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# REPORT TO CONGRESS BY THE FEDERAL AVIATION ADMINISTRATION ON THE ENERGY EFFICIENCY OF AGENCY REGULATIONS

FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.

NOVEMBER 1976

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# REPORT TO CONGRESS BY THE FEDERAL AVIATION ADMINISTRATION ON THE ENERGY EFFICIENCY OF AGENCY REGULATIONS

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**FEDERAL AVIATION ADMINISTRATION**
**Washington, D.C. 20591**

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16. Abstract

Pursuant to Section 382(a)(3) of the Energy Policy and Conservation Act, P.L. 94-163, this report examines the utilization of energy in operations governed by regulations administered by the FAA.

All regulations and laws administered by the FAA were examined for their effect on energy consumption. An inventory of regulations requiring activities which lead to fuel usage was prepared and organized. The following general groupings were identified:

- Flight Test Programs
- Environmental Control
- Aircraft Fuel Supply
- Aircraft Speed and Flight Altitude
- Airspace and Air Traffic Control
- Aircraft Equipment
- Crewmember Qualifications

The conclusion drawn from this investigation is that: Regulations and laws administered by the FAA are fuel efficient subject to the constraints of safety, environmental control, and existing technology.

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WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

Honorable Nelson A. Rockefeller
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

I am pleased to submit the enclosed report pursuant to Section 382(a)(3) of the Energy Policy and Conservation Act, Public Law 94-163. The report examines the utilization of energy in operations governed by regulations administered by the Federal Aviation Administration.

Sincerely,

John L. McLucas
Administrator

Enclosure

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**DEPARTMENT OF TRANSPORTATION**
**FEDERAL AVIATION ADMINISTRATION**

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

Honorable Carl Albert
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

I am pleased to submit the enclosed report pursuant to Section 382(a)(3) of the Energy Policy and Conservation Act, Public Law 94-163. The report examines the utilization of energy in operations governed by regulations administered by the Federal Aviation Administration.

Sincerely,

John McLucas

John L. McLucas
Administrator

Enclosure

# EXECUTIVE SUMMARY

# EXECUTIVE SUMMARY

## Background

This is the third of three reports to Congress by the Federal Aviation Administration (FAA) which respond to requirements of the Energy Policy and Conservation Act (EPCA). This Act establishes major new policy directions for both American industry and all levels of government concerning the conservation of domestic energy supplies and the more efficient utilization of scarce national energy resources.

Section 382 (a)(3) of the Act directs the Federal Aviation Administration to:

> "conduct a study and prepare a report with respect to any requirement of any law administered by such agency or any major regulatory action which the agency determines has the effect of requiring, permitting, or inducing the inefficient use of petroleum products, coal, natural gas, electricity, and other forms of energy, together with a statement of the need, purpose, or justification of any such requirement or such action."

This report responds to that requirement.

## Methodology

All regulations and laws, administered by the FAA, were examined for their effect on energy consumption. An inventory of regulations requiring activities which lead to fuel usage was prepared and organized. The following general groupings were identified:

-- Flight Test Programs

-- Environmental Control

-- Aircraft Fuel Supply

-- Aircraft Speed and Flight Altitude

-- Airspace and Air Traffic Control

-- Aircraft Equipment

-- Crewmember Qualifications

Each of these regulation categories requires activities which directly or indirectly result in increased fuel consumption.

The apparent intent of the Act was to isolate inefficient energy consumption. In this study, all regulations requiring energy consumption, whether efficient or inefficient, were identified. Then, through examination of the purpose or justification of the regulation and evaluation of existing technologies, inefficiencies were sought.

Conclusion

The analysis presented in this report leads to the following set of conclusions regarding the effect of FAA regulations on the efficient usage of petroleum products.

- Flight Test Programs: The safety of flight is related to the quality of the aircraft which must be ascertained through flight testing. Present required testing is not excessive. Fuel consumed in testing is a small fraction of total aviation fuel. No regulatory changes are recommended.

- Environmental Control: Although aircraft noise is predominantly an annoyance problem, sonic boom and excessively high noise levels in populated areas can damage health and property. Similarly, emission control protects the public from fuel or fuel usage byproducts which might be harmful to public health and safety. Present standards do not produce sizeable fuel inefficiencies relative to the protection given the public. No regulatory changes are recommended.

- Aircraft Fuel Supply: Fuel reserves are necessary for crew and passenger safety in the event of delay or diversion to alternate airports. Increasing volumes of air traffic have produced more frequent and more extensive delays. Weather continues to be both a factor in delays and diversions. Since many air carriers actually carry fuel in excess of the required minimums, the regulations do not appear to be responsible for fuel inefficiencies to any significant extent; therefore, no change is recommended.

- Aircraft Speed and Flight Altitude: In order to reduce the likelihood of airborne collision, regulations have been adopted relative to aircraft speed and flight altitude. Aircraft speed is regulated downward in congested airspace. For certain aircraft this produces inefficiencies. As ground and airborne equipment improve, including air traffic control equipment, the requirement can be changed. Assigned flight altitudes restrict the slightly more fuel efficient technique of cruise climb. Once again, as the appropriate technologies are available, these regulations can be changed.

- Airspace and Air Traffic Control: The existence of airways from one navigational aid to another produces a degree of circuitous routing and corresponding inefficiency. The technique of area navigation (RNAV) permits the optimal flight path to be flown. Efforts are now underway within FAA to improve the efficiency and utilization of RNAV routes and technology.

- Aircraft Equipment: Proper navigation and communication requires equipment. Flight under instrument flight rules (IFR), night flight, emergencies and flight over water impose additional equipment needs. Equipment weight increases fuel usage. An aid will be lowered equipment weight through new technology, i.e., subminiaturization and digital avionics. No regulatory changes are recommended.

- Crewmember Qualifications: In order to insure that crewmembers are properly qualified, regulations detail minimum experience and proficiency levels. Where passengers are carried commercially, qualifications are more rigid and continued training with associated frequent proficiency checks is mandated. The prime source of fuel conservation in training is use of simulators. Air carriers are currently using simulators extensively and increased utilization is desired in the future. Current regulations permit simulator usage and no regulatory changes are recommended.

Summary

The economics of aviation is such that excessive fuel consumption produces increased costs for aviation users and historically fuel economy has been a consideration in regulation creation by the Federal Aviation Administration. Any regulation requiring unnecessary fuel usage relative to the regulatory intent quickly produces a response from the industry. The conclusion drawn from this investigation is that: Regulations and laws administered by the FAA are fuel efficient subject to the constraints of safety, environmental control and existing technology.

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# I. INTRODUCTION

# I. INTRODUCTION

The Energy Policy and Conservation Act, P.L. 94-163, signed into law by the President on December 22, 1975, has established major new policy directions concerning the conservation of domestic energy supplies and the more efficient utilization of scarce national energy resources. Both American industry and all levels of government have been mobilized to accomplish the goals set forth in the EPCA; in particular government regulatory agencies have been charged with effectuating energy savings and evaluating the energy impact of existing regulations.

The Federal Aviation Administration responded to Section 382 (a)(1) of the Act on February 20, 1976, in the "Report to Congress on Energy Conservation Policies and Practices by the Federal Aviation Administration," wherein the innovative policies and procedures for conserving scarce energy resources, both before and after the October 1973 crisis, were delineated. In particualr, the FAA Seven-Point Conservation Program implemented on November 20, 1973, was detailed. The FAA responded to Section 382 (a)(2) of the Act on April 20, 1976, in the "Report to Congress by the Federal Aviation Administration on Proposed Programs for Aviation Energy Savings," wherein programs were delineated which have the potential for improving the efficiency of energy utilization by aviation.

Section 382 (a)(3) of the Act directs the Federal Aviation Administration to:

> "conduct a study and prepare a report with respect to any requirement of any law administered by such agency (the FAA) or any major regulatory action which the agency determines has the effect of requiring, permitting, or inducing the inefficient use of petroleum products, coal, natural gas, electricity, and other forms of energy, together with a statement of the need, purpose, or justification of any such requirement or such action."

This study responds to that requirement and examines the utilization of energy in operations governed by regulations administered by the FAA. A four-phase approach to the study was utilized. In phase one, every regulation

and act administered by the FAA was surveyed. In phase two, any regulation which required, permitted, or induced fuel usage was identified. All such regulations were then partitioned into groups having similar effect in phase three. Finally, in phase four, each such grouping was evaluated as to its effect upon fuel usage and a justification, or explanation, for the existence of the grouping of regulations was provided.

In phase one of this study, an exhaustive survey of regulations and laws administered by the FAA was conducted. Specifically, the Code of Federal Regulations 14, Aeronautics and Space, Part 1 to 199 (January 1, 1976), referred to as the FARs, was searched in detail. Additionally, the following laws were evaluated:

A. Section 6 (c)(1) of the Department of Transportation Act (49) U.S.C. 1655 (c)(1).

B. Sections 306, 307, 308, 312, 313, 314, 1101, 1105, and 1111 and Titles VI, VII, IX, and XII of the Federal Aviation Act of 1958, as amended.

C. The Airport and Airway Development Act of 1970, as amended (49 U.S.C. 1701 et. seq.) except sections 3 and 4 (49 U.S.C. 1702, 1703).

D. Sections 208 and 209 of the Airport and Airway Revenue Act of 1970 (84 Stat. 250, 253).

E. Part B. of Title II of the Clean Air Act, as amended (34 Stat. 1703).

F. Section 208 of the Appalachian Regional Development Act of 1965 (84 Stat. 168; 40 U.S.C. App. 208).

The six acts in and of themselves do not require fuel usage, but instead provide the authority under which FAA regulations are promulgated.

