DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

(14 CFR PART 37)

(Docket No. ; Notice No. 7 -)

DRAFT

AIRCRAFT FLIGHT RECORDERS

Notice of Proposed Rule Making,

The Federal Aviation Administration is considering amending Part 37 of the Federal Aviation Regulations by adding a new Technical Standard Order (TSO) concerning aircraft flight recorders that have the capability of recording the additional flight data required by the Federal Aviation Regulations.

Interested persons are invited to participate in the making of the proposed rule by submitting such written data, views, or arguments as they may desire. Comments relating to any significant environmental or economic impact that might result because of the adoption of these proposals may also be submitted. Communications should identify the regulatory docket or notice number and be submitted in duplicate to the Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket, AGC-24, 800 Independence Avenue, S. W., Washington, D.C. 20591. All communications received on or before _____, 1976, will be considered by the Administrator before taking action on the proposed rule. The proposals contained in this notice may be changed in

the light of comments received. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons.

On August 19, 1970, the Federal Aviation Administration published in the Federal Register ((35 FR 13191) Amendment 121-66 to Parts 25 and 121 concerning flight recorders. A further amendment, 121-82, to Part 121 was published on December 10, 1971 (36 FR 23552). These amendments require: (1) an increase in the recorded flight data for large airplanes, for which an original type certificate is issued after September 30, 1969, and that are turbine engine powered or certificated for operation above 25,000 feet altitude; (2) change in the requirement for keeping the recorded data; (3) a means to automatically prevent data erasure after crash impact on flight recorders which erase and re-use tape; (4) a device to assist in the location of flight recorders under water; and (5) a means to correlate the time of recorded data with the time of radio communications between the airplane and air traffic control.

Section 37.150, TSO-C51a, contains minimum performance standards for aircraft flight recorders capable of recording only five parameters: time, airspeed, altitude, vertical acceleration, and heading. These minimum performance standards are inadequate for the type of recorder required by Amendments 121-66 and 121-82. It is, therefore, proposed to issue a new TSO which will incorporate minimum performance standards for aircraft flight recorders designed to meet the additional requirements of Amendments 121-66 and 121-82.

Because the aircraft flight recorders required by Amendments 121-66 and 121-82 are mandatory only on certain aircraft, it is proposed to retain §37.150, TSO-C51a, to provide minimum performance standards for flight recorders on aircraft for which a more limited parameter recorder may continue to be used.

It should be noted that this TSO applies only to the flight recorder and the data acquisition unit, and not to the aircraft transducers. The data acquisition unit need not be subject to the survivability tests.

This amendment is proposed under the authority of sections 313(a) and 601 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a) and 1421), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, it is proposed to amend Part 37 of Chapter I of Title 14 of the Code of Federal Regulations as set forth below:

Part 37 - TECHNICAL STANDARD ORDER AUTHORIZATIONS

Part 37 is amended by adding a new §37.187 to read as follows:

§37.187 Aircraft flight recorders - TSO-C81.

(a) Applicability - Minimum Performance Standards.

This technical standard order prescribes the minimum performance standards that aircraft flight recorders and data acquisition equipment must meet in order to be identified with the applicable TSO marking. Aircraft flight recorder systems that are to be so identified must meet the requirements of the "Federal Aviation Standard, Aircraft Flight Recorder", set forth at the end of this section; Radio Technical Commission for Aeronautics (RTCA) Document No. DO-160, entitled "Environmental Conditions and Test Procedures for Airborne Electronic/

