an independent, lightweight, stand-by power supply to the CVR and FDR in the event of main bus power failure. He believes that power source should be available for 5 to 10 minutes. He believes that the NTSB agrees with his comment and asks for consideration in future rules if this comment cannot be included in this rulemaking.

FAA Response: The commenter did not present enough information to support the idea that a stand-by power supply would be useful during a catastrophic failure in which the recording sensors are disabled or destroyed. Since power sources for flight data recorder equipment were not part of the notice, the comment is beyond the scope of the rule, and no changes were made as a result of this comment.

Discussion of Comments to Proposals for Part 129

Airbus Industrie comments that it believes the most recent international standards, as established by ICAO, should be sufficient to meet the intent of the NTSB recommendations, and believes that to require additional standards for non-U.S. operators would impose heavy retrofit costs. The commenter believes that most parameters proposed can, with currently installed equipment, be either recorded directly or reliably determined from other data, and requests that more flexibility be allowed to derive certain parameters from other data as an alternative to direct recording.

FAA Response: The ARAC working group made every effort to make the proposal identical, where applicable, to the requirements of ED–55. However, the FAA has determined that those requirements alone are insufficient to satisfy the NTSB recommendations for U.S.-registered airplanes. Also, the FAA recognizes that there may be alternative methods available to obtain information, other than direct recording, but has determined that direct recordation is the most reliable method, and the best one to accomplish the needs of the NTSB. The NTSB has investigated a number of proposals wherein the proposed parameters were derived; however, the NTSB was not convinced that the methodology demonstrated was as accurate as direct recordation. No changes were made as a result of this comment.

Lufthansa German Airlines comments that a four-year compliance time is not sufficient to modify its fleet and maintains that, at a minimum, six years would be needed.

FAA Response: The commenter did not indicate the size of its fleet that would be subject to the retrofit requirements; however, the FAA would like to point out that the part 129 requirements apply only to U.S.-registered airplanes, not to the commenter's entire fleet. The FAA maintains that extending the compliance time would not significantly reduce the cost or down time involved per airplane. Since the commenter provided no further information regarding maintenance schedules or why the commenter could not meet a 4-year compliance date, no changes were made as a result of this comment.

Japan Airlines Company, Ltd. (JAL) comments that its Aircraft Integrated Monitoring System (AIMS) FDAU is almost fully occupied by parameters that JAL uses for monitoring on-board and ground-based operations. JAL maintains that requiring the recordation of additional parameters or increasing sampling rates would require modifications (including reviewing and rearranging all of the word slot assignments in its FDAU's) that would cost several million dollars and would require several months to accomplish. JAL requests that the FAA exempt from the final rule those airlines that are currently operating with AIMS, or to exempt those airlines from the proposed increased sampling rates for DFDR parameters.

FAA Response: As stated previously, the FAA acknowledges that some operators may have to change their preferred programming to accommodate recordation of the required parameters. The categories of aircraft retrofit created by this rule were chosen carefully to account for the majority of aircraft of a certain age and equipment installations. The requirements were set so as to not require overall equipment replacement for minimal gains. Accordingly, the FAA cannot exempt any aircraft simply because it is part of an AIMS-type system, as suggested by the commenter, without ignoring the carefully established categories. Moreover, JAL states that ''most of the newly-requested parameters are already recorded in (JAL's) DFDR,'' and that compliance would require a rearrangement of word slot assignments. JAL has not shown that this presents an undue regulatory burden or one that was not already considered by the FAA in this rulemaking.

The FAA again acknowledges that this rule will place some economic burdens on operators. Discussion of comments on economic issues can be found in the Regulatory Evaluation section of this preamble.

No other comments were received pursuant to these proposals. In the absence of sufficient, persuasive justification that is necessary to change the proposed regulations, they are adopted as proposed.

Discussion of Comments to the SNPRM

Two commenters stated that they support the proposals in the SNPRM.

TOIL submitted further comment to justify exemption of the DHC–6–300 from the DFDR retrofit requirements. The commenter's main concern is with ''the proposed reversal of policy established by Flight Standards Information Bulletin 92–09'' and again urges the FAA to adopt its previous policy interpretation regarding airplanes brought onto the register after October 11, 1991, and to codify that previous policy. TOIL did not offer comments on the proposals in the SNPRM.

FAA Response: The commenter seems to have misunderstood that the change in policy announced in the NPRM was a ''proposed'' reversal of policy. The change in policy was a determination already made; the NPRM was merely a conduit for announcing the change since the subject matter was relevant to the NPRM and the affected parties would be notified more efficiently using that document. As stated in the NPRM and the SNPRM, the previous policy interpretation was found to be inconsistent with the text of the rule. The FAA cannot, in good faith, allow operators to continue to operate without complying with the rule and has made no changes to the rule addressing the change of policy. Further explanation is provided in this preamble in the section, ''Discussion of Policy Change'' below.

One individual commented that the rule should address alternate methods of powering recording devices, stating that sometimes the busses powering the recorders are turned off for isolation purposes in the event of an emergency that involves fire or smoke.

FAA Response: The FAA acknowledges the merit of this comment; however, the issue it addresses is outside the scope of this rulemaking; it may be considered in a future rulemaking action. No changes were made as a result of this comment.

RAA comments that neither the NPRM nor the SNPRM have provided

data to suggest that adoption of the proposals will result in a reduction of accidents, and therefore the final rule should not be applicable for aircraft where it is shown that disproportionate economic hardship would result. The commenter feels that aircraft with 10 to 19 passenger seats should be affected only if they are newly manufactured after October 11, 1991 (as opposed to being brought onto the U.S. register, as the rule currently states). RAA comments that if the FAA does insist on adopting the rule as proposed, the 2 year compliance time stated in the SNPRM should be revised to 4 years, stating that it doesn't make sense to propose a 2 year compliance time for some airplanes and 4 years for others.

FAA Response: The FAA acknowledges that immediate benefits from this rule may not be readily recognized in terms of reducing accidents, and that DFDR's themselves can prevent accidents. However, to respond to the NTSB recommendations to provide better investigative tools for accidents and incidents, the FAA undertook this rulemaking action. Aviation industry representatives supplied the FAA with figures for the economic evaluation that was presented in the NPRM. The cost figures that the RAA submits in this comment refer only to the DHC–6–300, an airplane with a unique combination of cost factors. The FAA has determined that the DHC–6 will not have to comply with the DFDR requirements. Other operators that can justify why their airplanes should also be exempt, discussing the criteria outlined in the preamble of the NPRM and the SNPRM, may petition to have their airplanes added to the exemption paragraph in part 135.

The FAA agrees that the 2-year compliance time for airplanes of operators that ''thought their aircraft were grandfathered to meet the current requirements of part 135, not for installation of an upgrade'' should be revised to read 4 years, and those affected airplanes will have 4 years to come into compliance. The compliance time language that was included in the SNPRM has been removed to avoid any confusion in compliance times. Affected operators have four years to comply, whether operating under part 135 or part 121. Further explanation is provided in this preamble in the section, ''Discussion of Policy Change'' below.

The NTSB agrees with the intent of the SNPRM, but comments that specific language is needed to prevent part 121 operators from operating foreign-registered aircraft fitted with FDR's that have as few as five parameters. The commenter also states that the language intended to correct the policy decision discussed in the NPRM and SNPRM is somewhat confusing. The commenter feels that exemptions to § 135.152 should be handled through the exemption process on a case-by-case basis rather being addressed in rule language, and agrees that the ''out of production'' argument is not a sufficient reason for exclusion. The NTSB agrees that the increase in the minimum FDR recording duration for part 135 aircraft from 8 to 25 hours is an appropriate and timely change.

FAA Response: The language proposed in the SNPRM, that the flight data recorder requirements of § 135.152 apply to aircraft registered outside the United States but placed on the U.S. operations specifications of an operator, is included in the final rule. In its comment, the NTSB indicates that specific language should also be added to part 121 requirements to ensure that all aircraft operated in part 121 service, including those under foreign registration, are operated in accordance with the flight data recorder requirements of that part. The NTSB indicates that § 121.153 would permit the use of foreign-registered aircraft that record only 5 parameters of flight data. The FAA disagrees with the NTSB's reading of § 121.153. Paragraph (c)(2) of that section requires that foreign-registered aircraft operated under part 121 must meet all of the requirements ''of this chapter (14 CFR Chapter 1),'' which includes all of the part 121 requirements. Thus, any foreign-registered airplane operated under part 121 must meet the FDR requirements as though the aircraft were registered in the United States.

However, after further consideration, the FAA has decided that § 121.344a should contain the same language as § 135.152 concerning aircraft placed on the operations specifications of an operator. The ''brought on the U.S. register'' language of § 135.152 was repeated in new § 121.344a(a), and the correction proposed for § 135.152(a) in the SNPRM also applies to § 121.344a(a). The language is included in the final rule for clarity and parallelism between the two sections. The FAA does not want to cause confusion in the applicability of § 121.344a for airplanes that are subject to it beginning in March 1997.

The FAA agrees that the simple fact that airplanes are out of production is not sufficient justification for their exclusion from the DFDR requirements. The number of out of production airplanes still operating is significant, and many airplanes have too much economic life remaining to allow them to operate with no or limited flight data recorders. The FAA disagrees that any exception to this rule be handled as exemptions on a case-by-case basis. The FAA does not grant blanket permanent exemptions, and use of that process would necessitate the reapplication of affected parties every two years. The FAA does not anticipate that circumstances would change so as to justify later the retrofit of the airplanes listed in this final rule as exempt. Further, because these exceptions are listed for aircraft types, it is more efficient to list them as part of the rule rather than having individual operators apply on behalf of themselves and all affected operators of a certain airplane type design.

Discussion of Policy Change

In the preamble to Notice No. 96–7, the FAA announced a change in policy regarding certain airplanes that were brought on the U.S. register after October 11, 1991 (61 FR 37154, July 16, 1996). The language of current § 135.152 is clear that any aircraft subject to that section that was brought onto the U.S. register after that date would have to meet the flight data recorder requirements of that section. As explained in that Notice, there has been at least one previous policy determination that certain airplanes—those that were on the register before October 11, 1991, were taken off, and were added to the register again after October 11, 1991—do not have to meet the DFDR requirements because of their previous registration. As noted, this policy is inconsistent with the clear language of the rule, and with the recently adopted rules making part 135 scheduled commuter airplanes subject to part 121 beginning in March 1997.