The second phase of this effort was to identify those regulations that specifically require, permit, or induce

fuel usage. A thorough search of the code resulted in a large number of regulations which could be interpreted as having some influence upon fuel usage.

In phase three of the analysis, all fuel related regulations were then partitioned into groups having similar effect (e.g., all regulations dealing with flight testing were placed in one group). The grouping of similar regulations produced seven major partitions. This report devotes a chapter to each such grouping as follows:

Chapter II - Flight Test Programs

Chapter III - Environmental Control

Chapter IV - Aircraft Fuel Supply

Chapter V - Aircraft Speed and Flight Altitude

Chapter VI - Airspace and Air Traffic Control

Chapter VII - Aircraft Equipment

Chapter VIII - Crewmember Qualifications

Within each major grouping, subgroupings were formed which more specifically delineated the purpose of the selected regulations (e.g., emergency equipment is a subgroup within the group called aircraft equipment).

In phase four, each of the subgroupings was evaluated and a justification for the existence of each class of regulations was prepared. The justification is, therefore, purely an explanation of why the regulations exist since it was determined that none of the regulations evaluated required, permitted, or induced inefficient fuel usage.

Although no regulatory changes are recommended at this time, the FAA is currently conducting a major Airworthiness Review and Operations Review. Furthermore, the agency periodically reviews selected parts of the FARs and will consider recommendations from system users. More opportunities for energy savings exist in the operational/procedural/technological areas rather than in the regulatory areas of the FAA. Work is now underway to develop short, intermediate, and long-term options to save energy and improve aviation fuel efficiency.

The organization of this report is in nine chapters. Following this introductory chapter, the next seven chapters present regulations in the format discussed above. Then, Chapter IX summarizes the findings. The meticulous nature of this examination of the FAA regulations precludes the possibility of excluded regulations having significant fuel usage impacts. Indeed, the attitude of the analysis has no doubt resulted in the inclusion of numerous regulations which could reasonably have been excluded. All are included, however, since the inclusion of irrelevant regulations is far less serious than the exclusion of relevant ones.

The fundamental finding of the analysis herein is that: Regulations and laws administered by the FAA are fuel efficient subject to the constraints of safety, environmental control and existing technology.

# II. REGULATIONS PERTAINING TO THE FEDERAL AVIATION ADMINISTRATION FLIGHT TEST PROGRAMS

## II. REGULATIONS PERTAINING TO THE FEDERAL AVIATION ADMINISTRATION FLIGHT TEST PROGRAMS

For the protection of crew, passengers and the general public, the Federal Aviation Administration requires extensive flight testing of aircraft to insure their safety in operation. When a new type of aircraft is developed it must be flight tested. Each aircraft produced must be flown. Major modifications to the aircraft require testing before return to service. Certificate holders placing aircraft into new types of services must prove the aircraft.

Requiring flight tests of aircraft is requiring fuel consumption. These regulations, in mass if not individually, have a measurable effect on fuel consumption in aviation. Therefore, they are logically a component of the EPCA assignment.

Throughout this chapter, the subgroupings of flight tests are presented with justifications.

### A. Flight tests for type certification, production and airworthiness certification.

FAR 21.33 Inspection and tests

(a) Each applicant (for type certification) must allow the Administration to make any inspection and, in the case of aircraft, any flight and ground tests necessary to determine compliance with the applicable requirements of the Federal Aviation Regulations.

FAR 21.35 Flight tests

(a) Each applicant for an aircraft type certificate must make the tests listed in paragraph (b) of this section.

(b) Upon showing compliance with paragraph (a) of this section, the applicant must make all flight tests that the Administrator finds necessary--

(1) To determine compliance with the applicable requirements of this subchapter; and

(2) For aircraft to be certified under this subchapter, to determine whether there is reasonable assurance that the airplane, its components, and its equipment are reliable and function properly.

(f) The flight tests prescribed in paragraph (b)(2) of this section must include--

(1) For aircraft incorporating turbine engines of a type not previously used in a type certified aircraft, at least 300 hours of operation with a full complement of engines that conform to a type certificate; and

(2) For all other aircraft, at least 150 hours of operation.

FAR 21.81 Requirements for issue and amendment of Class I provisional type certificates

(g) The applicant must show that a prototype aircraft has been flown for at least 50 hours under an experimental certificate, or under the auspices of an Armed Force of the United States.

FAR 21.83 Requirements for issue and amendment of Class II provisional type certificates

(j) The applicant must show that a prototype aircraft has been flown for at least 100 hours.

FAR 21.127 Tests: Aircraft

(a) Each person manufacturing aircraft engines under a type certificate only shall establish an approved production flight test procedure and flight check-off form, and in accordance with that form, flight test each aircraft produced.

FAR 21.128 Tests: Aircraft engines

(a) Each person manufacturing aircraft engines under a type certificate only shall subject each engine to an acceptable test run that includes the following:

(1) Break-in runs

(2) At least five hours of operation at rated maximum continuous power or thrust.

FAR 21.221 Class I provisional airworthiness certificates

(d) The aircraft must be flown at least five hours by the manufacturer.

FAR 21.223 Class II provisional airworthiness certificates

(e) The aircraft must be flown at least five hours by the manufacturer.

FAR 12.225 Provisional airworthiness certificates corresponding with provisional amendments to type certificates

(d) The aircraft must be flown at least five hours by the manufacturer.

Justification: Flight tests for type certification, production and airworthiness certification of new aircraft are essential to the public safety. It is through such testing that design problems are detected and eliminated.

B. Flight test areas

FAR 91.93 Flight test areas

No person may flight test an aircraft except over open water, or sparely populated areas, having light air traffic.

Justification: Flight tests should not be conducted over heavily populated areas due to possible aircraft malfunction and aircraft abandonment by test pilot.

C. Flight test for Category II usage

FAR 91 Appendix A Category II operations

2.(2) Demonstrations. Unless otherwise authorized by the Administrator, the evaluation program for each airplane requires the demonstrations specified in this subparagraph. At least 50 ILS approaches must be flown with at least five approaches on each of three different ILS facilities and no more than one-half of the total approaches on any one ILS facility.

Justification: Category II ILS operation involves a lower runway visual range than Category I. This greater risk must be offset by more accurate equipment and proof of performance on the part of that equipment in flight.

D. Proving tests

FAR 121.163 Aircraft proving tests

(a) No domestic or flag air carrier may operate an aircraft not before proven for use in scheduled air carrier operations and no supplemental air carrier or commercial operator may operate an aircraft not before proven for use in air carrier or commercial operator operations unless an aircraft of that type has had, in addition to the aircraft certification tests, at least 100 hours of proving tests acceptable to the Administrator.

(b) A certificate holder may not operate an aircraft of a type that has been proven for use in its class of operation if it has not previously proved that type, or if that aircraft has been materially altered in design, unless--

(1) The aircraft has had at least 50 hours of tests acceptable to the Administrator.

FAR 127.73 Proving tests

(a) No air carrier may operate a helicopter not before proven for use in air carrier operations, unless a helicopter of that type has had in addition to the helicopter certification tests, at least 100 hours of proving tests acceptable to the Administrator.

(b) An air carrier may not operate a helicopter of a type that has been proven in commercial or extensive military service, if it has not previously used that type, or if that helicopter has been materially altered in design, unless--

(1) The aircraft has had at least 50 hours of tests acceptable to the Administrator.

FAR 133.41 Flight characteristics requirements

(a) The applicant must demonstrate to the Administrator, by performing the operational flight checks prescribed in paragraphs (b), (c) and (d) of this section, as applicable, that the rotor-craft-load combination has satisfactory flight characteristics.

FAR 135.32 Aircraft proving tests

(a) No certificate holder may operate a turbojet airplane, or an aircraft for which two pilots are required by this chapter for operations under VFR, if it has not previously proved that aircraft or an aircraft of the same make and similar design in any operation

to which this part applies unless, in addition to the aircraft certification tests, at least 25 hours of proving tests acceptable to the Administrator have been flown.

Justification: Even though an aircraft may be properly certified, it is still essential that it be tested under the conditions of its new intended use.

E. Summary

The safety of flight is a function of the quality of the aircraft flown. In Chapter II, an examination of those regulations pertaining to flight test programs for aircraft has been conducted. The required flight test time is not excessive compared to the safety benefits gained. The fuel consumption from flight testing is very small relative to total aviation fuel consumption. The flight test minimums are generally exceeded in practice by aircraft producers. In conclusion, no changes are recommended in the regulations relating to flight test programs.

# III. REGULATIONS PERTAINING TO THE FEDERAL AVIATION ADMINISTRATION ENVIRONMENTAL CONTROL PROGRAM

## III. REGULATIONS PERTAINING TO THE FEDERAL AVIATION ADMINISTRATION ENVIRONMENTAL CONTROL PROGRAM

The problem of noise in the airport vicinity is of concern to the Federal Aviation Administration (FAA) and regulations have been promulgated to put a lid on aircraft noise levels and to prohibit sonic boom by civil aircraft operating over the United States or territorial waters. Noise control is obtained by source noise reduction, by aircraft operational procedures, by air traffic routing procedures, and by land use compatibility development. In addition, the FAA and the Environmental Protection Agency (EPA) are concerned with the problem of air pollution. EPA has issued aircraft emission standards which the FAA has enforced through regulations.

The concern of this report is fuel consumption. Therefore, the search of the regulations has concentrated on those which impact fuel usage. Only those that appear to be associated with fuel consumption are presented for scrutiny.

### A. Aircraft Noise Measurement

FAR 36 Appendix A--Aircraft Noise Measurement

Section A 36.1 Noise certification test and measurement conditions

(b) General test conditions

(1) Tests to show compliance with established noise type certification levels must consist of a series of takeoffs and landings during which measurements must be taken at the measuring points defined in Appendix C of this part.