Electrical Equipment and Instruments", dated Feb. 28, 1975; and Federal Specification No. L-S-300A entitled "Sheeting and Tape, Reflective: Non-exposed Lens, Adhesive Backing", dated January 7, 1965. RTCA Document No. DO-160 and Federal Specification No. L-S-300A are incorporated in accordance with 5 U.S.C. 552(a)(1) and § 37.23 of the Federal Aviation Regulations and are available for inspection as indicated in §37.23. Additionally, RTCA Document No. DO-160 and Federal Specification No. L-S-300A may be examined at any FAA regional office of the Chief of Engineering and Manufacturing Branch (or in the case of the Western Region, the Chief, Aircraft Engineering Division). RTCA Document No. DO-160 may be obtained from the RTCA Secretariat, Suite 655, 1717 H Street, N.W., Washington, D.C. 20006, at a cost of $20.00 per copy; and Federal Specification No. L-S-300A may be obtained from the General Services Administration, Region 3, Specification Sales, Building 197, Washington Navy Yard, Washington, D.C. 20407, at a cost of 25 cents per copy.

(b) Marking: In addition to the markings required by § 37.7, the equipment must meet the following requirements:

(1) The recorder and the data acquisition unit must be marked in accordance with Appendix A of RTCA Document DO-160 to indicate the environmental categories over which it has been designed to operate. Where an environmental test procedure is not applicable and the test is not conducted, an "X" must be placed in the space assigned for that category.

(2) Each separate component of the recording system must be identified with at least the name of the manufacturer, model or part number, the TSO number, and the environmental

categories over which the component is designed to operate. Where an environmental test procedure described in DO-160 is not applicable to that component and the test is not conducted, an "X" must be placed in the space assigned for that environmental category.

(3) The recorder must be marked to indicate the manufacturer's declared service life for the recording medium.

(4) When the recorder incorporates or has attached to it an underwater locator beacon, it must be marked with the date, on or before which the underwater locator beacon battery must be replaced or recharged, as applicable, to comply with the useful life limitations prescribed in paragraph (c)(2) of this section.

(c) Data requirements. In accordance with § 37.5, the manufacturer must furnish to the Chief, Engineering and Manufacturing Branch, Flight Standards Division (or in the case of the Western Region, the Chief, Aircraft Engineering Division), Federal Aviation Administration, in the region in which the manufacturer is located, one copy of the following technical data, except that additional copies must be furnished to FAA upon request:

(1) Manufacturer's operating instructions and equipment limitations.

(2) Installation procedures with applicable schematic drawings, wiring diagrams, and specifications. The procedures must show all limitations, restrictions, or other conditions pertinent to the installation. The limitations must include, for batteries other than those that are essentially unaffected during probable storage

intervals, a limitation on the use of the battery beyond 50 percent of its useful life (or in the case of a rechargeable battery, beyond 50 percent of its useful life of charge) as established by the underwater beacon manufacturer. For the purpose of this paragraph, the useful life of the battery (established by the beacon manufacturer) is the length of time, after its date of manufacture, that the battery may be stored on the shelf under normal environmental conditions without losing its ability to meet the power supply requirements prescribed in Section 6.0 of the Federal Aviation Standard for Aircraft Flight Recorders.

(3) Manufacturer's test report(s).

(4) Equipment data sheet(s) specifying, within the prescribed range of environmental conditions, the actual performance of equipment of that type with respect to each performance factor prescribed in the applicable standard.

(5) A drawing list, enumerating all the drawings and processes that are necessary to define the article design.

(d) Data furnished with each article manufactured. A copy of the installation procedures specified in paragraphs (c)(1), (c)(2), and (c)(4) of this section and the equipment data sheets specified in paragraph (c)(4) of this section must be furnished with each article manufactured under this TSO.

Director
Flight Standards Service

Issued in Washington, D. C., on

FEDERAL AVIATION STANDARD
AIRCRAFT FLIGHT RECORDERS

1.0 PURPOSE. This document specifies the minimum performance standards for extended parameter non-ejectable aircraft flight recorders.

2.0 GENERAL STANDARDS.

2.1 Malfunction Indication. An aural or visual means must be provided for preflight checking of the recorder for proper recording medium movement.

2.2 Recorder Container Color. The recorder container and recording medium container must be colored either bright orange or bright yellow.