Comments to the NPRM and SNPRM, and telephone inquiries by operators, indicate to the FAA that some commenters thought that this is a proposed policy change. Commenters also took the opportunity to suggest alternative policies to cover these airplanes, including a change in § 135.152 to make it applicable only to airplanes manufactured after October 11, 1991. (See response at discussion of TOIL's comments, above.) Further, the NPRM did not contain any proposed compliance time for aircraft affected by the policy change, nor did it specifically indicate that the policy change affects all aircraft—airplanes and rotorcraft—subject to § 135.152.

In the SNPRM, the FAA proposed to give operators that had been operating under the old policy two years to comply with the regulation. The

commenters note, however, that this places a burden on some operators, and could cause operators of certain airplanes that are now subject to part 121 requirements to possibly undergo a second retrofit—first to meet § 135.152 because of the policy change and again to meet § 121.344a.

The FAA agrees that the proposed compliance time of two years may be short, and understands the confusion that resulted from the change in policy being announced in the NPRM and discussed again in the SNPRM. Accordingly, the policy change is effective on the effective date of this final rule. Operators of airplanes or rotorcraft that were operating pursuant to the old policy will have four years from the effective date of this rule in which to comply with § 135.152. Affected operators should note, however, that there is no change to the rule language of § 135.152 to indicate that this compliance period exists. The FAA found that a change in the rule language could be interpreted to apply to all operators, rather than those affected by the policy change; the compliance date proposed in the supplemental notice is not adopted in this final rule.

Changes Adopted in the Final Rule

As a result of comments to the NPRM, the following changes were made:

(1) The Lockhead Aircraft Corporation Electra L–188 airplane was added to the list of airplanes that need not comply with proposed §§ 121.344 and 125.226, but must continue to comply with § 121.343 or 125.225, whichever is appropriate:

(2) The reference to Fairchild Aircraft, Inc. FH 227 was corrected to reflect the manufacturer of the FH 227 is Fairchild Industries;

(3) In all appendices, the following comment was added to the Remarks column for Parameter #88: For airplanes that have a flight control break away capability that allows either pilot to operate the controls independently, record both control force inputs. The control force inputs may be samples alternatively once per 2 seconds to produce the sampling interval of 1;

(4) Technical changes to the appendices, including sampling rates; and

(5) Typographical errors were corrected and minor editorial changes were incorporated.

As a result of the SNPRM and comments to the SNPRM, the following changes were made:

(1) Proposed § 121.344a(a) and comment § 135.152(a) were revised to include turbine-engine-powered airplanes having a passenger seating configuration, excluding any required crewmember seat, of 10 to 19 seats, that were brought onto the U.S. register after, or that were registered outside the United States and added to the operator's U.S. operation specifications after, October 11, 1991;

(2) Section 135.152(k) was added to state that the deHavilland DHC-6 (The Twin Otter) airplane need not comply with DFDR rules. Parts 121 and 125 already included exception paragraphs; the DHC-6 was the only part 135 airplane for which justification was shown to grant noncompliance;

(3) References in part 135 to 8 hours of recorded aircraft operation were revised to read 25 hours, which reflects the current industry standard; and

(4) The rule language proposed in the SNPRM to allow a 2 year compliance time for airplanes currently not in compliance was not adopted in the final rule. These aircraft were operating without DFDR's based on a previous policy interpretation, the reversal of which was announced in the preamble of the NPRM. The policy interpretation was changed to be consistent with the current rule language, and no change in the rule language is necessary.

(5) Each of the exemption paragraphs has been revised to indicate that the exemption applies only to aircraft manufactured before the effective date of this final rule.

FLIGHT DATA RECORDER UPGRADE REQUIREMENTS

Category 1 No FDAU*, mfd on or before 10/11/91	Category 2 FDAU, mfd on or before 10/11/91	Category 3 FDAU, mfd after 10/11/91	Category 4 FDAU, mfd 3 (or 5) years after final rule
CURRENT PARAMETERS			
11 parameters	17 parameters	Up to 29 parameters	29 parameters
PROPOSED PARAMETERS			
17/18 parameters	17–22 parameters	34 parameters	57 parameters (3 years) 88 parameters (5 years)
AIRPLANES			
1929 airplanes over 30 seats; 727, 737, DC–8, DC–9, F–28	1360 airplanes over 30 seats 704 turboprops A–320, 737, 747, 757, 767, DC–10, F–28, MD–80, ATR–42, EMB–120, SAAB 340, DHC–8, L–1011	1036 airplanes over 30 seats 673 airplanes 10–19 seats 277 airplanes 20–30 seats 737, 747, 757, 767, 777, F–100, MD–11, MD–80, MD–88, MD–90, ATR–72	All newly manufactured airplanes Existing derivatives and any new type certificates

*FDAU=Flight Data Acquisition Unit

International Compatibility

The FAA has reviewed corresponding International Civil Aviation Organization regulations and Joint Aviation Authority regulations, where they exist. Any differences between those documents and these regulations are of a minor, technical nature, and are deemed insignificant. As noted in the discussion of comments, the review included the technical material for parameters numbered 1 through 57. Beyond parameter 57, no international standards exist. The differences noted above will not adversely affect harmonization.

Paperwork Reduction Act

This final rule contains information collections which are subject to review by OMB under the Paperwork Reduction Act of 1995 (Pub. L. 104–13). The title, description, and respondent description of the annual burden are shown below.

Title: Revisions to Digital Flight Data Recorders Rules.

Description: This regulation revises and updates the Federal Aviation Regulations to require that certain airplanes be equipped to accommodate additional digital flight data recorder (DFDR) parameters. These revisions follow a series of safety recommendations issued by the National Transportation Safety Board (NTSB), and the Federal Aviation Administration's (FAA) decision that the DFDR rules should be revised to upgrade recorder capabilities in most transport airplanes. These revisions will require additional information to be collected to enable more thorough accident or incident investigation and to enable industry to predict certain trends and make necessary modifications before an accident or incident occurs.

Description of Respondents: Businesses or other for profit organizations.

There are no annual reporting or recordkeeping burdens associated with this rule. The information is collected automatically, electronically. It is retained for only 25 hours, and is overwritten on a continuing basis. In the event of an accident or incident, the information is downloaded by the NTSB as a part of its statutory mission. The airplane operators are not required to keep the information, nor to report it.

Cost estimates shown here are aggregates for the entire 4-year compliance time frame. In determining capital and start-up costs to the airline industry, the FAA has assumed that in determining the figures, commercial airline operators took into account the annualized expected useful life of the equipment to be installed in their aircraft. Total capital investment costs, as detailed in the Regulatory Evaluation are estimated at $155.4 million ($131.6 million discounted), and engineering costs are estimated at $3.2 million ($2.7 million discounted). Other costs, which include recurrent and nonrecurrent maintenance costs and costs associated with retrieving information from DFDR units following an accident or incident, are estimated at $16.4 million ($11.4 million discounted).

The agency solicits public comment on the information collection requirements in order to: (1) Evaluate whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; (2) evaluate the accuracy of the agency's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used; (3) enhance the quality, utility, and clarity of the information to be collected; and (4) minimize the burden of the collection of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology.

Individuals and organizations may submit comments on the information collection requirements by September 15, 1997, and should direct them to the address listed in the **ADDRESSES** section of this document. Comments should also be submitted to the Office of Information and Regulatory Affairs, OMB, New Executive Office Bldg., Room 10202, 725 17th St. NW, Washington, DC 20503, Attention, Desk Officer for FAA.

Persons are not required to respond to a collection of information unless it displays a currently valid OMB control number. The burden associated with this final rule has been submitted to OMB for review. The FAA will publish a notice in the **Federal Register** notifying the public of the approval numbers and expiration date.

Regulatory Evaluation Summary

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effect of regulatory changes on international trade.

With regard to Executive Order 12866, the FAA determined that this rulemaking is significant because of the substantial public interest in obtaining flight data and the NTSB's ability to conduct full investigations. Accordingly, the FAA evaluated two alternative approaches. In consideration of these alternatives, the FAA has concluded that (1) shortening the compliance time frame to two years as analyzed in the NPRM, would increase the cost of this rulemaking by as much as $170.6 million, discounted; and (2) adopting a simulator methodology to obtain more DFDR parametric detail, although less costly, would not measure all parameters specified in this final rule, nor satisfactorily meet the needs of the NTSB. Hence, the FAA has rejected both of these alternative approaches.

With regard to the Regulatory Flexibility Act of 1980, the FAA has determined that a substantial number of small entities will not be significantly affected economically by this final rule. With regard to the OMB directive, the FAA has concluded that this final rule could have a potential, but insignificant, indirect affect on international trade. A full regulatory evaluation of the final rule providing a detailed discussion of the costs and benefits summarized in this section is available in the docket for this rulemaking action.

Costs

To obtain representative and comprehensive information from which to develop the industry costs of this final rule, the FAA relied on the responses of the Air Transport Association (ATA) and the Regional Airline Association (RAA) members to an air carrier cost survey developed by the ARAC working group. (The FAA augmented this information with adjusted cost analyses from the recently effectively commuter rule). The principle aggregate costs detailed in the cost survey were (1) equipment and inventory/spares; (2) engineering, installation, and other costs, inclusive of recurrent maintenance costs; and (3) aircraft out-of-service costs, which reflect net operating revenue losses resulting from unscheduled aircraft downtime.

The FAA estimates that total costs for air carriers operating turbojets under part 121 would equal $308.9 million ($259.1 million, discounted) within the 4-year compliance time frame of this rulemaking. The equivalent total turboprop fleet costs for air carriers operating under part 121 are estimated to be $30.4 million ($25.8 million, discounted) under the same 4-year compliance time frame. Estimates of the total 4-year compliance time frame costs for part 135, 10–19 seat aircraft required to operate under part 121 as of March 1997 are $26.4 million ($22.3 million, discounted) and for part 135, 20–30 seat aircraft, are $10.9 million ($9.2 million, discounted). Total part 135 costs are $37.3 million ($31.5 million, discounted). Thus, the estimated total 4-year compliance time frame discounted costs for the retrofits required under this final rule are $316.3 million.