Section F 36.203 Validity of results

(b) The samples must be large enough to establish statistically a 90 percent confidence limit not to exceed $\pm$ 1.5 dB (A).

Justification: Flight tests for noise certification are required to assure compliance with FAR Part 36 Appendix C noise limits. The sample size for each flight test must be sufficiently large to result in statistically reliable noise measurements.

B. Sonic Boom

FAR 91.55 Civil aircraft sonic boom

No person may operate a civil aircraft at a true flight mach number greater than 1 except in compliance with conditions and limitations in an authorization to exceed Mach 1 issued to the operator under Appendix B of this part.

FAR 91 Appendix B--Authorizations to Exceed Mach 1

Section 1.

(c) In addition, each application for an authorization to exceed Mach 1 covered by Section 2(a) of this appendix must contain--

(3) Conditions and limitations that will insure that no measureable sonic boom overpressure will reach the surface outside of the designated test area.

Justification: Sonic boom overpressure can cause damage to property and individuals when it is extensive. Control of boom is essential to public safety and health.

C. Noise Abatement Runway System

FAR 91.87 Operation at airports with operating control towers

(g) Noise abatement runway system. When landing or taking off from an airport with an operating control tower, and for which a formal runway use program has been established by the FAA, each pilot of a turbine-powered

airplane and each pilot of a large airplane, assigned a noise abatement runway by ATC, shall use that runway.

Justification: The impact on the general public of airport noise can be controlled in many cases by ATC. The assignment of noise abatement runways by ATC can lower the impact of noise on the surrounding community.

D. Aircraft Emission Requirements

SFAR No. 27 Fuel venting and exhaust emission requirements for turbine engine powered airplanes, effective February 1, 1974

Section 15. Type certificates

(a) Notwithstanding Part 21 of the Federal Aviation Regulations, and irrespective of the date of application no type certificate is issued, on and after the dates specified in subparagraphs (a)(1) through (a)(4) of this section, for the airplanes specified therein, unless--

(1) For airplanes powered by engines of Class T2, Class T3, Class T4, or Class T5, the airframe or engine complies with the fuel venting emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(2) For airplanes powered by engines of Class T4, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(3) For airplanes powered by engines of Class T1 or Class P2, the airframe or engine complies with the fuel venting emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1975; and

(4) For airplanes powered by engines of Class T2 that have a rated power of 29,000 pounds thrust or greater, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1976.

(b) Notwithstanding Part 21 of the Federal Aviation Regulations, and irrespective of the date of application, no type cerfificate is issued, on and after the date specified in subparagraph (a)(4) of this section, for an engine specified therein, unless the engine complies with that subparagraph.

Section 17 Supplemental or amended type certificates

(a) Not withstanding Part 21 of the Federal Aviation Regulations, and irrespective of date of application, no supplemental or amended type certificate is issued on and after the dates specified in subparagraphs (a)(1) through (a)(4) of this section, for the airplanes specified therein, unless--

(1) For airplanes powered by engines of Class T2, Class T3, Class T4 and Class T5, the airframe or engine complies with the fuel venting emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(2) For airplanes powered by engines of Class T4, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(3) For airplanes powered by engines of Class T1 or Class P2, the airframe or engine complies with the fuel venting emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1975; and

(4) For airplanes powered by engines of Class T2 that have a rated power of 29,000 pounds thrust or greater, each each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1976.

(b) Notwithstanding Part 21 of the Federal Aviation Regulations, and irrespective of the date of application, no supplemental or amended type certificate is issued, on or after the dates specified in subparagraphs (a)(2) and (a)(4) of this section, for an engine specified therein, unless the engine complies with that subparagraph.

Section 19 Airworthiness approval tags. Notwithstanding Part 21 of the Federal Aviation Regulations, no airworthiness approval tag (FAA Form 8130-3) is issued on and after--

(a) February 1, 1974, for an engine of Class T4, unless the engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974; and

(b) January 1, 1976, for an engine of Class T2 that has a rated power of 29,000 pounds thrust or greater, unless the engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1976.

Section 21 Standard airworthiness certificates. Notwithstanding Part 21 of the Federal Aviation Regulations, and irrespective of the date of application, no standard airworthiness certificate is issued, on and after the dates specified in paragraphs (a) through (d) of this section, for the airplanes specified therein, unless--

(a) For airplanes powered by engines of Class T2, Class T3, Class T4, or Class T5 the airframe or engine complies with the fuel venting emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(b) For airplanes powered by engines of Class T4, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(c) For airplanes powered by engines of Class T1 or Class P2, the airframe or engine complies with the fuel venting emission requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1975; and

(d) For airplanes powered by engines of Class T2 that have a rated power of 29,000 pounds thrust or greater, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1976.

Section 25 Operation. On and after the dates specified in paragraphs (a) through (d) of this section, no person may, within the United States, operate an airplane specified in those paragraphs unless--

(a) For airplanes powered by engines of Class T2, Class T3, Class T4, or Class T5, the airframe or the engine complies with the fuel venting emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(b) For airplanes powered by engines of Class T4, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning February 1, 1974;

(c) For airplanes powered by engines of Class T1 or Class P2, the airframe or engine complies with the fuel venting emissions requirements and related test procedures

of 40 CFR Part 87 that apply beginning January 1, 1975; and

(d) For airplanes powered by engines of Class T2 that have a rated power of 29,000 pounds thrust or greater, each engine complies with the exhaust emissions requirements and related test procedures of 40 CFR Part 87 that apply beginning January 1, 1976.

Justification: The Clean Air Act, as amended on December 31, 1970, gave the Environmental Protection Agency (EPA) and the Secretary of Transportation responsibility for issuing and enforcing emission standards applicable to aircraft or aircraft engines. Emission standards are necessary so that there will be control of emissions from either aircraft or aircraft engines which might cause or contribute to air pollution which endangers the public health or welfare.

E. Summary

Noise control is an acute problem for airport management and the Federal Aviation Administration. In order for ground access to the central business district to be minimized, airports have been located near the district. Growth has been permitted to occur around these and other newer airports. This causes high noise levels generally for either the downtown area or a nearby suburb. Noise control has been accomplished by prohibition of supersonic flight, noise certification tests, the use of noise abatement runway systems, and noise-alleviating aircraft operational procedures and ATC procedures. The fuel consumption due to noise control is small. Pollution control is essential for achieving cleaner air. EPA aircraft emission standards are enforced by FAA through regulations. The present regulations do not appear excessive or unreasonable. Nevertheless, Congress, through separate actions, has mandated that the FAA promote clean air, noise standards and the efficient use of energy. These policy goals can sometimes conflict which may necessitate trade-offs. At present, priorities in realization of congressionally mandated goals is left to the judgment of the FAA in consultation with other agencies. With respect to energy conservation, the

FAA held a Consultative Planning Conference of representatives from all segments of the aviation community in October 1973 to look at "The Energy Outlook for Aviation." The most important result of the conference was to develop a series of steps that could be taken immediately by the FAA and system users to conserve fuel. In addition, the agency has coordinated extensively with industry and other Federal agencies in executing the requirements of the Energy Policy and Conservation Act.

# IV. REGULATIONS PERTAINING TO AIRCRAFT FUEL SUPPLY

## IV. REGULATIONS PERTAINING TO AIRCRAFT FUEL SUPPLY

In order to protect crew and passengers, the Federal Aviation Administration requires fuel reserves which, in essence, constitute extra weight to a flight and this extra weight raises fuel burn. The general purpose of the reserves is to permit delay absorption and/or flight to an alternate airport. The reserves are therefore a function of the amount of delay and the alternate chosen.

### A. Fuel Requirements for Flight in IFR Conditions

FAR 91.23 Fuel requirements for flight in IFR conditions

No person may operate a civil aircraft in IFR conditions unless it carries enough fuel (considering weather reports and forecasts, and weather conditions) to--

(a) Complete the flight to the first airport of intended landing;

(b) Fly from that airport to the alternate airport; and

(c) Fly thereafter for 45 minutes at normal cruising speed.

Justification: Fuel on board for flight in IFR conditions should be sufficient to provide some safety margin in the event of delay, poor weather conditions or diversions to alternate airports.

### B. Fuel Requirements for Flight in VFR Conditions

FAR 91.207 VFR fuel requirements

No pilot may begin a flight in an airplane under VFR unless, considering wind and forecast weather conditions, it has enough fuel to fly to the first point of intended landing and, assuming normal cruising fuel consumption, to fly thereafter for at least 30 minutes.

Justification: For reasons of safety, fuel on board for flight in VFR conditions should be sufficient to provide latitude in case of delays, bad weather, or diversions.

C. Fuel Requirements for Air Carriers, Air Taxi and Commercial Operators

FAR 121.639 Fuel supply; all operations: Domestic air carriers

No person may dispatch or take off an airplane unless it has enough fuel--

(a) To fly to the airport to which it is dispatched; and

(b) Thereafter, to fly to and land at the most distant alternate airport (where required) for the airport to which dispatched; and

(c) Thereafter, to fly for 45 minutes at normal cruising fuel consumption.

FAR 121.641 Fuel supply; nonturbine and turbo-propeller-powered airplanes: Flag air carriers

(a) No person may dispatch or take off a non-turbine or turbo-propeller-powered airplane unless, considering the wind and other weather conditions expected, it has enough fuel--

(1) To fly to and land at the airport to which it is dispatched;

(2) Thereafter, to fly to and land at the most distant alternate airport specified in the dispatch release; and

(3) Thereafter, to fly for 30 minutes plus 15 percent of the total time required to fly at normal cruising fuel consumption to the airports specified in subparagraphs (1) and (2) of this paragraph

or to fly for 90 minutes at normal cruising fuel consumption, whichever is less.