2.3 Reflective Marking. The recorder container must be marked with reflective patches made from material which meets Federal Specification L-S-300A dated January 7, 1970, Type I or II, Class 1, 2, 3, 4, or 5, Reflectivity No. 1, and color h-Silver White No. 2. The patches must either be circular having a diameter of 4 inches, or squares having 4 inch sides. Polyhedron type containers must have two patches on each side, two on top, and one on the back (none required on front and bottom). Spherical containers must have six patches, one each at the intersection of the three mutually perpendicular axes with the exterior surface of the container.

2.4 Recorder Inputs. The manufacturer must specify the equipment input requirements, including the information format needed to obtain the accuracies stated in Table I. This applies to the input of the flight data acquisition unit inputs or other inputs to the flight data recorder.

2.5 Testing. All testing must be conducted on a recorder incorporating a recording medium whose declared service life has been exhausted by 95 percent.

3.0 MINIMUM PERFORMANCE STANDARDS UNDER STANDARD TEST CONDITIONS.

3.1 Standard Conditions. Unless otherwise specified herein, all performance requirements are for an atmospheric pressure of 29.92±1 inches of mercury, an ambient temperature of +25 ± 5 °C, and a relative humidity of not greater than 85 percent. Unless otherwise specified, all performance measurements must be made while the recorder is being subjected to 0.0 and 6.0 gs. and is in its normal operating position, inverted from its normal operating position, pitched 90 degrees from its normal operating position, and rolled 90 degrees from its normal operating position. If the recorder position is limited, i.e., longitudinal axis must be parallel to the aircraft's longitudinal axis to meet the requirements of Table I, this must be stated as a limitation to the equipment in accordance with § 37.187(c)(2).

3.2 Parameters. The equipment must be designed to record data from which at least the following information may be determined: time, altitude, airspeed, vertical acceleration, heading, pitch attitude, roll attitude, lateral acceleration or side slip angle, pitch trim position, control column or pitch control surface position, control wheel or lateral control surface position, rudder pedal or yaw control surface position, thrust of each engine, position of each thrust reverser, trailing edge flap or cockpit flap control position, leading edge flap or cockpit flap

control position, and the time of each radio transmission either to or from an Air Traffic Control facility.

3.3 Accuracy. The equipment must be designed to record the data specified in paragraph 3.2 of this standard within the ranges, accuracies, and recording intervals specified in Table I of this standard.

3.4 Retention Of Recorded Information.

(a) The recorder must be capable of continuously recording and retaining the data specified in paragraph 3.2 of this standard for at least 25 hours.

(b) The data loss throughout the manufacturer declared recording medium service life must not exceed .3 percent of the recorded data required by subparagraph (a) of this paragraph.

4.0 MINIMUM PERFORMANCE STANDARDS UNDER ENVIRONMENTAL TEST CONDITIONS.

Unless otherwise specified herein, the test procedures applicable to a determination of the performance of Aircraft flight Recorders under environmental conditions are set forth in Radio Technical Commission for Aeronautics (RTCA) Document No. DO-160, entitled "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments", dated February 28, 1975.

4.1 Temperature and Altitude Tests.

(a) When subjected to the Low Temperature Test Procedure (DO-160, paragraph 4.4), the equipment must meet the requirements of paragraphs

3.2, 3.3, and 3.4 of this standard.

(b) When the equipment is subjected to the High Operating Temperature Test Procedure (DO-160, paragraph 4.5)-

(1) All mechanical devices must perform their intended function;

(2) The equipment must operate electically; and

(3) There must be no evidence of materials such as grease or potting or sealing compounds, exuding or dripping from the equipment.

(c) When subjected to the High Temperature Test Procedure (DO-160, paragraph 4.5.2), the equipment must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

(d) When subjected to the Altitude Test Procedure (DO-160, paragraph 4.6.1), the equipment must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.2 Humidity Test. When the equipment is subjected to the Humidity Test (DO-160, paragraph 6.0), it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.3 Shock Test.