The costs associated with upgrading the industry's turbojet fleet with the new DFDR requirements are in excess of 80 percent of the total air carrier industry costs (turbojets, turboprops and part 135 airplanes required to begin operating under part 121 in 1997). Just over 20 percent of the total turbojet fleet costs ($70.1 million; $59.4 million,

discounted) are out-of-service costs or lost net operating revenues that result from this rulemaking. No similar estimates of the out-of-service costs were provided to the FAA for either the turboprop fleet or part 135 carriers that will now be required to operate under part 121. Proportionately however, the FAA does not expect these to be significantly different than those estimated for the turbojet fleet.

Benefits

The FAA finds that the benefits that will result from this final rule can be considered as two interrelated areas. First, there are inherent, non-measurable benefits that evolve from increasing the volume of detailed accident and incident information from which the aviation industry as a whole can draw upon as an added resource. Second, there are the direct, measurable benefits that would result from potentially averting an accident as a result of the DFDR enhancements.

In the first instance, this final rule supports the recent voluntary efforts of those air carriers that have introduced data acquisition enhancements into their newer model airplanes. This subset of new airplanes with upgraded DFDR's has provided certain air carriers with ''quick access'' capability and allowed for the development of integrated maintenance and training programs predicated on the additional information being collected. It has also allowed for more rapid and comprehensive detail to be obtained by the FAA and NTSB in certain recent airplane accidents. The inherent benefits resulting from this rulemaking will evolve as all commercial air carriers adopt the required DFDR enhancements in their airplanes.

Although DFDR's do not in and of themselves prevent accidents, through their use as an investigative tool when accidents or incidents do occur, trends that may adversely affect flight operations in certain airplanes can be determined. Accident investigators in obtaining a greater understanding of the accident dynamics from the DFDR information, can, in turn, be used to more easily determine the probable causes of accidents and incidents. With this knowledge, a ''fix'' can be developed to reduce the chance of a similar occurrence in the future.

In the second instance noted above, although the FAA is not able to quantify precisely the likely benefits that will ultimately result from this rulemaking, the FAA anticipates that the DFDR enhancements required by this final rule will lead to a reduction in accidents and a saving of lives. As a result of analyzing incidents involving aircraft with DFDR enhancements in place, the FAA finds that there is a reasonable prospect that as many as 1.43 accidents could be prevented over the next 20 years. This could save up to 143 lives. The FAA anticipates that, particularly in light of the NTSB recommendations, information concerning enhanced parameters can be collected cost-effectively; it is also expected that the FAA will be able to use incident information to reduce accidents of the nature that are currently of undetermined cause.

Benefit Cost Comparison

The FAA cautions that the cost analysis detailed in the preceding sections is not necessarily exhaustive. The purpose of this rulemaking is to require the installation of DFDR's that record more flight information. This in turn, will allow industry to recognize certain trends in order to make any necessary modifications to avoid future accidents or incidents. Thus, the FAA presumes that, as a result of this rulemaking, the quantity and quality of information will increase. To the extent that NTSB is able to make findings of probable cause in the event of accidents or incidents, the FAA will be able to determine what, if any, appropriate additional action is needed to prevent a recurrence of those kinds of accidents or incidents.

Future FAA actions could take the form of Advisory Circulars, Airworthiness Directives, or possibly, additional rulemaking. The costs of these follow-on FAA actions could vary from negligible costs to considerable costs of some unknown amount. While the costs of such future follow-on actions by the FAA might be considered part of the costs of this rulemaking, the FAA cannot estimate the costs of these unknown future actions. The FAA acknowledges that, to the extent that the costs of any follow-on actions are more than negligible, the current cost estimates would tend to underestimate the total cost of this rulemaking.

Public Comments on Economic Issues in the NPRM

The FAA received comments from twenty-six parties in response to the published DFDR NPRM. Most of the comments concerned engineering and other technical detail germane to the reconfiguration requirements; fewer comments presented any detailed economic considerations of the proposed rule. This was expected since the regulatory evaluation and economic analysis were derived from the airline-specific cost information as provided through the ATA and RAA, both of which participated in the ARAC process. The comments containing more specific economic content are summarized below.

Several commenters addressed specific issues with regard to airplanes currently operating under part 135. Piedmont Airlines notes that the recorders currently used in its ATR–72 record 98 parameters and those used in its SAAB 340 record 128 parameters. In both cases, certain of the parameters specified by this rulemaking are not currently being recorded but could be derived; the cost however, to retrofit these airplanes to be in compliance would be about $100,000 per aircraft. Similarly, Aerospatiale and Alenia (ATR), manufacturers of ATR airplanes, suggest some requirements flexibility should be introduced for those airplanes such as the ATR 42/72 with recorder requirements that are essentially in harmonization with EUROCAE ED–55 requirements.

Comments submitted by the RAA include statements by RAA members that question the rationale of including for retrofit certain aircraft that currently have demonstrably effective recorder systems. In addition to the above noted ATR 42, ATR 73 and SAAB 340, the RAA, in an attachment submitted by Atlantic Southeast Airlines, Inc. (ASA), objects to the retrofit of BAe 146 and EMB–120 aircraft. ASA also cites a previous estimate submitted by Aerospatiale to retrofit the ATR 72 as costing $30,000 and 20 man-hours per aircraft, and a previous estimate submitted by AVRO to retrofit the BAe 146 as costing $110,000, 1200 man-hours, and 2.5 weeks downtime per aircraft.

In another statement submitted with the RAA comment, Comair believes the recorder capabilities currently employed on its in-service fleet far exceed those of the rulemaking's ''target aircraft'', e.g., older 737's and DC–9's. Comair also provided retrofit cost data for its fleet of 40 Embraer EMB 120 aircraft ($51,450 and 6 days downtime per aircraft) and its fleet of 70 Canadair CL600–2B19 regional jets ($136,600 and 6 days downtime per aircraft). Although not part of the RAA comment and attachments, Embraer also provided detailed cost information for the retrofitting of the EMB–120 aircraft under each of the categories specified in the rule. Embraer's retrofit cost estimates are more in line with those presented in the NPRM and considerably less than those cited above.

A statement from USAir Express notes that the cost data submitted by the RAA

were primarily for aircraft operated by RAA members under part 121, not part 135 as estimated in the regulatory evaluation; only the EMB–120 is operated exclusively under part 135. As a consequence, RAA/USAir Express suggest that the FAA cost estimates for retrofitting aircraft operating under part 121 are from 5 percent to 10 percent low.

Finally, Twin Otter International (TOIL) contends that the DHC–6–300, which is no longer in production, was not designed for FDR's and no engineering data exists to support an FDR installation. TOIL estimates the costs to redesign the DHC–6–300 aircraft systems and recertify would be in excess of $130,000, and deHavilland, the Twin Otter manufacturer, has no interest in participating in the cost of certifying/retrofitting the DHC–6–300. TOIL concludes that application of the rule would inhibit the ability of U.S. operators to purchase additional aircraft, particularly since the majority of available Twin Otters are registered outside the U.S.

FAA Response: The FAA appreciates the additional cost detail regarding aircraft operating under part 135 as provided in these comments, as well as the clarification of the cost detail as provided by the RAA. The FAA relied heavily on ARAC working group members to supply accurate and timely cost detail and economic information. This reliance also assumed that the cost detail supplied clearly delineated the retrofit costs associated with aircraft operating under part 135 from those operating under part 121.

With regard to the so-called ''requirements flexibility'' or possible exemption of certain aircraft, this is not a matter for consideration in the regulatory evaluation. It should be noted that the ARAC working group, with significant industry input, concluded that the differences between the NTSB recommendations and ED–55 would be insignificant for U.S. operators. Finally, with regard to the DHC–6–300 airplane (the Twin Otter) the FAA received sufficient information to support the exemption of these aircraft operated under part 135. Section 135.152(k) was added to provide that exemption.

Several comments were received regarding the 88 parameter list for airplanes in category V (those that will be manufactured five years after the effective date of this rule), most of which noted the absence of a detailed cost/benefit analysis specific to this requirement for future newly manufactured aircraft. Airbus Industrie notes an inexact match between the 88 or more parameters currently being recorded by some European manufacturers of FDRs and those on the NTSB list. This is also true of the currently operational A300–600/310 and A319/320/321 aircraft which can record up to 270 parameters and the A330/A340 models which can record up to 400 parameters.

The Air Line Pilots Association (ALPA) notes that the cost data supplied by ATA and RAA was inclusive only up to 57 parameters (category IV), but contends that there is no justifiable technical or economic reason not to include 88 parameters 3 years (not 5 years) after the promulgation of the final rule as is the case with the 57 parameter group. Fairchild Aircraft disagrees with the position that newly manufactured 10–19 seat airplanes should be required to have either 57 parameters within 3 to 5 years after issuance of the final rule or 88 parameters 5 years after issuance of the final rule. Fairchild Aircraft also maintains that compliance with § 135.152 is more than adequate for airplanes operating under part 135. Fairchild Aircraft, one of two U.S. manufacturers of commuter category airplanes also included aggregate recurring and non-recurring cost estimates for retrofitting its Metro 23 airplane to be in compliance with final rule's 57 and 88 parameter requirements. The General Aviation Manufacturers Association (GAMA) notes that under all scenarios, the cost of this rule exceed the benefits and faults the FAA with not having developed separate cost/benefit analysis for newly manufactured aircraft (57 or 88 parameters); GAMA believes this to be required under the law. Finally, ATA contends that the disharmony arising over the 31 parameter discrepancy (88 vs. 57 parameters) would affect sales/transfers of airplanes between European airlines/carriers and U.S. airlines/carriers.

FAA Response: The FAA notes that no cost detail for the 88 parameter list was included in the information provided by ATA or RAA for analysis in the NPRM, and the detail that was provided for the 57 parameter list was incomplete and essentially unusable. In both cases, this was due to the lack of adequate vendor cost detail for products which may not even be on the market as yet, and the generally speculative nature that would be required or air carriers in developing macro cost breakouts for newly manufactured airplanes in the future. These impediments were recognized by the ARAC working group, and, as a consequence, no request for this information was tendered.