(b) No person may dispatch a nonturbine or turbo-propeller-powered airplane to an airport for which an alternate is not specified under 121.621 (a)(2), unless it has enough fuel, considering wind and forecast weather conditions, to fly to that airport and thereafter to fly for three hours at normal cruising fuel consumption.

FAR 121.643 Fuel supply: Nonturbine and turbo-propeller-powered airplanes: Supplemental air carriers and commercial operators.

(a) Except as provided in paragraph (b) of this section, no person may release for flight or take off a nonturbine or turbo-propeller-powered airplane unless, considering the wind and other weather conditions expected, it has enough fuel--

(1) To fly to and land at the airport to which it is released;

(2) Thereafter, to fly to and land at the most distant alternate airport specified in the flight release; and

(3) Thereafter, to fly for 45 minutes at normal cruising fuel consumption.

(b) If the airplane is released for a flight other than from one point in the contiguous United States to another point in the contiguous United States, it must carry enough fuel to meet the requirements of subparagraphs (1) and (2) of paragraph (a) of this section and thereafter fly for 30 minutes plus 15 percent of the total time required to fly at normal cruising fuel consumption to the airports specified in subparagraphs (1) and (2) of paragraph (a) of this section, or to fly for 90 minutes at normal cruising fuel consumption, whichever is less.

(c) No person may release a nonturbine or turbo-propeller-powered airplane to an airport for which an alternate is not specified under FAR 121.623(b), unless it has enough fuel, considering wind and other weather conditions expected, to fly to that airport and thereafter to fly for three hours at normal cruising fuel consumption.

FAR 121.645 Fuel supply: Turbine-engine powered airplanes, other than turbo propeller: Flag and supplemental air carriers and commercial operators

(a) For any flag carrier operation and for a supplemental air carrier or commercial operator operation outside the 48 contiguous States and the District of Columbia, no person may release for flight or take off a turbine-engine powered airplane (other than a turbo-propeller airplane) unless, considering wind and other weather conditions expected, it has enough fuel--

(1) To fly to and land at the airport to which it is released;

(2) Thereafter, to fly for a period of 10 percent of the total time required to fly from the airport of departure to and land at, the airport to which it was released;

(3) Thereafter, to fly to and land at the most distant alternate airport specified in the flight release, if any alternate is required; and

(4) Thereafter, to fly for 30 minutes at holding speed at 1,500 feet above the alternate airport (or the destination airport if no alternate is required) under standard temperature conditions.

(b) No person may release a turbine-engine powered airplane (other than a turbo-propeller airplane) to an airport for which an alternate is not specified under FAR 121.621(a)(2) and 121.623(b)

unless it has enough fuel, considering wind and other weather conditions expected, to fly to that airport and thereafter to fly for at least two hours at normal cruising fuel consumption.

(c) The Administrator may amend the operations specifications of a flag or supplemental air carrier or commercial operator to require more fuel than any of the minimums stated in paragraph (a) or (b) of this section if he finds that additional fuel is necessary for a particular route in the interest of safety.

(d) For a supplemental air carrier or commercial operator operation within the 48 contiguous States and the District of Columbia with a turbine engine powered airplane the fuel requirements of FAR 121.643 apply.

FAR 127.253 Fuel supply for VFR operations

No person may release a helicopter for VFR flight unless it carries enough fuel--

(a) To fly to the heliport to which released; and

(b) Thereafter, to fly at least 20 minutes at normal cruising consumption.

FAR 135.97 VFR: Fuel supply

(a) No person may begin a flight operation in an airplane under VFR unless, considering wind and forecast weather conditions, it has enough fuel to fly to the first point of intended landing, and assuming normal cruising fuel consumption--

(1) During the day, to fly thereafter for at least 30 minutes; or

(2) At night, to fly thereafter for at least one hour.

(b) No person may begin a flight operation in a helicopter under VFR unless, considering

wind and forecast weather conditions, it has enough fuel to fly to the first point of intended landing, and assuming normal cruising fuel consumption, to fly thereafter for at least 20 minutes.

Justification: Whereas flight under IFR or VFR conditions as presented in part A and B of this chapter may or may not involve passengers other than crew, flights of air carriers, air taxi and commercial operators are primarily passenger carrying flights. For the protection and safety of these passengers as well as the crews in case of delays, bad weather, or diversions, sufficient fuel to satisfactorily complete the flight is essential.

D. Summary

Fuel reserves are necessary for crew and passenger safety in the event of diversions to alternate airports and/or delay. IFR conditions involve greater probability of diversion and deserve higher reserve requirements. Present regulations specify minimum fuel reserves. Since many air carriers actually carry fuel in excess of the required minimums, the regulations do not appear to be responsible for substantial fuel inefficiencies and no change is recommended.

# V. REGULATIONS PERTAINING TO AIRCRAFT SPEED AND FLIGHT ALTITUDE

## V. REGULATIONS PERTAINING TO AIRCRAFT SPEED AND FLIGHT ALTITUDE

In order to reduce the likelihood of airborne collision, the Federal Aviation Administration has established regulations relative to speed and altitude. In the more highly congested air traffic areas, airspeed is regulated downward to increase reaction time upon visual sighting of another aircraft. Research is now underway with the National Aeronautics and Space Administration Ames Research Center to determine the impact of speed restrictions on safety and fuel efficiency. Also regulated is airspace separations en route. By assigning specific altitudes or flight levels to eastbound versus westbound traffic, separations from 1,000 feet to 2,000 feet for aircraft meeting from opposite directions are produced. Thus mid-air collisions in the vicinity of airports and also en route are being reduced through regulations.

### A. Aircraft Speed

FAR 91.70 Aircraft speed

(a) Unless otherwise authorized by the Administrator, no person may operate an aircraft below 10,000 feet MSL at an indicated airspeed of more than 250 knots (288 m.p.h.).

(b) Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area at an indicated airspeed of more than--

(1) In the case of a reciprocating engine aircraft, 156 knots (180 m.p.h.); or

(2) In the case of a turbine-powered aircraft, 200 knots (230 m.p.h.).

Paragraph (b) of this section does not apply to any operations within a Terminal Control Area. Such operations shall comply with paragraph (a) of this section.

(c) No person may operate an aircraft in the airspace underlying a terminal control area, or in a VFR corridor designated through

a terminal control area, at an indicated airspeed of more than 200 knots (230 m.p.h.).

Justification: Reaction time in an aircraft relative to distance covered is a function of aircraft speed. At lower airspeeds, improved reactions to visual sightings are possible. With the airspace below 10,000 feet, in airport traffic areas, and in TCA's highly congested at times, visual sightings with sufficient time to react lower the number of midair mishaps.

B. Cruising altitudes or flight levels

FAR 19.109 VFR cruising altitude or flight level

Except while holding in a holding pattern of 2 minutes or less, or while turning, each person operating an aircraft under VFR in level cruising flight at an altitude of more than 3,000 feet above the surface shall maintain the appropriate altitude prescribed below:

(a) When operating below 18,000 feet MSL and--

(1) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude plus 500 feet (such as 3,500, 5,500, or 7,500); or

(2) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude plus 500 feet (such as 4,500, 6,500, or 9,500).

(b) When operating above 18,000 feet MSL to flight level 290 (inclusive), and --

(1) On a magnetic course of zero degrees through 179 degrees, any odd flight level plus 500 feet (such as 195, 215, or 235); or

(2) On a magnetic course of 180 degrees through 359 degrees, any even flight level plus 500 feet (such as 185, 205, or 225).

(c) When operating above flight level 290 and--

(1) On a magnetic course of zero degrees through 179 degrees, any flight level, at 4,000 foot intervals, beginning at and including flight level 300 (such as flight level 300, 340, or 380); or

(2) On a magnetic course of 180 degrees through 359 degrees, any flight level, at 4,000 foot intervals, beginning at and including flight level 320 (such as flight level 320, 360, or 400).

FAR 91.121 IFR cruising altitude or flight level

(a) In controlled airspace. Each person operating an aircraft under IFR in level cruising flight in controlled airspace shall maintain the altitude or flight level assigned that aircraft by ATC. However, if the ATC clearance assigns "VFR conditions on-top," he shall maintain an altitude or flight level as prescribed by FAR 91.109.

(b) In uncontrolled airspace. Except while holding in a holding pattern of two minutes or less, or while turning, each person operating an aircraft under IFR in level cruising flight, in uncontrolled airspace, shall maintain an appropriate altitude as follows:

(1) When operating below 18,000 feet MSL and--

(i) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude (such as 3,000, 5,000, or 7,000); or

(ii) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude (such as 2,000, 4,000, or 6,000).

(2) When operating at or above 18,000 feet MSL but below flight level 290, and--

(i) On a magnetic course of zero degrees through 179 degrees, any

odd flight level (such as 190, 210, or 230); or

(ii) On a magnetic course of 180 degrees through 359 degrees, any even flight level (such as 180, 200, or 220).

(3) When operating at flight level 290 and above, and--

(i) On a magnetic course of zero degrees through 179 degrees, any flight level, at 4,000 foot intervals, beginning at and including flight level 290 (such as flight level 290, 330, or 370); or

(ii) On a magnetic course of 180 degrees through 359 degrees, any flight level, at 4,000 foot intervals, beginning at and including flight level 310 (such as flight level 310, 350, or 390).

Justification: By assigning altitudes based on direction of flight and on conditions of flight, separations between aircraft are established which reduce the likelihood of collision. The head-on collision is avoided by assigning odd altitudes to the east and even altitudes to westbound traffic. The over-take collision is at least partially avoided by placing IFR traffic (generally radar tracked) 500 feet below VFR traffic. At higher altitudes, the possible errors in altitude measurement require greater separations.