(a) When the equipment is tested in accordance with paragraph 7.1 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

(b) Crash safety shocks. When the equipment is tested in accordance with paragraph 7.2 of DO-160, it must remain in its mounting and no part of the equipment or its mounting may become detached and free of the shock

test table or of the equipment under test. The application of these tests may result in damage to the equipment; therefore, they may be conducted after the other tests are completed.

4.4 Vibration Test. When the equipment is tested in accordance with paragraph 8.2 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.5 Power Input Test.

(a) When the equipment is tested in accordance with paragraph 16.0 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

(b) When the equipment is tested in accordance with paragraph 16.2.3.2 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

(c) When the equipment is tested in accordance with paragraph 16.3.4.2 of DO-160, it must operate electrically and mechanically.

(d) When the equipment is being subjected to the Low Voltage Tests in accordance with paragraphs 16.3.2 and 16.3.4.2 of DO-160, there must be no evidence of fire or smoke. On completion of Low Voltage Tests, the equipment must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard, under standard atmospheric conditions.

4.6 Voltage Spike Conducted Test. When the equipment is tested in accordance with paragraph 17.0 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.7 Audio Frequency Conducted Susceptibility Test. When the equipment is tested in accordance with paragraph 18.0 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.8 Audio Frequency Susceptibility Test. When the equipment is tested in accordance with paragraph 19.0 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.9 Radio Frequency Susceptibility Test. When the equipment is tested in accordance with paragraph 20.0 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.10 Emission of Spurious R.F. Energy Test. The levels of conducted and radiated spurious radio frequency energy emitted by the equipment, when measured in accordance with paragraph 21.0 of DO-160, must not exceed those levels specified in DO-160 for Category A equipment.

4.11 Transient Spike Voltage Test. After the equipment is tested, in accordance with paragraph 17.0 of DO-160, the equipment must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard at standard atmospheric conditions and design voltages.

4.12 Explosion Test. Equipment which is to be marked Explosion Category E, must not cause explosion when tested in accordance with paragraph 9.0 of Do-160.

4.13 Waterproofness Test.

(a) All of the components of the equipment which are to be marked Waterproofness Category W must be tested in accordance with DO-160, paragraph 10.0.

(b) When the equipment is tested in accordance with paragraph 10.0 of DO-160, it must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.14 Hydraulic Fluid Test.

(a) Equipment which is to be marked Hydraulic Fluid Category H must be tested in accordance with DO-160, paragraph 11.0.

(b) When the equipment is tested in accordance with paragraph 11.0 of DO-160, it must meet the requirement of paragraphs 3.2, 3.3, and 3.4 of this standard.

4.15 Sand and Dust Test. Equipment is to be marked Sand and Dust Category D must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard, when tested in accordance with paragraph 12.0 of DO-160.

4.16 Fungus Resistance Test. Equipment which is to be marked Fungus Resistance Category F must meet the requirements of paragraphs 3.2, 3.3, and 3.4 of this standard, when tested in accordance with paragraph 13.0 of DO-160.

4.17 Salt Spray Test. Equipment which is to be marked Salt Spray Category S must meet the requirements of paragraphs 3.2, 2.2, and 3.4 of this standard when tested in accordance with paragraph 14.0 of DO-160.

4.18 Warm-up Time Test. With the room at ambient atmospheric pressure and the equipment not operating, stabalize the equipment temperature at the appropriate Low Operating Temperature specified in Table 4-1 of DO-160. Maintain this stabilized temperature for 30 minutes;

then stabilize the equipment temperature at the appropriate Low Operating Temperature specified in Table 4-1 of DO-160. Within one minute after being switched on the equipment must be fully operational.

5.0 SURVIVABILITY. The impact, penetration resistance, static crush, fire protection, and water protection tests must be made in the order in which they are listed below and without any repairs during or between tests.

5.1 Impact. Apply to the recorder at each of its three main orthogonal axes an impact shock having the characteristics of a half sine wave with a peak amplitude of 1000g and of five milliseconds duration.