With regard to the remaining issues noted above concerning the parameter requirements of newly manufactured airplanes, the potential cost burden, and the apparent excessive cost/benefit ratio, Federal regulations in general, require only that the complete rule be subjected to a cost/benefit analysis, not its component parts. Furthermore, although the cost information provided by ATA and RAA allowed detailed analysis of the first three aircraft categories, an analysis of the benefits cannot be estimated in similar manner; benefits therefore, were determined for the overall rule. Finally, as noted in the preamble, cost alone cannot justify ignoring the recognized potential safety gains inherent in this rule, the inclusion of certain airplanes now operating under part 135 to comply with the requirements of part 121 is a result of the commuter or ''one level of safety'' rule.

With regard to parts vendors and the disaggregation of materials costs, comments were received from two suppliers (Flight Systems Engineering, Inc. and Patriot Sensors and Controls Corporation) and one trade association (Airlines Pilot Association (ALPA)). The vendors' comments addressed the costs of specific equipment components and the lead time required to meet orders. A portion of ALPA's comments focused on the need for a more extensive review of cost data and recommended contacting individual manufacturers of FDRs and FDAUs.

FAA Response: The FAA appreciates the logistics information regarding vendor lead times which are well within the 4-year compliance time of this final rule. The FAA however, notes that the cost data developed for this rulemaking was provided by ATA and RAA at the aggregate level; it does not lend itself to the micro detail of specific retrofit components. No changes to the regulatory evaluation or the rule were made in response to these comments.

Finally, a comment was submitted by the Department of Civil and Environmental Engineering of the University of West Virginia (WVU) proposing an alternative approach to the retrofitting requirements of this rule based on Artificial Intelligence, or more specifically, Neural Network theory. Relying on an alternate set of assumptions, the WVU team estimates the cost of the DFDR final rule at $1.046 billion, or more than three times the FAA estimate, and offers their software-based system, the Virtual Flight Data Recorder (VFDR), as a low-cost alternative. Utilizing the data taken from an existing conventional 11-parameter FDR, the VFDR, according to the WVU

team, would accurately ''reconstruct'' most of the additional parameters detailed in the final rule via a Neural Network mapping process at a cost of about $800–$1,000 per aircraft, or about 1 percent of their cost estimate for this final rule. The WVU comment concludes that the opportunity cost of the hard retrofit is lost savings which could be invested in a variety of safety enhancements.

FAA Response: The FAA appreciates the efforts of the WVU team in presenting an innovative, low-cost ''simulator'' alternative to the hardware retrofits that will be required by this rule. However, the rulemaking is concerned with expanding the number of parameters to be recorded as requested by the NTSB, not with revising the means by which additional data can be collected. The NTSB has made it clear that its requirements must be met by direct parametric measurement via recorder, and has not supported industry comments with respect to parameter redundancy or inference from parameters already recorded. The FAA supports the continued efforts on the part of the WVU team to disseminate VFDR information to the NTSB, FAA Research Office and airline industry. The FAA, through this rulemaking, takes no position at this time on the VFDR or the commenter's measurement of the opportunity costs of this final rule.

Final Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by Federal regulations. The RFA requires regulatory agencies to review rules which may have ''a significant economic impact on a substantial number of small entities.'' For this final rulemaking, a ''small entity'' is an operator of aircraft for hire that owns, but does not necessarily operate, nine (9) aircraft or fewer. A ''substantial number of small entities'', as defined in FAA order 2100.14A—Regulatory Flexibility Criteria and Guidance, is a number (in this instance, the number of operators) that is not fewer than eleven and is more than one-third of the small entities subject to final rule.

A ''significant economic impact'' or cost threshold, is defined as an annualized net compliance cost level that exceeds (1) $122,400 (1995 dollars) in the case of scheduled operators of aircraft for hire whose entire fleet has a seating capacity in excess of 60 seats; (2) $69,800 (1995 dollars) in the case of scheduled operators of aircraft for hire for which the entire fleet has a seating capacity less than or equal to 60 seats; and (3) $4,900 (1995 dollars) in the case of unscheduled operators of aircraft for hire.

The FAA has determined the annualized costs (20 years) for scheduled operators of large aircraft to be $5,611 per aircraft. Multiplying this estimate by 9 (the upper bound of the small entity criteria) yields a result of $50,501. This estimate is significantly below the minimum compliance cost criteria of $122,400 for scheduled operators of large aircraft.

The FAA has also determined the annualized costs (20 years) for scheduled operators of small aircraft to be $3,067 per aircraft. The upper bound costs for consideration within the small entity (9 aircraft) criteria are $27,603, which is well below the minimum compliance cost of $69,800. Thus, the FAA has determined that a substantial number of small entities will not be significantly affected by this final rule.

International Trade Impact Assessment

The FAA anticipates that revisions to digital flight data recorder rules could have some indirect affect on international trade. The FAA finds that while the final rule will not effect non-U.S. operators of foreign aircraft operating outside the United States, it could affect the suppliers of materials required for retrofitting the affected aircraft in the domestic fleet. Domestic sources of the required retrofit components may not be able to meet all of the increased demand of the domestic air carriers for DFDR's as these air carriers increase their orders to meet the compliance time frame for these regulations. Foreign producers may benefit by supplying the unfilled orders.

Conclusion

For the reasons discussed in the preamble, and based on the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the FAA has determined that this final rule is a significant regulatory action under Executive Order 12866. In addition, the FAA certifies that this rule will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This rule is considered significant under Department of Transportation Order 2100.5, Policies and Procedures for Simplification, Analysis, and Review of Regulations. A regulatory evaluation of the rule, including a Regulatory Flexibility Determination and International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under the heading **FOR FURTHER INFORMATION CONTACT.**

List of Subjects

14 CFR Part 121

Air carriers, Aviation safety, Reporting and recordkeeping requirements, Transportation.

14 CFR Part 125 and Part 129

Aviation safety, Reporting and recordkeeping requirements.

14 CFR Part 135

Aviation safety, Reporting and recordkeeping requirements.

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends 14 CFR parts 121, 125, 129 and 135 of the Federal Aviation Regulations as follows:

PART 121—OPERATING REQUIREMENTS: DOMESTIC, FLAG, AND SUPPLEMENTAL OPERATIONS

1. The authority citation for part 121 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 40119, 44101, 44701–44702, 44705, 44709–44711, 44713, 44716–44717, 44722, 44901, 44903–44904, 44912, 46105.

2. Section 121.344 is revised to read as follows:

§ 121.344 Digital flight data recorders for transport category airplanes.

(a) Except as provided in paragraph (1) of this section, no person may operate under this part a turbine-engine-powered transport category airplane unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The operational parameters required to be recorded by digital flight data recorders required by this section are as follows: the phrase ''when an information source is installed'' following a parameter indicates that recording of that parameter is not intended to require a change in installed equipment:

(1) Time;

(2) Pressure altitude;

(3) Indicated airspeed;

(4) Heading—primary flight crew reference (if selectable, record discrete, true or magnetic);

(5) Normal acceleration (Vertical);

(6) Pitch attitude;

(7) Roll attitude;

(8) Manual radio transmitter keying, or CVR/DFDR synchronization reference;
(9) Thrust/power of each engine—primary flight crew reference;
(10) Autopilot engagement status;
(11) Longitudinal acceleration;
(12) Pitch control input;
(13) Lateral control input;
(14) Rudder pedal input;
(15) Primary pitch control surface position;
(16) Primary lateral control surface position;
(17) Primary yaw control surface position;
(18) Lateral acceleration;
(19) Pitch trim surface position or parameters of paragraph (a)(82) of this section if currently recorded;
(20) Trailing edge flap or cockpit flap control selection (except when parameters of paragraph (a)(85) of this section apply);
(21) Leading edge flap or cockpit flap control selection (except when parameters of paragraph (a)(86) of this section apply);
(22) Each Thrust reverser position (or equivalent for propeller airplane);
(23) Ground spoiler position or speed brake selection (except when parameters of paragraph (a)(87) of this section apply);
(24) Outside or total air temperature;
(25) Automatic Flight Control System (AFCS) modes and engagement status, including autothrottle;
(26) Radio altitude (when an information source is installed);
(27) Localizer deviation, MLS Azimuth;
(28) Glideslope deviation, MLS Elevation;
(29) Marker beacon passage;
(30) Master warning;
(31) Air/ground sensor (primary airplane system reference nose or main gear);
(32) Angle of attack (when information source is installed);
(33) Hydraulic pressure low (each system);
(34) Ground speed (when an information source is installed);
(35) Ground proximity warning system;
(36) Landing gear position or landing gear cockpit control selection;
(37) Drift angle (when an information source is installed);
(38) Wind speed and direction (when an information source is installed);
(39) Latitude and longitude (when an information source is installed);
(40) Stick shaker/pusher (when an information source is installed);
(41) Windshear (when an information source is installed);
(42) Throttle/power lever position;
(43) Additional engine parameters (as designated in Appendix M of this part);
(44) Traffic alert and collision avoidance system;
(45) DME 1 and 2 distances;
(46) Nav 1 and 2 selected frequency;
(47) Selected barometric setting (when an information source is installed);
(48) Selected altitude (when an information source is installed);
(49) Selected speed (when an information source is installed);
(50) Selected mach (when an information source is installed);
(51) Selected vertical speed (when an information source is installed);
(52) Selected heading (when an information source is installed);
(53) Selected flight path (when an information source is installed);
(54) Selected decision height (when an information source is installed);
(55) EFIS display format;
(56) Multi-function/engine/alerts display format;
(57) Thrust command (when an information source is installed);
(58) Thrust target (when an information source is installed);
(59) Fuel quantity in CG trim tank (when an information source is installed);
(60) Primary Navigation System Reference;
(61) Icing (when an information source is installed);
(62) Engine warning each engine vibration (when an information source is installed);
(63) Engine warning each engine over temp. (when an information source is installed);
(64) Engine warning each engine oil pressure low (when an information source is installed);
(65) Engine warning each engine over speed (when an information source is installed);
(66) Yaw trim surface position;
(67) Roll trim surface position;
(68) Brake pressure (selected system);
(69) Brake pedal application (left and right);
(70) Yaw or sideslip angle (when an information source is installed);
(71) Engine bleed valve position (when an information source is installed);
(72) De-icing or anti-icing system selection (when an information source is installed);
(73) Computed center of gravity (when an information source is installed);
(74) AC electrical bus status;
(75) DC electrical bus status;
(76) APU bleed valve position (when an information source is installed);
(77) Hydraulic pressure (each system);
(78) Loss of cabin pressure;
(79) Computer failure;
(80) Heads-up display (when an information source is installed);
(81) Para-visual display (when an information source is installed);
(82) Cockpit trim control input position—pitch;
(83) Cockpit trim control input position—roll;
(84) Cockpit trim control input position—yaw;
(85) Trailing edge flap and cockpit flap control position;
(86) Leading edge flap and cockpit flap control position;
(87) Ground spoiler position and speed brake selection; and
(88) All cockpit flight control input forces (control wheel, control column, rudder pedal).