C. Summary

The maximum speed at which aircraft can fly in congested airspace is controlled by regulations. In the case of large air carrier aircraft, the speed limit produces a higher rate of fuel burn. The need for uniform speed of all aircraft in congested airspace is based on maintenance of appropriate separations for avoidance of midair collisions. As the equipment on board and on the ground for use in air traffic control improves, the speed limit can be altered. As the appropriate technology is implemented, the regulations will be adjusted.

The use of assigned flight levels provides airspace separations en route. From a fuel conservation standpoint, this increases burn since the technique of cruise climb is thus not permitted. As better equipment is developed, particularly in the altitude reporting category, then regulation adjustments can be made which improve operating efficiency.

# VI. REGULATIONS PERTAINING TO AIRSPACE AND AIR TRAFFIC CONTROL

## VI. REGULATIONS PERTAINING TO AIRSPACE AND AIR TRAFFIC CONTROL

The airspace of the United States has been divided and defined for purposes of air traffic control. Federal airways, classified as LF/MF and VOR Federal airways, extend from one navigational aid or intersection to another navigational aid. Area low routes are similar to airways but are based on area navigation and require use of an on-board computer. Area low routes extend from one waypoint to another waypoint, or through several waypoints to another waypoint, and do not necessarily go over navigational aids. Control airspace consists of control areas, the continental control area, control zones, transition areas, positive control areas, and terminal control areas. The detailed descriptions of airways, control zones, etc., are defined in Subparts B through K of Part 71.

In addition to the general use airspace of Part 71, special use airspace assignments including restricted areas and prohibited areas are made in Part 73. Special use airspace consists of airspace wherein activities must be confined--usually because of their hazardous nature, or wherein limitations are imposed upon nonparticipating aircraft. Most special use airspace is for military training activities. Restricted areas are designated to confine activities considered to be hazardous to nonparticipating aircraft. It is the policy of the FAA that restricted areas should be available for use by all civil and military aviation when not required to contain the activity for which designated. Nonparticipating aircraft can frequently avoid the necessity of circumnavigating restricted areas by obtaining permission from the controlling agency or using agency (published on aeronautical charts) to fly through the restricted area. Prohibited areas are normally not available for transit by nonparticipating aircraft but are designated only at low altitudes, and they can be easily overflown without the necessity of long circumnavigation.

Special routes for jet aircraft at altitudes above 18,000 feet MSL are described in Part 75 and include jet routes and area high routes. Jet routes extend between high altitude navigational aids or intersections of their signals, and area high routes extend between waypoints specified for the route, and do not necessarily overfly the navigational aids.

From the standpoint of fuel conservation, the definition of the airways and jet routes alone does not increase consumption. However, the large majority of instrument flight rule flights do operate along established airways and jet routes with the resultant increase in distance and use of fuel. It should be noted that even without definition of airways and jet routes, most flights would fly over successive navigational aids along the intended flight path for the purpose of navigational guidance, with a similar increase in distance and use of fuel.

The theoretically ideal flight profile would be straight-line flight from the takeoff point to the touchdown point. Airways and jet routes must vary from straight-line flight to go over navaids and intersections of their signals. Area navigation routes do not have to vary from the desired straight-line flight to go over navaids, so theoretically could be aligned from takeoff point direct to touchdown point. From a practical standpoint, however, area navigation routes vary from the desired straight-line flight to avoid certain special use areas. Also, until a predominate number of aircraft become area navigation equipped, area navigation routes must be aligned so that they do not conflict with existing airways and traffic flows used by the large number of conventionally equipped aircraft.

A. ATC Clearances and Instructions

FAR 91.75 Compliance with ATC clearances and instructions

(a) When an ATC clearance has been obtained, no pilot in command may deviate from that clearance, except in an emergency, unless he obtains an amended clearance. However, except in positive controlled airspace, this paragraph does not prohibit him from cancelling an IFR flight plan if he is operating in VFR weather conditions. If a pilot is uncertain of the meaning of an ATC clearance, he shall immediately request clarification from ATC.

(b) Except in an emergency, no person may, in an area in which air traffic control is exercised, operate an aircraft contrary to an ATC instruction.

FAR 91.87 Operation at airports with operating control towers

(e) Approaches. When approaching to land at an airport with an operating control tower, each pilot of--

(1) An airplane, shall circle the airport to the left.

FAR 91.89 Operation at airports without control towers

(a) Each person operating an aircraft to or from an airport without an operating control tower shall--

(1) In the case of an airplane approaching to land, make all turns of that airplane to the left unless the airport displays approved light signals or visual markings indicating that turns should be made to the right, in which case the pilot shall make all turns to the right.

FAR 91.123 Course to be flown

Unless otherwise authorized by ATC, no person may operate an aircraft within controlled airspace, under IFR, except as follows:

(a) On a Federal airway, along the centerline of the airway.

(b) On any other route, along the direct course between the navigational aids or fixes defining that route.

However, this section does not prohibit maneuvering the aircraft to pass well clear of other air traffic or the maneuvering of the aircraft in VFR conditions to clear the intended flight path both before and during climb or descent.

FAR 99.27 Deviation from flight plans and ATC clearances and instruction

(a) No pilot may deviate from the provisions of an ATC clearance or ATC instruction except in accordance with 91.75 of this chapter.

(b) No pilot may deviate from his filed IFR flight plan when operating an aircraft in uncontrolled airspace unless he notifies an appropriate aeronautical facility before deviating.

(c) No pilot may deviate from his filed DVFR flight plan unless he notifies an appropriate aeronautical facility before deviating.

Justification: For maintenance of safety in flight, it is necessary to have controlled airspace. No control and no rules of flight would increase the number of midair and ground aircraft accidents. Further, following established routes increases the potential success of rescue efforts in event of emergency. Expanding the RNAV program can satisfy the fuel conservation objections while maintaining safety in airspace.

B. Summary

Route definition and the requirement that air carrier traffic be flown under IFR produces circuitous routing. This deviation from straight-line flight raises fuel consumption. The technique of area navigation offers the possibility for redesign of airways so that better flight paths may be selected. Current growth is proceeding slowly due to the cost of procuring and installing the airborne equipment. Until the majority of aircraft using the National Airspace System are so equipped, the existing route structure will stay in effect. Since the existing system and the RNAV system have conflicts from an air traffic control standpoint, and the cost of retrofitting existing aircraft is high, it is estimated that as long as a decade will pass before RNAV is phased in fully as the primary means of airway navigation.

# VII. REGULATIONS PERTAINING TO AIRCRAFT EQUIPMENT

## VII. REGULATIONS PERTAINING TO AIRCRAFT EQUIPMENT

Proper navigation and communication with air traffic control dictates that an aircraft carry appropriate equipment. Various conditions of flight; VFR, VFR on top, IFR and night operations impose additional equipment requirements for navigation, communication and safety purposes. Flight at high altitude requires onboard oxygen equipment both for the crew and passengers. Where operations are conducted over water, water-oriented survival equipment is needed. In the event of emergency, basic survival equipment is essential to minimize the risk to human life of an aircraft emergency, especially away from an airport.

Each additional required article of equipment on an aircraft adds weight to the unit. The greater the weight of an aircraft, the greater will be its fuel burn in flight. Therefore, careful consideration of required equipment is essential to balance the conflicting objectives of fuel conservation and safety in flight.

### A. Visual Flight Rules: Day

FAR 91.33 Powered civil aircraft with standard category U.S. airworthiness certificates; instrument and equipment requirements

(a) General. Except as provided in paragraphs (c)(3) and (e) of this section, no person may operate a powered civil aircraft with a standard category U.S. airworthiness certificate in any operation described in paragraphs (b) through (f) of this section unless that aircraft contains the instruments and equipment specified in those paragraphs (or FAA-approved equivalents) for that type of operation, and those instruments and items of equipment are in operable condition.

(b) Visual flight rules (day). For VFR flight during the day the following instruments and equipment are required:

(1) Airspeed indicator

(2) Altimeter

(3) Magnetic direction indicator.

(4) Tachometer for each engine.

(5) Oil pressure gauge for each engine using pressure system.

(6) Temperature gauge for each liquid-cooled engine.

(7) Oil temperature gauge for each air-cooled engine.

(8) Manifold pressure gauge for each altitude engine.

(9) Fuel gauge indicating the quantity of fuel in each tank.

(10) Landing gear position indicator, if the aircraft has a retractable landing gear.

(11) If the aircraft is operated for hire over water and beyond power-off gliding distance from shore, approved flotation gear readily available to each occupant, and at least one pyrotechnic signaling device.

(12) Except as to airships, approved safety belts for all occupants who have reached their second birthday. The rated strength of each safety belt shall not be less than that corresponding with the ultimate load factors specified in the current applicable aircraft airworthiness requirements considering the dimensional characteristics of the safety belt installation for the specific seat or berth arrangement. The webbing of each safety belt shall be replaced as required by the Administrator.

FAR 135.151 Equipment requirements: General

No person may operate an aircraft unless it is equipped with--

(a) A sensitive altimeter that is adjustable for barometric pressure;

(b) Heating or de-icing equipment for each carburetor or, in the case of a pressure carburetor, an alternate air source, and

(c) In the case of turbine engine aircraft, such other equipment as the Administrator may require.

Justification: For airplane operations under the most basic conditions, visual flight rules during daylight hours, there is a minimum instrument and equipment package which is essential for normal flight and navigation.

B. Night Operations

FAR 91.33 Powered civil aircraft with standard category U.S. airworthiness certificates: Instrument and equipment requirements

(c) Visual flight rules (night). For VFR flight at night the following instruments and equipment are required:

(1) Instruments and equipment specified in paragraph (b) of this section.