5.2 Penetration resistance. Apply to each side of the recorder, in the most critical plane, an impact force equal to that produced by a 500 pound weight that is dropped from a height of ten feet. The impact force must be applied through a straight steel circular bar having a cross-sectional area of no more than 0.05 square inches and a length of not less than 1 1/2 inches. The direction of the load must be along the longitudinal axis of the bar. Following impact, the steel bar must be whole and the end which first contacted the recorder must not have laterally deflected, relative to the bar's longitudinal axis of symmetry prior to the test, more than 0.265 inch. The recorder must be positioned in a horizontal, 3 to 6 feet square bed of 65 mesh sand, that is 18^{+o}_{-1} inches deep. At the moment of impact, the longitudinal axis of the bar must be within 5^{o} of the vertical.

5.3 Static crush. Apply to the recorder, in the most critical direction, a uniform distributed load of not less than 5000 pounds, for a

minimum of 5 minutes.

5.4 Fire protection. Expose the recorder to flames of 1100°C for 30 minutes. The flames must envelope at least 50 percent of the recorder surface area. Except for small parts (such as knobs, fasteners, seals, grommets, and small electrical parts), that would not contribute significantly to the spread of a fire, all combustible materials must be self-extinguishing. When tested in an approved method, the average burn length must not exceed three (3) inches, and the average flame time after removal of the flame source must not exceed 30 seconds. Drippings from the test specimen must not continue to flame for more than an average of three (3) seconds after falling.

5.5 Water protection. Immerse the recorder in sea water at a simulated depth of 1500 feet for 30 days.

5.6 Intelligence of recording medium. On completion of the tests specified in paragraphs 5.1 through 5.5, inclusive, it must be possible to obtain from the recorder the information specified in paragraph 3.2, within the ranges, accuracies, and recording intervals specified in paragraph 3.3, for the time interval specified in paragraph 3.4 of this standard.

6.0 UNDERWATER LOCATOR BEACON.

6.1 Performance requirements. An accoustic underwater beacon (pinger) incorporated in or attached to the flight recorder must have-

(a) An operating frequency of 37.5 ± 1 KHZ;

(b) A pulse length of not less than 9.0 milliseconds;

(c) A pulse repetition rate of not less than .9 pulses per second;

(d) An operating life of not less than 30 days;

(e) An initial acoustic peak pressure output of not less than 1,500 dynes/cm^2, measured at a distance of one meter from the beacon;

(f) An acoustic peak pressure output, at the end of 30 days, of not less than 1000 dynes/cm^2, measured at a distance of one meter from the beacon;

(g) Its free-space rated acoustic output radiated over at least 80 percent of a spehrical pattern. If more than one beacon is needed to achieve this pattern, beacon approval must include the limitation that the required number of beacons must be installed in certain relative positions; and

(h) An actuation means that will cause the beacon to commence transmitting within four hours after it is immersed in water. The means of actuation must work well in both fresh and salt water at any depth down to 2000 feet.

6.2 Test conditions. The beacon must meet the requirements of paragraph 6.1 of this standard after it is subjected to all of the following tests in the order given, and while submerged in 1500 feet of salt water at temperatures of between $+26^{\circ}$ to $+100^{\circ}$ F.

(a) Inadvertent actuation (condensation). The beacon must be cold soaked at 15^{+5}_{-0} F. for six hours and then immediately placed in a chamber maintained at 95^{+5}_{-0} F. and 95 $^{+}_{-}$ percent relative humidity for 18 hours. This complete cycle must be conducted 15 times. During these cycles there must be no actuation of beacon transmissions. The beacon must be tested in the most critical position concerning inadvertent actuation by condensation.

(b) Storage temperature. Store the beacon for 48 hours each at -65^{+0}_{-5} F. and at $+160^{+5}_{-0}$ F.

(c) Vibration. Vibrate the equipment for one hour, in each of the three main orthogonal axes at a constant total excursion of .020 inches from 5 to 2000 Hertz and with a maximum acceleration of 3g.