(b) For all turbine-engine powered transport category airplanes manufactured on or before October 11, 1991, by August 20, 2001.

(1) For airplanes not equipped as of July 16, 1996, with a flight data acquisition unit (FDAU), the parameters listed in paragraphs (a)(1) through (a)(18) of this section must be recorded within the ranges and accuracies specified in Appendix B of this part, and—

(i) For airplanes with more than two engines, the parameter described in paragraph (a)(18) is not required unless sufficient capacity is available on the existing recorder to record that parameter;

(ii) Parameters listed in paragraphs (a)(12) through (a)(17) each may be recorded from a single source.

(2) For airplanes that were equipped as of July 16, 1996, with a flight data acquisition unit (FDAU), the parameters listed in paragraphs (a)(1) through (a)(22) of this section must be recorded within the ranges, accuracies, and recording intervals specified in Appendix M of this part. Parameters listed in paragraphs (a)(12) through (a)(17) each may be recorded from a single source.

(3) The approved flight recorder required by this section must be installed at the earliest time practicable, but no later than the next heavy maintenance check after August 18, 1999 and no later than August 20, 1997. A heavy maintenance check is considered to be any time an airplane is scheduled to be out of service for 4 or more days and is scheduled to include access to major structural components.

(c) For all turbine-engine powered transport category airplanes manufactured on or before October 11, 1991—

(1) That were equipped as of July 16, 1996, with one or more digital data bus(es) and an ARINC 717 digital flight data acquisition unit (DFDAU) or equivalent, the parameters specified in paragraphs (a)(1) through (a)(22) of this section must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix M of this part by August 18, 2001. Parameters listed in paragraphs (a)(12) through (a)(14) each may be recorded from a single source.

(2) Commensurate with the capacity of the recording system (DFDAU or equivalent and the DFDR), all additional parameters for which information sources are installed and which are connected to the recording system must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix M of this part by August 18, 2001.

(3) That were subject to § 121.343(e) of this part, all conditions of § 121.343(e) must continue to be met until compliance with paragraph (c)(1) of this section is accomplished.

(d) For all turbine-engine-powered transport category airplanes that were manufactured after October 11, 1991—

(1) The parameters listed in paragraph (a)(1) through (a)(34) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix M of this part by August 20, 2001. Parameters listed in paragraphs (a)(12) through (a)(14) each may be recorded from a single source.

(2) Commensurate with the capacity of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix M of this part by August 20, 2001.

(e) For all turbine-engine-powered transport category airplanes that are manufactured after August 18, 2000—

(1) The parameters listed in paragraph (a)(1) through (57) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix M of this part.

(2) Commensurate with the capacity of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system, must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix M of this part.

(f) For all turbine-engine-powered transport category airplanes that are manufactured after August 19, 2002 the parameters listed in paragraph (a)(1) through (a)(88) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix M of this part.

(g) Whenever a flight data recorder required by this section is installed, it must be operated continuously from the instant the airplane begins its takeoff roll until it has completed its landing roll.

(h) Except as provided in paragraph (i) of this section, and except for recorded data erased as authorized in this paragraph, each certificate holder shall keep the recorded data prescribed by this section, as appropriate, until the airplane has been operated for at least 25 hours of the operating time specified in § 121.359(a) of this part. A total of 1 hour of recorded data may be erased for the purpose of testing the flight recorder or the flight recorder system. Any erasure made in accordance with this paragraph must be of the oldest recorded data accumulated at the time of testing. Except as provided in paragraph (i) of this section, no record need be kept more than 60 days.

(i) In the event of an accident or occurrence that requires immediate notification of the National Transportation Safety Board under 49 CFR 830 of its regulations and that results in termination of the flight, the certificate holder shall remove the recorder from the airplane and keep the recorder data prescribed by this section, as appropriate, for at least 60 days or for a longer period upon the request of the Board or the Administrator.

(j) Each flight data recorder system required by this section must be installed in accordance with the requirements of § 25.1459 (a), (b), (d), and (e) of this chapter. A correlation must be established between the values recorded by the flight data recorder and the corresponding values being measured. The correlation must contain a sufficient number of correlation points to accurately establish the conversion from the recorded values to engineering units or discrete state over the full operating range of the parameter. Except for airplanes having separate altitude and airspeed sensors that are an integral part of the flight data recorder system, a single correlation may be established for any group of airplanes—

(1) That are of the same type;

(2) On which the flight recorder system and its installation are the same; and

(3) On which there is no difference in the type design with respect to the installation of those sensors associated with the flight data recorder system. Documentation sufficient to convert recorded data into the engineering units and discrete values specified in the applicable appendix must be maintained by the certificate holder.

(k) Each flight data recorder required by this section must have an approved device to assist in locating that recorder under water.

(l) The following airplanes that were manufactured before August 18, 1997 need not comply with this section, but must continue to comply with applicable paragraphs of § 121.343 of this chapter, as appropriate:

(1) Airplanes that meet the State 2 noise levels of part 36 of this chapter and are subject to § 91.801(c) of this chapter, until January 1, 2000. On and after January 1, 2000, any Stage 2 airplane otherwise allowed to be operated under Part 91 of this chapter must comply with the applicable flight data recorder requirements of this section for that airplane.

(2) General Dynamics Convair 580, General Dynamics Convair 600, General Dynamics Convair 640, deHavilland Aircraft Company Ltd. DHC–7, Fairchild Industries FH 227, Fokker F–27 (except Mark 50), F–28 Mark 1000 and Mark 4000, Gulfstream Aerospace G–159, Lockheed Aircraft Corporation Electra 10–A, Lockheed Aircraft Corporation Electra 10–B, Lockheed Aircraft Corporation Electra 10–E, Lockheed Aircraft Corporation Electra L–188, Maryland Air Industries, Inc. F27, Mitsubishi Heavy Industries, Ltd. YS–11, Short Bros. Limited SD3–30, Short Bros. Limited SD3–60.

3. Section 121.344a is added to read as follows:

§ 121.344a Digital flight data recorders for 10–19 seat airplanes.

(a) Except as provided in paragraph (f) of this section, no person may operate under this part a turbine-engine-powered airplane having a passenger seating configuration, excluding any required crewmember seat, of 10 to 19 seats, that was brought onto the U.S. register after, or was registered outside the United States and added to the operator's U.S. operations specifications after, October 11, 1991, unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. On or before August 18, 2001, airplanes brought onto the U.S. register after October 11, 1991, must comply with either the requirements in this section or the applicable paragraphs in § 135.152 of this chapter. In addition, by August 18, 2001.

(1) The parameters listed in §§ 121.344(a)(1) through 121.344(a)(11) of this part must be recorded with the ranges, accuracies, and resolutions specified in Appendix B of part 135 of this chapter, except that—

(i) Either the parameter listed in § 121.344 (a)(12) or (a)(15) of this part must be recorded; either the parameters listed in § 121.344(a)(13) or (a)(16) of this part must be recorded; and either the parameter listed in § 121.344(a)(14) or (a)(17) of this part must be recorded.

(ii) For airplanes with more than two engines, the parameter described in § 121.344(a)(18) of this part must also be recorded if sufficient capacity is available on the existing recorder to record that parameter;

(iii) Parameters listed in §§ 121.344(a)(12) through 121.344(a)(17) of this part each may be recorded from a single source;

(iv) Any parameter for which no value is contained in Appendix B of part 135 of this chapter must be recorded within the ranges, accuracies, and resolutions specified in Appendix M of this part.

(2) Commensurate with the capacity of the recording system (FDAU or equivalent and the DFDR), the parameters listed in §§ 121.344(a)(19) through 121.344(a)(22) of this part also must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix B of part 135 of this chapter.

(3) The approved flight recorder required by this section must be installed as soon as practicable, but no later than the next heavy maintenance check or equivalent after August 18, 1999. A heavy maintenance check is considered to be any time an airplane is scheduled to be out of service for 4 more days and is scheduled to include access to major structural components.

(b) For a turbine-engine-powered airplanes having a passenger seating configuration, excluding any required crewmember seat, of 10 to 19 seats, that are manufactured after August 18, 2000.

(1) The parameters listed in §§ 121.344(a)(1) through 121.344(a)(57) of this part, must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix M of this part.

(2) Commensurate with the capacity of the recording system, all additional parameters listed in § 121.344(a) of this part for which information sources are installed and which are connected to the recording system, must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix M of this part by August 18, 2001.

(c) For all turbine-engine-powered airplanes having a passenger seating configuration, excluding any required crewmember seats, of 10 to 19 seats, that are manufactured after August 19, 2002, the parameters listed in § 121.344(a)(1) through (a)(88) of this part must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix M of this part.

(d) Each flight data recorder system required by this section must be installed in accordance with the requirements of § 23.1459 (a), (b), (d), and (e) of this chapter. A correlation must be established between the values recorded by the flight data recorder and the corresponding values being measured. The correlation must contain a sufficient number of correlation points to accurately establish the conversion from the recorded values to engineering units or discrete state over the full operating range of the parameter. A single correlation may be established for any group of airplanes—

(1) That are of the same type;

(2) On which the flight recorder system and its installation are the same; and

(3) On which there is no difference in the type design with respect to the installation of those sensors associated with the flight data recorder system. Correlation documentation must be maintained by the certificate holder.

(e) All airplanes subject to this section are also subject to the requirements and exceptions stated in §§ 121.344(g) through 121.344(k) of this part.