(2) Approved position lights.

(3) An approved aviation red or aviation white anticollision light system on all large aircraft, on all small aircraft when required by the aircraft's airworthiness certificate, and on all other small aircraft after August 11, 1972.

(4) If the aircraft is operated for hire, one electric landing light.

(5) An adequate source of electrical energy for all installed electrical and radio equipment.

(6) One spare set of fuses, or three spare fuses of each kind required.

FAR 91.187 Equipment requirements: Over-the-top, or night VFR operations

No person may operate an airplane over-the-top, or at night under VFR unless that airplane is equipped with the instruments and equipment required for IFR operations under 91.33(d) and one electric landing light for night operations. Each required instrument and item of equipment must be in operable condition.

FAR 121.323 Instruments and equipment for operations at night

No person may operate an airplane at night unless it is equipped with the following instruments and equipment in addition to those required by 121.305 through 121.321:

(a) Position lights.

(b) An anti-collision light, for large airplanes.

(c) Two landing lights.

(d) Instrument lights providing enough light to make each required instrument, switch, or similar instrument, easily readable and installed so that the direct rays are shielded from the flight crewmembers' eyes and that no objectionable reflections are visible to them. There must be a means of controlling the intensity of illumination unless it is shown that nondimming instrument lights are satisfactory.

(e) An airspeed-indicating system with heated pitot tube or equivalent means for preventing malfunctioning due to icing.

(f) A sensitive altimeter.

FAR 127.119 Instruments and equipment for operations at night

No person may operate a helicopter at night unless it is equipped with the following instruments and equipment in addition to those required by 127.103 through 127.117:

(a) Position lights.

(b) An anti-collision light.

(c) Two landing lights, at least one of which is controllable to light the area forward of and below the helicopter.

(d) Instrument lights providing enough light to each required instrument or switch easily readable, and installed so that the direct rays are shielded from the flight crewmembers' eyes and that no objectionable reflections are visible to them. There must be a means of controlling the intensity of illumination unless the operator shows that nondimming instrument lights are satisfactory.

(e) A generator of adequate capacity.

(f) A gyroscopic bank and pitch indicator (artificial horizon).

(g) A gyroscopic direction indicator (direction gyro).

(h) A gyroscopic rate-of-turn indicator with bank indicator.

(i) A vertical speed indicator (rate-of-climb indicator).

Justification: When conducting flight activities at night, it is essential that the pilot be able to see the runway (landing light), that he be seen by others (anti-collision lights), and that he be able to see his instruments clearly (instrument lights).

C. Instrument Flight Rules

FAR 91.33 Powered civil aircraft with standard category U.S. airworthiness certificates: Instrument and equipment requirements

(d) Instrument flight rules. For IFR flight the following instruments and equipment are required:

(1) Instruments and equipment specified in paragraph (b) of this section and for night flight, instruments and equipment specified in paragraph (c) of this section.

(2) Two-way radio communications system and navigational equipment appropriate to the ground facilities to be used.

(3) Gyroscopic rate-of-turn indicator, except on large aircraft with a third attitude instrument system useable through flight attitudes of 360 degrees of pitch and roll and installed in accordance with 121.305(j) of this title.

(4) Slip-skid indicator.

(5) Sensitive altimeter adjustable for barometric pressure.

(6) Clock with sweep-second hand.

(7) Generator of adequate capacity.

(8) Gyroscopic bank and pitch indicator (artificial horizon).

(9) Gyroscopic direction indicator (directional gyro or equivalent).

(e) Flight at and above 24,000 feet MSL. If VOR navigational equipment is required under paragraph (d)(2) of this section, no person may operate a U.S. registered civil aircraft in the State of Alaska after March 31, 1968,

in the State of Hawaii after April 30, 1967 or in the 48 contiguous States or in the District of Columbia, at and above 24,000 feet MSL, unless that aircraft is equipped with an approved distance measuring equipment (DME). When DME required by this paragraph fails at and above 24,000 feet MSL, each pilot shall notify ATC immediately, and may then continue operations at and above 24,000 feet MSL to the next airport of intended landing at which repairs can be made.

(f) Category II operations. For Category II operations the instruments and equipment specified in paragraph (d) of this section and Appendix A to this part are required. This paragraph does not apply to operations conducted by the holder of a certificate issued under Part 121 of this chapter.

FAR 91 Appendix A Category II operations: Manual. Instruments, Equipment and Maintenance

2. Required instruments and equipment. The instruments and equipment listed in this section must be installed in each airplane operated in a Category II operation. This section does not require duplication of instruments and equipment required by 91.33 or any other provisions of this chapter.

(a) Group I.

(1) Two localizer and glide slope receiving systems. Each system must provide a basic ILS display and each side of the the instrument panel must have a basic ILS display. However, a single localizer antenna and a single glide slope antenna may be used.

(2) A communications system that does not affect the operation of at least one of the ILS systems.

(3) A marker beacon receiver that provides distinctive aural and visual indications of the outer and the middle marker.

(4) Two gyroscopic pitch and bank indicating systems.

(5) Two gyroscopic direction indicating systems.

(6) Two airspeed indicators.

(7) Two sensitive altimeters adjustable for barometric pressure, each having a placarded correction for altimeter scale error and for the wheel height of the airplane.

(8) Two vertical speed indicators.

(9) A flight control guidance system that consists of either an automatic approach coupler or a flight director system. A flight director system must display computed information as steering command in relation to an ILS localizer and on the same instrument, either computed information as pitch command in relation to an ILS glide slope or basic ILS glide slope information. An automatic approach coupler must provide, at least automatic steering in relation to an ILS localizer. The flight control guidance system may be operated from one of the receiving systems required by subparagraph (1) of this paragraph.

(10) For Category II operations with decision heights below 150 feet, either a marker beacon receiver providing aural and visual indications of the inner marker or a radio altimeter.

(b) Group II

(1) Warning systems for immediate detection by the pilot of system faults in items (1), (4), (5), and (9) of Group I and, if installed, for use in Category II operations, the radio altimeter and auto throttle system.

(2) Dual controls.

(3) An externally vented static pressure system with an alternate static pressure source.

(4) A windshield wiper or equivalent means of providing adequate cockpit visibility for a safe visual transition by either pilot to touch down and roll out.

(5) A heat source for each airspeed system pitot tube installed or an equivalent means of preventing malfunctioning due to icing of the pitot system.

FAR 121.325 Instruments and equipment for operations under IFR or over-the-top

No person may operate an airplane under IFR or over-the-top conditions unless it is equipped with the following instruments and equipment, in addition to those required by 121.305 through 121.321:

(a) An airspeed indicating system with heated pitot tube or equivalent means for preventing malfunctioning due to icing.

(b) A sensitive altimeter.

(c) Instrument lights providing enough light to make each required instrument, switch, or similar instrument easily readable and so installed that the direct rays are shielded from the flight crewmembers' eyes and that no objectionable reflections are visible

to them and a means of controlling the intensity of illumination unless it is shown that nondimming instrument lights are satisfactory.

FAR 135.155 Equipment requirements: Airplanes carrying passengers under IFR

No person may operate an airplane under IFR, carrying passengers, unless it has--

(a) A vertical speed indicator;

(b) A free-air temperature indicator;

(c) A heated pitot tube for each airspeed indicator;

(d) A power failure warning device on vacuum indicator to show the power available for gyroscopic instruments from each power source;

(e) After March 6, 1965, an alternate source of static pressure for the altimeter and the airspeed and vertical speed indicators;

(f) In the case of a single-engine airplane, a generator or generators able to supply all probable combinations of continuous in-flight electrical loads for required equipment and for recharging the battery;

(g) In the case of multiengine airplanes, at least two generators, each of which is on a separate engine, of which any combination of one-half of the total number are rated sufficiently to supply the electrical loads of all required instruments and equipment necessary for safe emergency operation of the airplane; and

(h) Two independent sources of energy (with a means of selecting either), of which at least one is an engine-driven pump or generator, each of which is able to drive all gyroscopic instruments and installed so that failure

of one instrument or source does not interfere with the energy supply to the remaining instruments or the other energy source, unless, in the case of a single-engine aircraft, the rate-of-turn and bank-and-pitch indicators, have separate sources of energy.

Justification: When conditions dictate that a flight be conducted under instrument flight rules, the pilot needs to have sufficient instrumentation on board to navigate and fly the airplane without visual reference to the ground. With IFR flight, radios become mandatory for ground assistance. Making turns under IFR requires a rate-of-turn indicator and a clock with a second hand. The slip-skid indicator, artificial horizon and directional gyro facilitate straight and level flight and navigation. The altimeter assists in maintaining proper altitude for safe flight.

D. Radio Equipment

FAR 121.345 Radio equipment

(a) No person may operate an airplane unless it is equipped with radio equipment required for the kind of operation being conducted.

(b) Where two independent (separate and complete) radio systems are required by 121.347 and 121.349, each system must have an independent antenna installation except that, where rigidly supported nonwire antennas or other antenna installations of equivalent reliability are used, only one antenna is required.

(c) ATC transponder equipment installed after January 1, 1974, in aircraft not previously equipped with an ATC transponder and all ATC transponder equipment used after July 1, 1975, must meet the performance and environmental requirements of any class of TSO-C74b, or class 1A or class 1B of TSO-C74c, as appropriate, except that the Administrator may approve the use of TSO-C74 or TSO-C74a equipment beyond July 1, 1975, if the applicant submits data showing that such

equipment meets the minimum performance standards of class 1A or class 1B of TSO-C74c and the environmental conditions of the TSO under which it was manufactured.