(d) Impact. Apply to the beacon at each of its three main orthogonal axes with a peak amplitude of 1000g and of five milliseconds duration.

(e) Static crush. Apply to the beacon in the most critical direction a uniform distributed load of not less than 5,000 pounds, for a minimum of 5 minutes.

6.3 Beacon Attachment. The beacon must be incorporated in, or attached to the recorder when the recorder is tested in accordance with paragraph 5.1 of this standard. On completion of that test, the beacon must not have separated from the recorder.

Director
Flight Standards Service

Issued in Washington, D.C., on

TABLE I

INFORMATION	RANGE	ACCURACY, MINIMUM (RECORDER AND READOUT)	RECORDING INTERVAL, MAXIMUM (SECONDS)
Time		±0.125 percent per hour, except accuracy need not exceed ±4 seconds.	60
Altitude	-1000 feet to maximum declared altitude by the manufacturer.	±100 to ±700 feet, reference TABLE II.	1
Airspeed	100 to 450 KIAS or 100 KIAS to 1.0 V_D, whichever is greater.	±10 knots at room temperature and ±12 knots at the low temperature.	1
Vertical acceleration	-3g to +6g	±0.2g stabilizer and ±10 percent transient	0.25 (or one second in which the ± acceleration peaks are recorded).
Heading	360°	±2°	1
Pitch attitude	±75°	±2°	1
Roll attitude	±180°	±2°	1
Lateral acceleration	±1.0g	±0.05g stabilized or ±10 percent transient	0.25 (or one second in which the ± acceleration peaks are recorded).
Sideslip angle (In lieu of lateral acceleration).	±30°	±2°	0.5

TABLE I (cont.)

INFORMATION	RANGE	ACCURACY	RECORDING INTERVAL
Pitch trim position	Range to be declared by the manufacturer	$\pm 1^{\circ}$ or ± 5 percent whichever is greater	2
Control column or pitch control surface position	Range to be declared by the manufacturer	$\pm 2^{\circ}$	1
Control wheel or lateral control surface position	Range to be declared by the manufacturer	$\pm 2^{\circ}$	1
Rudder pedal or yaw control surface position	Range to be declared by the manufacturer	$\pm 2^{\circ}$	0.5
Thrust	Range to be declared by the manufacturer	$\pm 2^{\circ}$	4
Position of each thrust reverser	Stowed and full reverse		4
Trailing edge flap or cockpit flap control position	Each discrete position or range to be declared by the manufacturer	$\pm 3^{\circ}$	2
Leading edge flap or cockpit flap control position	Each discrete position		2
Angle of attack (if recorded directly)	-20° to $+40^{\circ}$	$\pm 1^{\circ}$	0.5

TABLE II - ALTITUDE RECORD ERROR TABLE

Standard Altitude (Feet)	Equivalent Pressure Mercury		Tolerance, Feet Plus or Minus *	
	MM	IN. HG	Room Temp.	Low Temp.
-1000	787.9	31.02	100	150
-500	773.8	30.47	100	-
0	760.0	29.92	100	150
500	746.4	29.39	100	-
1,000	732.9	28.86	100	-
1,500	719.7	28.33	100	-
2,000	706.6	27.82	100	-
3,000	681.1	26.81	125	-
4,000	656.3	25.84	150	210
6,000	609.0	23.98	150	250
8,000	564.4	22.22	150	-
10,000	522.6	20.58	150	-
12,000	483.3	19.03	180	350
14,000	446.4	17.57	210	-
16,000	411.8	16.21	240	-
18,000	379.4	14.94	270	450
20,000	349.1	13.75	300	-
22,000	320.8	12.63	335	-
25,000	281.9	11.10	375	560
30,000	225.6	8.88	450	600
35,000	178.7	7.04	525	730
40,000	140.7	5.54	600	800
50,000	87.3	3.44	700	-

* NOTE: The tolerance specified in this table may be increased by 25 feet, when the flight recorder is rotated, from its normal operating position, 180° about its lateral or longitudinal axis.