(f) For airplanes that were manufactured before July 17, 1997, the following airplane types need not comply with this section, but must continue to comply with applicable paragraphs of § 135.152 of this chapter, as appropriate: Beech Aircraft–99 Series, Beech Aircraft 1300, Beech Aircraft 1900C, Construcciones Aeronauticas, S.A. (CASA) C–212, deHavilland DHC–6, Dornier 228, HS–748, Embraer EMB 110, Jetstream 3101, Jetstream 3201, Fairchild Aircraft SA–226.

4. Appendix M to part 121 is added to read as follows:

Appendix M to Part 121—Airplane Flight Recorder Specification

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. 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.	24 Hrs, 0 to 4095	+/−0.125% Per Hour	4	1 sec	UTC time preferred when available. County 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 airspeed or Calibrated airspeed.	50 KIAS or minimum value to Max V_{so} and V_{so} 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).	−3g to +6g	+/−1% of max range excluding datum error of +/−5%.	0.125	0.004g	
6. Pitch Attitude	+/−7°	+/−2°	1 or 0.25 for airplanes operated under §121.344(f).	0.5°	A sampling rate of 0.25 is recommended.
7. Roll Attitude	+/−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)	0.2% of full range	Sufficient parameters (e.g. EPR, N1 or Torque, NP) as appropriate to the particular engine be recorded to determine power in forward and reverse thrust, including potential overspeed conditions.
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 (non-fly-by-wire systems.	Full Range	+/−2% Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(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.
12b. Pitch Control(s) position (fly-by-wire systems).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(f).	0.2% of full range	
13a. Lateral Control position(s) (non-fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(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).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(f).	0.2% of full range	

14a. Yaw Control position(s) (non-fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	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.
14b. Yaw Control position(s) (fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	0.2% of full range.	
15. Pitch Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(f).	0.2% of full range	For airplanes fitted with multiple or split surfaces, a suitable combination of inputs is acceptable in lieu or recording each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
16. Lateral Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §121.344(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.
17. Yaw Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	0.2% of full range	For airplanes 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	+/−lg	+/−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	0.3% of full range	
20. Trailing Edge Flap or Cockpit Control Selection.	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 alternately at 4 second intervals, to give a data point every 2 seconds.
21. Leading Edge Flap or Cockpit Control Selection.	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 discretes enable the 3 states to be determined. Turbo-prop—discrete.
23. Ground Spoiler Position or Speed Brake Selection.	Full Range or Each Position (discrete).	+/−2° Unless Higher Accuracy Uniquely Required.	1 or 0.5 for airplanes operated under §121.344(f).	0.2% of full range	
24. Outside Air Temperature or Total Air Temperature.	−50°C to +90°C	+/−2°C	2	0.3°C	
25. Autopilot/Autothrottle/AFCS Mode and Engagement Status.	A suitable combination of discretes.		1		Discretes should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft.
26. Radio Altitude	−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.

Appendix M to Part 121—Airplane Flight Recorder Specification—Continued

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
27. Localizer Deviation, MLS Azimuth, or GPS Latitude 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 +/3−3% recommended.	1	0.3% of full range	For autoland/category 3 operations. Each system should be recorded by 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).		
32. Angle of Attack (If measured directly).	As installed	As installed	2 or 0.5 for airplanes operated under §121.344(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	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.	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	
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	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 discretes 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		

Appendix M to Part 121—Airplane Flight Recorder Specification—Continued

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
72. De-icing or anti-icing system selection.	Discrete ''on'' or ''off''	.....	4		
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''	.....			
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	0.2% of full range	Where mechanical means for control inputs are not available, cockpit display trim positions should be recorded.
84. Cockpit trim control input position—yaw.	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.
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	0.2% of full range	
88. All cockpit flight control input forces (control wheel, control column, rudder pedal).	Full Range Control wheel +/−70 lbs Control Column +/−85 lbs Rudder pedal +/−165 lbs	+/−5%	1	0.2% 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.

PART 125–CERTIFICATION AND OPERATIONS: AIRPLANES HAVING A SEATING CAPACITY OF 20 OR MORE PASSENGERS OR A MAXIMUM PAYLOAD CAPACITY OF 6,000 POUNDS OR MORE

5. The authority citation for part 125 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701–44702, 44705, 44710–44711, 44713, 44716–44717, 44722.

6. Section 125.226 is added to read as follows:

§ 125.226 Digital flight data recorders.

(a) Except as provided in paragraph (1) of this section, no person may operate under this part a turbine-engine-powered transport category airplane unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The operational parameters required to be recorded by digital flight data recorders required by this section are as follows: the phrase ''when an information source is installed'' following a parameter indicates that recording of that parameter is not intended to require a change in installed equipment:

(1) Time;
(2) Pressure altitude;
(3) Indicated airspeed;
(4) Heading—primary flight crew reference (if selectable, record discrete, true or magnetic);
(5) Normal acceleration (Vertical);
(6) Pitch attitude;
(7) Roll attitude;
(8) Manual radio transmitter keying, or CVR/DFDR synchronization reference;
(9) Thrust/power of each engine—primary flight crew reference;
(10) Autopilot engagement status;
(11) Longitudinal acceleration;
(12) Pitch control input;
(13) Lateral control input;
(14) Rudder pedal input;
(15) Primary pitch control surface position;
(16) Primary lateral control surface position;
(17) Primary yaw control surface position;
(18) Lateral acceleration;
(19) Pitch trim surface position or parameters of paragraph (a)(82) of this section if currently recorded;
(20) Trailing edge flap or cockpit flap control selection (except when parameters of paragraph (a)(85) of this section apply);
(21) Leading edge flap or cockpit flap control selection (except when parameters of paragraph (a)(86) of this section apply);
(22) Each Thrust reverser position (or equivalent for propeller airplane);
(23) Ground spoiler position or speed brake selection (except when parameters of paragraph (a)(87) of this section apply);
(24) Outside or total air temperature;
(25) Automatic Flight Control System (AFCS) modes and engagement status, including autothrottle;
(26) Radio altitude (when an information source is installed);
(27) Localizer deviation, MLS Azimuth;
(28) Glideslope deviation, MLS Elevation;
(29) Marker beacon passage;
(30) Master warning;
(31) Air/ground sensor (primary airplane system reference nose or main gear);
(32) Angle of attack (when information source is installed);
(33) Hydraulic pressure low (each system);
(34) Ground speed (when an information source is installed);
(35) Ground proximity warning system;
(36) Landing gear position or landing gear cockpit control selection;
(37) Drift angle (when an information source is installed);
(36) Wind speed and direction (when an information source is installed);
(39) Latitude and longitude (when an information source is installed);
(40) Stick shaker/pusher (when an information source is installed);
(41) Windshear (when an information source is installed);
(42) Throttle/power lever position;
(43) Additional engine parameters (as designed in appendix E of this part);
(44) Traffic alert and collision avoidance system;
(45) DME 1 and 2 distances;
(46) Nav 1 and 2 selected frequency;
(47) Selected barometric setting (when an information source is installed);
(48) Selected altitude (when an information source is installed);
(49) Selected speed (when an information source is installed);
(50) Selected mach (when an information source is installed);
(51) Selected vertical speed (when an information source is installed);
(52) Selected heading (when an information source is installed);
(53) Selected flight path (when an information source is installed);
(54) Selected decision height (when an information source is installed);
(55) EFIS display format;
(56) Multi-function/engine/alerts display format;
(57) Thrust command (when an information source is installed);
(58) Thrust target (when an information source is installed);
(59) Fuel quantity in CG trim tank (when an information source is installed);
(60) Primary Navigation System Reference;
(61) Icing (when an information source is installed);
(62) Engine warning each engine vibration (when an information source is installed);
(63) Engine warning each engine over temp. (when an information source is installed);
(64) Engine warning each engine oil pressure low (when an information source is installed);
(65) Engine warning each engine over speed (when an information source is installed);
(66) Yaw trim surface position;
(67) Roll trim surface position;
(68) Brake pressure (selected system);
(69) Brake pedal application (left and right);
(70) Yaw of sideslip angle (when an information source is installed);
(71) Engine bleed valve position (when an information source is installed);
(72) De-icing and anti-icing system selection (when an information source is installed);
(73) Computed center of gravity (when an information source is installed);
(74) AC electrical bus status;
(75) DC electrical bus status;
(76) APU bleed valve position (when an information source is installed);
(77) Hydraulic pressure (each system);
(78) Loss of cabin pressure;
(79) Computer failure;
(80) Heads-up display (when an information source is installed);
(81) Para-visual display (when an information source is installed);
(82) Cockpit trim control input position-pitch;
(83) Cockpit trim control input position—roll;
(84) Cockpit trim control input position—yaw;
(85) Trailing edge flap and cockpit flap control position;
(86) Leading edge flap and cockpit flap control position;
(87) Ground spoiler position and speed brake selection; and
(88) All cockpit flight control input forces (control wheel, control column, rudder pedal).

(b) For all turbine-engine powered transport category airplanes manufactured on or before October 11, 1991, by August 18, 2001—

(1) For airplanes not equipped as of July 16, 1996, with a flight data

acquisition unit (FDAU), the parameters listed in paragraphs (a)(1) through (a)(18) of this section must be recorded within the ranges and accuracies specified in Appendix D of this part, and—

(i) For airplanes with more than two engines, the parameter described in paragraph (a)(18) is not required unless sufficient capacity is available on the existing recorder to record that parameter.

(ii) Parameters listed in paragraphs (a)(12) through (a)(17) each may be recorded from a single source.

(2) For airplanes that were equipped as of July 16, 1996, with a flight data acquisition unit (FDAU), the parameters listed in paragraphs (a)(1) through (a)(22) of this section must be recorded within the ranges, accuracies, and recording intervals specified in Appendix E of this part. Parameters listed in paragraphs (a)(12) through (a)(17) each may be recorded from a single source.

(3) The approved flight recorder required by this section must be installed at the earliest time practicable, but no later than the next heavy maintenance check after August 18, 1999 and no later than August 18, 2001. A heavy maintenance check is considered to be any time an airplane is scheduled to be out of service for 4 or more days and is scheduled to include access to major structural components.

(c) For all turbine-engine-powered transport category airplanes manufactured on or before October 11, 1991—

(1) That were equipped as of July 16, 1996, with one or more digital data bus(es) and an ARINC 717 digital flight data acquisition unit (DFDAU) or equivalent, the parameters specified in paragraphs (a)(1) through (a)(22) of this section must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix E of this part by August 18, 2001. Parameters listed in paragraphs (a)(12) through (a)(14) each may be recorded from a single source.