FAR 121.347 Radio equipment for operations under VFR over routes navigated by pilotage

(a) No person may operate an airplane under VFR over routes that can be navigated by pilotage, unless it is equipped with the radio equipment necessary under normal operating conditions to fulfill the following:

(1) Communicate with at least one appropriate ground station from any point on the route.

(2) Communicate with appropriate traffic control facilities from any point in the control zone within which flights are intended.

(3) Receive meteorological information from any point en route by either of two independent systems. One of the means provided to comply with this subparagraph may be used to comply with subparagraphs (1) and (2) of this paragraph.

(b) No person may operate an airplane at night under VFR over routes that can be navigated by pilotage unless that airplane is equipped with the radio equipment necessary under normal operating conditions to fulfill the functions specified in paragraph (a) of this section and to receive radio navigational signals applicable to the route flown, except that a marker beacon receiver or ILS receiver is not required.

FAR 121.349 Radio equipment for operations under VFR over routes not navigated by pilotage or for operations under IFR or over-the-top.

(a) No person may operate an airplane under VFR over routes that cannot be navigated by pilotage or for operations conducted under IFR or over-the-top, unless the airplane is equipped with that radio equipment necessary under normal operating conditions to fulfill the functions specified in 121.347 (a) and to receive satisfactorily by either of two independent systems radio navigational facilities intended to be used. However, only one marker beacon receiver providing visual and aural signals and one ILS receiver need be provided. Equipment provided to receive signals en route may be used to receive signals on approach, if it is capable of receiving both signals.

(b) In the case of operation over routes on which navigation is based on low frequency radio range or automatic direction finding, only one low frequency radio range or ADF receiver need be installed if the airplane is equipped with two VOR receivers, and VOR navigational aids are so located and the airplane is so fueled that, in the case of failure of the low frequency radio range receiver or ADF receiver, the flight may proceed safely to a suitable airport, by means of VOR aids, and complete an instrument approach by use of the remaining airplane radio system.

(c) Whenever VOR navigational receivers are required by paragraph (a) or (b) of this section, at least one approved distance measuring equipment unit (DME), capable of receiving and indicating distance information from VORTAC facilities, must be installed on each airplane, when operated in the 48 contiguous States and the District of Columbia. This paragraph also applies to each airplane operated at and above 24,000 feet MSL, in the State of Alaska after March 31, 1968, in the State of Hawaii after April 30, 1967, and to each of the following airplanes regardless of the altitude flown when operated within the States of Alaska or Hawaii after the indicated dates:

(1) Turbine engine powered aircraft: Within Alaska--March 31, 1968; within Hawaii--April 30, 1967.

(2) Pressurized reciprocating engine powered airplanes; Within Alaska--September 30, 1968; within Hawaii--December 31, 1967.

(3) Other large airplanes: Within Alaska--March 31, 1969; within Hawaii--April 30, 1968.

FAR 127.123 Radio equipment

(a) No person may operate a helicopter unless it is equipped with the approved radio equipment specified for the kind of operation being conducted.

(b) ATC transponder equipment installed after January 1, 1974, in helicopters not previously equipped with an ATC transponder and all ATC transponder equipment used after July 1, 1975, must meet the performance and environmental requirements of any class of TSO-C74b, or class 1A or class 1B of TSO-C74c, as appropriate, except that the Administrator may approve the use of TSO-C74 or TSO-C74a equipment beyond July 1, 1975, if the applicant submits data showing that such equipment meets the minimum performance standards of class 1A or class 1B of TSO-C74c and the environmental conditions of the TSO under which it was manufactured.

FAR 127.125 Radio equipment for operations over routes navigated by pilotage

No person may operate a helicopter over a route that can be navigated by pilotage, unless the helicopter is equipped with the radio equipment needed to perform the following functions under normal operating conditions:

(a) Communicate with at least an appropriate ground station in the vicinity, as prescribed in 127.47, and with other helicopters operated by the air carrier.

(b) Communicate with ATC towers from any point in the control zone within which flight is intended.

(c) Receive meteorological information at the minimum en route altitude specified in the air carrier's operations specification, either separately or by the means required to comply with paragraph (a) or (b) of this section.

FAR 135.157 Radio and navigational equipment: Carrying passengers under VFR at night, over-the-top, or in a control zone

(a) No person may operate, under VFR, an aircraft carrying passengers at night, in a control zone, or, except as provided in paragraph (c) of this section, over-the-top unless that aircraft has two-way radio communications equipment able at least, in flight, to transmit to, and receive from, ground facilities 25 miles away.

Justification: The carrying of passengers for compensation is a sizeable responsibility and therefore air carrier operations require constant contact with air traffic control for assistance purposes. Such contact is best accomplished by radio communications. This contact can be augmented by a transponder which provides either two or three dimensional (or four if speed transmitted) location of the aircraft.

E. Flight and Navigational Equipment

FAR 121.305 Flight and navigational equipment

No person may operate an airplane unless it is equipped with the following flight and navigational instruments and equipment:

(a) An airspeed indicating system with heated pitot tube or equivalent means for preventing malfunctioning due to icing.

(b) A sensitive altimeter.

(c) A sweep-second hand clock (or approved equivalent).

(d) A free-air temperature indicator.

(e) A gyroscopic bank and pitch indicator (artificial horizon).

(f) A gyroscopic rate-of-turn indicator combined with an integral slip-skid indicator (turn-and-bank indicator) except that only a slip-skid indicator is required when a third attitude instrument system useable through flight attitudes of 360 degrees of pitch and roll is installed in accordance with paragraph (j) of this section.

(g) A gyroscopic direction indicator (directional gyro or equivalent).

(h) A magnetic compass.

(i) A vertical speed indicator (rate-of-climb indicator).

(j) After August 5, 1971, on large turbojet powered airplanes, in addition to two gyroscopic bank-and-pitch indicators (artificial horizons) for use at the pilot stations, a third such instrument that--

(1) Is powered from a source independent of the electrical generating system;

(2) Continues reliable operation for a minimum of 30 minutes after total failure of the electrical generating system;

(3) Operates independently of any other attitude indicating system;

(4) Is operative without selection after total failure of the electrical generating system;

(5) Is located on the instrument panel in a position acceptable to the Administrator that will make it plainly visible to and useable by any pilot at his station; and

(6) Is appropriately lighted during all phases of operation.

FAR 127.103 Flight and navigational equipment

No person may operate a helicopter unless it is equipped with the following flight and navigational instruments and equipment:

(a) An airspeed indicating system with heated pitot tube or equivalent means for preventing malfunctioning due to icing.

(b) A sensitive altimeter.

(c) A sweep-second clock.

(d) A free-air temperature indicator.

(e) A magnetic compass.

FAR 135.157 Radio and navigational equipment: Carrying passengers under VFR at night, over-the-top, or in a control zone

(b) No person may operate an airplane at night, or, except as provided in paragraph (c) of this section, any aircraft over-the-top, carrying passengers under VFR unless it has radio navigational equipment able to receive radio signals from the ground facilities to be used.

Justification: The flight and navigational equipment necessary for IFR operation should be on all aircraft operated by commercial carriers. Should solid IFR conditions be encountered along the flight path, then the pilot has sufficient equipment to continue flight without a lessening of passenger safety.

F. Engine Instruments

FAR 121.307 Engine instruments

Unless the Administrator allows or requires different instrumentation for turbine engine powered airplanes to provide equivalent safety, no person may conduct any operation under this part without the following engine instruments:

(a) A carburetor air temperature indicator for each engine.

(b) A cylinder head temperature indicator for each air cooled engine.

(c) A fuel pressure indicator for each engine.

(d) A fuel flowmeter or fuel mixture indicator for each engine not equipped with an automatic altitude mixture control.

(e) A means for indicating fuel quantity in each fuel tank to be used.

(f) A manifold pressure indicator for each engine.

(g) An oil pressure indicator for each engine.

(h) An oil quantity indicator for each oil tank when a transfer or separate oil reserve supply is used.

(i) An oil-in temperature indicator for each engine.

(j) A tachometer for each engine.

(k) An independent fuel pressure warning device for each engine or a master warning device for all engines with a means for isolating the individual warning circuits from the master warning device.

(1) A device for each reversible propeller, to indicate to the pilot when the propeller is in reverse pitch, that complies with the following:

(1) The device may be actuated at any point in the reversing cycle between the normal low pitch stop position and full reverse pitch, but it may not give an indication at or above the normal low pitch stop position.

(2) The source of indication must be actuated by the propeller blade angle or be directly responsive to it.

FAR 127.105 Engine instruments and equipment

No person may operate a helicopter unless it is equipped with the following engine instruments and equipment:

(a) A carburetor air temperature indicator for each engine.

(b) A cylinder head temperature indicator for each air-cooled engine.

(c) A fuel pressure indicator and warning light for each engine.

(d) A means for indicating fuel quantity in each fuel tank to be used, and for helicopters with more than one independent fuel tank, a warning device indicating when the fuel in any independent tank becomes low.

(e) A manifold pressure indicator for each engine.

(f) An oil pressure indicator and warning light for each engine.

(g) An oil-in temperature indicator for each engine.

(h) An oil temperature indicator or warning device to indicate when the oil temperature

exceeds a safe value in each main rotor drive gearbox, including those gearboxes essential to rotor phasing, having an oil system independent of the engine oil system.

(i) An oil pressure indicator and warning light for each transmission using a separate oil pump.

(j) Carburetor heating or deicing equipment for each engine.

(k) If equipped with a rotor brake, a means to indicate full or partial engagement.

(l) A tachometer for the main rotor, or for each main rotor the speed of which may vary appreciably with respect to another main rotor.

(m) A tachometer for each engine.