(2) Commensurate with the capacity of the recording system (DFDAU or equivalent and the DFDR), all additional parameters for which information sources are installed and which are connected to the recording system must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix E of this part by August 18, 2001.

(3) That were subject to § 125.225(e) of this part, all conditions of § 125.225(c) must continue to be met until compliance with paragraph (c)(1) of this section is accomplished.

(d) For all turbine-engine-powered transport category airplanes that were manufactured after October 11, 1991—

(1) The parameters listed in paragraphs (a)(1) through (a)(34) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix E of this part by August 18, 2001. Paramaters listed in paragraphs (a)(12) through (a)(14) each may be recorded from a single source.

(2) Commensurate with the capacity of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system, must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix E of this part by August 18, 2001.

(e) For all turbine-engine-powered transport category airplanes that are manufactured after August 18, 2000—

(1) The parameters listed in paragraph (a) (1) through (57) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix E of this part.

(2) Commensurate with the capacity of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system, must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix E of this part.

(f) For all turbine-engine-powered transport category airplanes that are manufactured after August 19, 2002 parameters listed in paragraph (a)(1) through (a)(88) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix E of this part.

(g) Whenever a flight data recorder required by this section is installed, it must be operated continuously from the instant the airplane begins its takeoff roll until it has completed its landing roll.

(h) Except as provided in paragraph (i) of this section, and except for recorded data erased as authorized in this paragraph, each certificate holder shall keep the recorded data prescribed by this section, as appropriate, until the airplane has been operated for at least 25 hours of the operating time specified in § 121.359(a) of this part. A total of 1 hour of recorded data may be erased for the purpose of testing the flight recorder or the flight recorder system. Any erasure made in accordance with this paragraph must be of the oldest recorded data accumulated at the time of testing. Except as provided in paragraph (i) of this section, no record need to be kept more than 60 days.

(i) In the event of an accident or occurrence that requires immediate notification of the National Transportation Safety Board under 49 CFR 830 of its regulations and that results in termination of the flight, the certificate holder shall remove the recorder from the airplane and keep the recorder data prescribed by this section, as appropriate, for at least 60 days or for a longer period upon the request of the Board or the Administrator.

(j) Each flight data recorder system required by this section must be installed in accordance with the requirements of § 25.1459 (a), (b), (d), and (e) of this chapter. A correlation must be established between the values recorded by the flight data recorder and the corresponding values being measured. The correlation must contain a sufficient number of correlation points to accurately establish the conversion from the recorded values to engineering units or discrete state over the full operating range of the parameter. Except for airplanes having separate altitude and airspeed sensors that are an integral part of the flight data recorder system, a single correlation may be established for any group of airplanes—

(1) That are of the same type;

(2) On which the flight recorder system and its installation are the same; and

(3) On which there is no difference in the type design with respect to the installation of those sensors associated with the flight data recorder system. Documentation sufficient to convert recorded data into the engineering units and discrete values specified in the applicable appendix must be maintained by the certificate holder.

(k) Each flight data recorder required by this section must have an approved device to assist in locating that recorder under water.

(l) The following airplanes that were manufactured before August 18, 1997 need not comply with this section, but must continue to comply with applicable paragraphs of § 125.225 of this chapter, as appropriate:

(1) Airplanes that meet the Stage 2 noise levels of part 36 of this chapter and are subject to § 91.801(c) of this chapter, until January 1, 2000. On and after January 1, 2000, any Stage 2 airplane otherwise allowed to be operated under Part 91 of this chapter must comply with the applicable flight data recorder requirements of this section for that airplane.

(2) General Dynamics Convair 580, General Dynamics Convair 600, General Dynamics Convair 640, deHavilland

Aircraft Company Ltd. DHC–7, Fairchild Industries FH 227, Fokker F–27 (except Mark 50), F–28 Mark 1000 and Mark 4000, Gulfstream Aerospace G–159, Lockheed Aircraft Corporation Electra 10–A, Lockheed Aircraft Corporation Electra 10–B, Lockheed Aircraft Corporation Electra 10–E, Lockheed Aircraft Corporation L–188, Maryland Air Industries, Inc. F27, Mitsubishi Heavy Industries, Ltd. YS–11, Short Bros. Limited SD3–30, Short Bros, Limited SD3–60.

7. Appendix E to part 125 is added to read as follows:

Appendix E to Part 125—Airplane Flight Recorder Specification

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. 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 Time Counts.	24 Hrs, 0 to 4095	+/−0.125% Per Hour	4	1 sec	UTC time preferred when available. Counter 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 airspeed or Calibrated airspeed.	50 KIAS or minimum value to Max V_{so}, and V_{so} 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).	−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	+/−180°	+/−2°	1 or 0.5 for airplanes operated under §125.226(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)	0.2% of full range	Sufficient parameters (e.g. EPR, N1 or Torque, NP) as appropriate to the particular engine be recorded to determine power in forward and reverse thrust, including potential overspeed conditions.
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 (non-fly-by-wire systems.	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.
12b. Pitch Control(s) position (fly-by-wire systems).	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	
13a. Lateral Control position(s) (non-fly-by-wire).	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).	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) (non-fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	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.
14b. Yaw Control position(s) (fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	0.2% of full range.	
15. Pitch Control Surface(s) Position.	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 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.
16. Lateral Control Surface(s) Position.	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 recoding each surface separately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
17. Yaw Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	0.2% of full range	For airplanes 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	0.3% of full range.	
20. Trailing Edge Flap or Cockpit Control Selection.	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 alternately at 4 second intervals, to give a data point every 2 seconds.
21. Leading Edge Flap or Cockpit Control Selection.	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 discretes enable the 3 states to be determined. Turbo-prop—1 discrete.
23. Ground Spoiler Position or Speed Brake Selection.	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.	−50°C to −90°C	+/−2 °C	2	0.3 °C.	
25. Autopilot/Autothrottle/AFCS Mode and Engagement Status.	A suitable combination of discretes.		1		Discretes should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft.
26. Radio Altitude	−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.

Appendix E to Part 125—Airplane Flight Recorder Specification—Continued

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
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).		
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	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/longtitude 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.	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.	
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	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.

Appendix E to Part 125—Airplane Flight Recorder Specification—Continued

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
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.	Decrete ''open'' or ''closed''.		4.		
72. De-icing or anti-icing system selection.	Discrete ''on'' or ''off''		4.		
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	0.2% of full range	Where mechanical means for control inputs are not available, cockpit display trim positions should be recorded.
84. Cockpit trim control input position—yaw.	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.
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	0.2% of full range.	

88. All cockpit flight control input forces (control wheel, control column, rudder pedal).	Full Range Control wheel +/−70 lbs. Control Column +/−85 lbs Rudder pedal +/−165 lbs.	+/−5%	1	0.2% 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.

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

8. The authority citation for part 129 continues to read as follows:

Authority: 49 USC 106(G), 40104–40105, 40113, 40119, 44701–44702, 44712, 44716–44717, 44722, 44901–44904, 44906.

9. The first sentence of paragraph (b) is revised to add reference to new § 129.20, to read as follows:

§ 129.1 Applicability.

* * * * *

(b) Sections 129.14 and 129.20 also apply to U.S.-registered aircraft operated in common carriage by a foreign person or foreign air carrier solely outside the United States. * * *

10. Section 129.20 is added to read as follows:

§ 129.20 Digital flight data recorders.

No person may operate an aircraft under this part that is registered in the United States unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The flight data recorder must record the parameters that would be required to be recorded if the aircraft were operated under part 121, 125, or 135 of this chapter, and must be installed by the compliance times required by those parts, as applicable to the aircraft.

PART 135—OPERATING REQUIREMENTS: COMMUTER AND ON-DEMAND OPERATIONS

11. The authority citation for part 135 continues to read as follows:

Authority: 49 USC 106(g), 40113, 44701–44702, 44705, 44709, 44711–44713, 44715–44717, 44722.

12. Section 135.152(a) is revised to read as follows:

§ 135.152 Flight recorders.

(a) Except as provided in paragraph (k) of this section, no person may operate under this part a multi-engine, turbine-engine powered airplane or rotorcraft having a passenger seating configuration, excluding any required crewmembers seat, of 10 to 19 seats, that was either brought onto the U.S. register after, or was registered outside the United States and added to the operator's U.S. operations specifications after, October 11, 1991, unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The parameters specified in either Appendix B or C of this part, as applicable must be recorded within the range, accuracy, resolution, and recording intervals as specified. The recorder shall retain no less than 25 hours of aircraft operation.

* * * * *

§ 135.152 [Amended]

13. In § 135.152(d), the first sentence is amended by removing the phrase ''8 hours'' and adding the phrase ''25 hours'' in its place.

14. Section 135.152(f) is revised to read as follows:

§ 135.152 Flight recorders.

* * * * *

(f)(1) For airplanes manufactured on or before August 18, 2000, and all other aircraft, each flight recorder required by this section must be installed in accordance with the requirements of § 23.1459, 25.1459, 27.1459, or 29.1459, as appropriate, of this chapter. The correlation required by paragraph (c) of § 23.1459, 25.1459, 27.1459, or 29.1459, as appropriate, of this chapter need be established only on one aircraft of a group of aircraft:

(i) That are of the same type;

(ii) On which the flight recorder models and their installations are the same; and

(iii) On which there are no differences in the type designs with respect to the installation of the first pilot's instruments associated with the flight recorder. The most recent instrument calibration, including the recording medium from which this calibration is derived, and the recorder correlation must be retained by the certificate holder.

(f)(2) For airplanes manufactured after August 18, 2000, each flight data recorder system required by this section must be installed in accordance with the requirements of § 23.1459 (a), (b), (d) and (e) of this chapter, or § 25.1459 (a), (b), (d), and (e) of this chapter. A correlation must be established between the values recorded by the flight data recorder and the corresponding values being measured. The correlation must contain a sufficient number of correlation points to accurately establish the conversion from the recorded values to engineering units or discrete state over the full operating range of the parameter. Except for airplanes having separate altitude and airspeed sensors that are an integral part of the flight data recorder system, a single correlation may be established for any group of airplanes—

(i) That are of the same type;

(ii) On which the flight recorder system and its installation are the same; and

(iii) On which there is no difference in the type design with respect to the installation of those sensors associated with the flight data recorder system. Documentation sufficient to convert recorded data into the engineering units and discrete values specified in the applicable appendix must be maintained by the certificate holder.

* * * * *

15. In § 135.152, new paragraphs (h), (i), and (j) and (k) are added to read as follows:

* * * * *

(h) The operational parameters required to be recorded by digital flight data recorders required by paragraphs (i) and (j) of this section are as follows, the phrase ''when an information source is installed'' following a parameter indicated that recording of that parameter is not intended to require a change in installed equipment.

(1) Time;

(2) Pressure altitude;

(3) Indicated airspeed;

(4) Heading—primary flight crew reference (if selectable, record discrete, true or magnetic);

(5) Normal acceleration (Vertical);

(6) Pitch attitude;

(7) Roll attitude;

(8) Manual radio transmitter keying, or CVR/DFDR synchronization reference;

(9) Thrust/power of each engine—primary flight crew reference;

(10) Autopilot engagement status;

(11) Longitudinal acceleration;

(12) Pitch control input;

(13) Lateral control input;

(14) Rudder pedal input;

(15) Primary pitch control surface position;

(16) Primary lateral control surface position;

(17) Primary yaw control surface position;

(18) Lateral acceleration;

(19) Pitch trim surface position or parameters of paragraph (h)(82) of this section if currently recorded;

(20) Trailing edge flap or cockpit flap control selection (except when parameters of paragraph (h)(85) of this section apply);

(21) Leading edge flap or cockpit flap control selection (except when parameters of paragraph (h)(86) of this section apply);

(22) Each Thrust reverser position (or equivalent for propeller airplane);

(23) Ground spoiler position or speed brake selection (except when parameters

of paragraph (h)(87) of this section apply);

(24) Outside or total air temperature;

(25) Automatic Flight Control System (AFCS) modes and engagement status, including autothrottle;

(26) Radio altitude (when an information source is installed);

(27) Localizer deviation, MLS Azimuth;

(28) Glideslope deviation, MLS Elevation;

(29) Marker beacon passage;

(30) Master warning;

(31) Air/ground sensor (primary airplane system reference nose or main gear);

(32) Angle of attack (when information source is installed);

(33) Hydraulic pressure low (each system);

(34) Ground speed (when an information source is installed);

(35) Ground proximity warning system;

(36) Landing gear position or landing gear cockpit control selection;

(37) Drift angle (when an information source is installed);

(38) Wind speed and direction (when an information source is installed);

(39) Latitude and longitude (when an information source is installed);

(40) Stick shaker/pusher (when an information source is installed);

(41) Windshear (when an information source is installed);

(42) Throttle/power lever position;

(43) Additional engine parameters (as designated in appendix F of this part);

(44) Traffic alert and collision avoidance system;

(45) DME 1 and 2 distances;

(46) Nav 1 and 2 selected frequency;

(47) Selected barometric setting (when an information source is installed);

(48) Selected altitude (when an information source is installed);

(49) Selected speed (when an information source is installed);

(50) Selected mach (when an information source is installed);

(51) Selected vertical speed (when an information source is installed);

(52) Selected heading (when an information source is installed);

(53) Selected flight path (when an information source is installed);

(54) Selected decision height (when an information source is installed);

(55) EFIS display format;

(56) Multi-function/engine/alerts display format;

(57) Thrust command (when an information source is installed);

(58) Thrust target (when an information source is installed);

(59) Fuel quantity in CG trim tank (when an information source is installed);

(60) Primary Navigation System Reference;

(61) Icing (when an information source is installed);

(62) Engine warning each engine vibration (when an information source is installed);

(63) Engine warning each engine over temp. (when an information source is installed);

(64) Engine warning each engine oil pressure low (when an information source is installed);

(65) Engine warning each engine over speed (when an information source is installed;

(66) Yaw trim surface position;

(67) Roll trim surface position;

(68) Brake pressure (selected system);

(69) Brake pedal application (left and right);

(70) Yaw or sideslip angle (when an information source is installed);

(71) Engine bleed valve position (when an information source is installed);

(72) De-icing or anti-icing system selection (when an information source is installed);

(73) Computed center of gravity (when an information source is installed);

(74) AC electrical bus status;

(75) DC electrical bus status;

(76) APU bleed valve position (when an information source is installed);

(77) Hydraulic pressure (each system);

(78) Loss of cabin pressure;

(79) Computer failure;

(80) Heads-up display (when an information source is installed);

(81) Para-visual display (when an information source is installed);

(82) Cockpit trim control input position—pitch;

(83) Cockpit trim control input position—roll;

(84) Cockpit trim control input position—yaw;

(85) Trailing edge flap and cockpit flap control position;

(86) Leading edge flap and cockpit flap control position;

(87) Ground spoiler position and speed brake selection; and

(88) All cockpit flight control input forces (control wheel, control column, rudder pedal).

(i) For all turbine-engine powered airplanes with a seating configuration, excluding any required crewmember seat, of 10 to 30 passenger seats, manufactured after August 18, 2000—

(1) The parameters listed in paragraphs (h)(1) through (h)(57) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix F of this part.

(2) Commensurate with the capacity of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system must be recorded within the ranges, accuracies, resolutions, and sampling intervals specified in Appendix F of this part.

(j) For all turbine-engine-powered airplanes with a seating configuration, excluding any required crewmember seat, of 10 to 30 passenger seats, that are manufactured after August 19, 2002 the parameters listed in paragraph (a)(1) through (a)(88) of this section must be recorded within the ranges, accuracies, resolutions, and recording intervals specified in Appendix F of this part.

(k) For airplanes manufactured before August 18, 1997 the following airplane type need not comply with this section: deHavilland DHC–6.

Apendix B to Part 135—[Amended]

16. In Appendix B to part 135, Airplane Flight Recorder Specifications, in the ''Range'' column, the first entry is amended by removing the phrase ''8 hr minimum'' and adding the phrase ''25 hr minimum'' in its place.

Appendix C to Part 135—[Amended]

17. In Appendix C to part 135, Helicopter Flight Recorder Specifications, in the ''Range'' column, the first entry is amended by removing the phrase ''8 hr minimum'' and adding the phrase ''25 hr minimum'' in its place.

18. Appendix F to part 135 is added to read as follows:

Appendix F to Part 135—Airplane Flight Recorder Specification

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. 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 Time Counts.	24 Hrs, 0 to 4095	+/−0.125% Per Hour	4	1 sec	UTC time preferred when available. Counter 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 airspeed or Calibrated airspeed.	50 KIAS or minimum value to Max V_{so+} and V_{so} 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).	−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 §135.152(j).	0.5°	A sampling rate of 0.25 is recommended.
7. Roll Attitude	+/−180°0	+/−2°	1 or 0.5 for airplanes operated under §135.152(j).	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)	0.2% of full range	sufficient parameters (e.g., EPR, N1 or Torque, NP) as appropriate to the particular engine be recorded to determine power in forward and reverse thrust, including potential overspeed conditions.
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 (non-fly-by-wire systems.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §135.152(j).	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.
12b. Pitch Control(s) position (fly-by-wire systems).	Full Range	+/−2° Unless Higher Accuracy.	0.5 or 0.25 for airplanes operated under §135.152(j).	0.2% of full range.	
13a. Lateral Control position(s) (non-fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §135.152(j).	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 intereval of 0.5 or 0.25, as applicable.
13b. Lateral Control position(s) (fly-by-wire).	Full range	+/−2° Unless Higher Accuracy Uniquely required.	0.5 or 0.25 for airplanes operated under §135.152(j).	0.2% of full range.	

14a. Yaw Control position(s) (non-fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §135.152(j)..	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.
14b. Yaw Control position(s) (fly-by-wire).	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	0.2% of full range.	
15. Pitch Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §135.152(j).	0.2% of full range	For airplanes fitted with multiple or split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface spearately. The control surfaces may be sampled alternately to produce the sampling interval of 0.5 or 0.25.
16. Lateral Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5 or 0.25 for airplanes operated under §135.152(j).	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.
17. Yaw Control Surface(s) Position.	Full Range	+/−2° Unless Higher Accuracy Uniquely Required.	0.5	0.2% of full range	For Airplanes 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	0.3% of full range.	
20. Trailing Edge Flap or Cockpit Control Selection.	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 alternately at 4 second intervals, to give a data point every 2 seconds.
21. Leading Edge Flap or Cockpit Control Selection.	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 discretes enable the 3 states to be determined Turbo-prop—1 discrete
23. Ground Spoiler Position or Speed Brake Selection.	Full Range or Each Position (discrete)..	+/−2° Unless Higher Accuracy Uniquely Required.	1 0.5 for airplanes operated under §135.152(j).	0.2% of full range.	
24. Outside Air Temperature or Total Air Temperature.	−50°C to +90°C	+/−2° C	2	0.3° C.	
25. Autopilot/Autothrottle/AFCS Mode and Engagement Status.	A suitable combination of discretes.	.....	1	.....	Discretes should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft.
26. Radio Altitude	−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.

Appendix F to Part 135—Airplane Flight Recorder Specification—Continued

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
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.)		
32. Angle of Attack (If measured directly).	As installed	As installed	2 or 0.5 for airplanes operated under §135.152(j).	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	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.	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.	
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	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 Glidescope.		4		A suitable combination of discretes 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.		

Appendix F to Part 135—Airplane Flight Recorder Specification—Continued

The recorded values must meet the designated range, resolution, and accuracy requirements during dynamic and static conditions. All data recorded must be correlated in time to within one second.

Parameters	Range	Accuracy (sensor input)	Seconds per sampling interval	Resolution	Remarks
72. De-icing or anti-icing system selection.	Discrete ''on'' or ''off''		4.		
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 positions—roll.	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.
84. Cockpit trim control input position—yaw.	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.
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	0.2% of full range.	
88. All cockpit flight control input forces (control wheel, control column, rudder pedal).	Full Range Control wheel +/−70 lbs. Control Column +/−85 lb Rudder pedal +/−165 lbs	+/−5%	1	0.2% 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 second to produce the sampling interval of 1.

(Revisions to Digital Flight Data Recorders; Final Rule; Docket No. 28109)

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Barry J. Valentine,

Acting Administrator.

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