Justification: The loss of an engine is much more critical in air transportation than in ground transportation. Therefore, a constant monitoring of engine performance and condition is necessary. Cylinder head temperature, fuel pressure, manifold pressure, oil pressure, and tachometer all relay engine information to the pilot. Quantities of fuel and lubricants unused are needed for planning of flight durations.

G. Airborne Weather Radar

FAR 121.357 Airborne weather radar equipment requirements

(a) No person may operate any airplane certificated under the transport category rules (except C-46 type airplanes), in passenger-carrying operations, unless approved airborne weather radar equipment has been installed in the airplane.

(b) No person may operate any of the following airplanes certificated under the transport category rules (except C-46 type airplanes) in cargo-only operations after the listed date unless approved airborne weather radar equipment has been installed in that airplane:

(1) Turbojet powered airplanes--
December 31, 1966.

(2) Other transport category airplanes--
December 31, 1967.

Justification: Weather forecasts and briefings are useful to the crew in plotting the course to be flown. However, as the flight progresses the timeliness of the weather data is lost. Further even with ground updates by radio, the information is still not as accurate as on-board radar. With such equipment, the pilot can navigate around hazardous weather with great precision.

H. Icing

FAR 121.341 Equipment for operations in icing conditions

(a) Unless an airplane is certificated under the transport category airworthiness requirements relating to ice protection, no person may operate an airplane in icing conditions unless it is equipped with means for the prevention or removal of ice on windshields, wings, empennage, propellers, and other parts of the airplane where ice formation will adversely affect the safety of the airplane.

(b) No person may operate an airplane in icing conditions at night unless means are provided for illuminating or otherwise determining the formation of ice on the parts of the wings that are critical from the standpoint of ice accumulation. Any illuminating that is used must be of a type that will not cause glare or reflection that would handicap crewmembers in the performance of their duties.

Justification: Flight in icy weather should only be attempted by aircraft equipped with means of removing the ice both on the ground and en route. The windshields must be clear of ice so the pilot can see. The wings, empennage and propeller are essential exposed surfaces for which ice accumulation affects aircraft control.

## I. Flight Recorders

FAR 91.35 Flight recorders and cockpit voice recorders

No holder of an air carrier or commercial operator certificate may conduct any operation under this part with an aircraft listed in his operations specifications or current list of aircraft used in air transportation unless that aircraft complies with any applicable flight recorder and cockpit voice recorder requirements of the part under which its certificate is issued.

FAR 121.343 Flight recorders

(a) No persons may operate a large airplane that is certificated for operations above 25,000 feet altitude or is turbine engine powered, unless it is equipped with one or more approved flight recorders that record data from which the following information may be determined within the ranges, accuracies, and recording intervals specified in Appendix B of this part--

(1) Time, altitude, airspeed, vertical acceleration, and heading; and

(2) After September 18, 1973, for airplanes having an original type certificate issued after September 30, 1969, pitch-attitude, roll attitude, side-slip angle or lateral acceleration, 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 reverser, trailing edge flap or cockpit flap control position, and leading edge flap or cockpit control position.

FAR 121.359 Cockpit voice recorders

(a) No certificate holder may operate any of the following airplanes after the listed date unless an approved cockpit voice

recorder is installed in that airplane and is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight), to completion of the final checklist at the termination of the flight:

(1) Large turbine engine powered airplanes--September 15, 1966.

(2) Large pressurized airplanes with four reciprocating engines--December 31, 1966.

FAR 127.127 Cockpit voice recorders

(a) No certificate holder may operate a large transport category helicopter after July 8, 1971, unless an approved cockpit voice recorder is installed in that helicopter and is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight) to completion of the final checklist at the termination of the flight.

Justification: The study of why accidents occur leads to the causes and hence solution of the problems which generated the mishaps. The determination of accident causes is greatly enhanced by having communications and basic aircraft conditions taped in crashproof units.

J. Flight in Terminal Control Areas

FAR 91.90 Flight in terminal control areas: Operating rules and pilot and equipment requirements

(a) Group I terminal control area--

(3) Equipment requirements. Unless otherwise authorized by ATC in the case of in-flight VOR, TACAN, or two-way radio

failure; or unless otherwise authorized by ATC in the case of a transponder failure occurring at any time no person may operate an aircraft within a Group I Terminal Control Area unless that aircraft is equipped with--

(i) An operable VOR or TACAN receiver (except in the case of helicopters).

(ii) An operable two-way radio capable of communicating with ATC on the appropriate frequencies for that terminal control area; and

(iii) On and before the applicable dates specified in paragraphs (a) and (b)(2) of 91.24, an operable coded radar beacon transponder having at least a mode 3/A 64-code capability, replying to mode 3/A interrogation with the code specified by ATC.

(b) Group II terminal control areas--

(2) Equipment requirements. Unless otherwise authorized by ATC in the case of in-flight VOR, TACAN, or two-way radio failure; or unless otherwise authorized by ATC in the case of a transponder failure occurring at any time, no person may operate an aircraft within a Group II terminal control area unless that aircraft is equipped with--

(i) An operable VOR or TACAN receiver (except in the case of helicopters),

(ii) An operable two-way radio capable of communicating with ATC on the appropriate frequencies for that terminal control area; and

(iii) On and before the applicable dates specified in paragraphs (a) and (b)(2) of 91.24, an operable coded radar beacon transponder having at least a Mode 3/A 64-code capability, replying to Mode 3/A interrogation with the code specified by ATC.

(c) Group III terminal control areas. After the date specified in 91.24 (b)(3), no person may operate an aircraft within a group III terminal control area designated in part 71 unless the applicable provisions of 91.24(b) are complied with, except that such compliance is not required if two-way radio communications are maintained, within the TCA, between the aircraft and the ATC facility, and the pilot provides position, altitude, and proposed flight path prior to entry.

Justification: Terminal control areas exist where one or more airports in a given geographical area experience a high volume of air traffic. Due to the congestion of the airspace in TCA's precise control is needed. The VOR, two-way radio, and transponder are minimum equipment for high density control.

K. Public Address and Interphone System

FAR 121.318 Public address system

(a) After September 8, 1975, no person may operate an airplane with a seating capacity of more than 19 passengers unless the airplane is equipped with a public address system that:

(1) Is capable of operation independent of the crewmember interphone system required by 121.319(a) except for handsets, headsets, microphones, selector switches, and signaling devices; and

(2) Meets the requirements of paragraph (b) of this section.

(b) The public address system required by paragraph (a) of this section must be approved in accordance with 21.305 of this chapter and meet the following requirements:

(1) It must be accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(2) It must be accessible for use from at least one normal flight attendant station in the passenger compartment;

(3) It must be capable of operation within ten seconds by a flight attendant at those stations in the passenger compartment from which its use is accessible; and

(4) Transmission must be audible at each passenger and flight attendant seat and in each lavatory.

FAR 121.319 Crewmember interphone system

(a) After September 8, 1975, no person may operate an airplane with a seating capacity of more than 19 passengers unless the airplane is equipped with a crewmember interphone system that:

(2) Is capable of operation independent of the public address system required by 121.318(a) except for handsets, headsets, microphones, selector switches, and signaling devices; and

(3) Meets the requirements of paragraph (b) of this section.

(b) The crewmember interphone system required by paragraph (a) of this section must be approved in accordance with 21.305 of this chapter and meet the following requirements:

(1) It must provide a means of two-way communication between the pilot compartment and the passenger compartment;

(2) It must be accessible for immediate use from each of two flight crewmember stations in the pilot compartment;

(3) It must be accessible for use from at least one normal flight attendant station in the passenger compartment;

(4) It must be capable of operation within ten seconds by a flight attendant at those stations in the passenger compartment from which its use is accessible; and

(5) For large turbojet-powered airplanes:

(i) It must be accessible for use at enough flight attendant stations so that all floor level emergency exits in the passenger compartment are observable from one or more of those stations so equipped;

(ii) It must have an alerting system incorporating aural or visual signals for use by flight crewmembers to alert flight attendants and for use by flight attendants to alert flight crewmembers;

(iii) The alerting system required by subparagraph (b)(5)(ii) of this section must have a means for the recipient of a call to determine whether it is a normal call or an emergency call; and

(iv) When the airplane is on the ground, it must provide a means of two-way communication between ground personnel and either of at least two flight crewmembers in the pilot compartment. The interphone system station for use by ground personnel must be so located that personnel using the system may avoid visible detection from within the airplane.

Justification: Communications (even one-way) between the passengers and crew are vital to proper behavior during real or pending emergencies.

L. Equipment for Over-Water Operations

FAR 91.189 Survival equipment for over-water operations

(a) No person may take off an airplane for a flight over water more than 50 nautical miles from the nearest shoreline, unless that airplane is equipped with a life preserver or an approved flotation means for each occupant of the airplane.

(b) No person may take off an airplane for a flight over water more than 30 minutes flying time or 100 nautical miles from the nearest shoreline, unless it has on board the following survival equipment:

(1) A life preserver equipped with an approved survivor locator light, for each occupant of the airplane.

(2) Enough liferafts (each equipped with an approved survivor locator light) or a rated capacity and buoyancy to accommodate the occupants of the airplane.

(3) At least one pyrotechnic signaling device, that is capable of transmission on the appropriate emergency frequency or frequencies, and not dependent upon the airplane power supply.

(c) The required liferafts, life preservers, and signaling devices must be installed in conspicuously marked locations and easily accessible in the event of a ditching without appreciable time for preparatory procedures.

(d) A survival kit, appropriately equipped for the route to be flown, must be attached to each required liferaft.

FAR 91.191 Radio equipment for over-water operations

(a) Except as provided in paragraph (c) of this section, no person may take off an airplane for a flight over water more than 30 minutes flying time or 100 nautical miles from the nearest shoreline, unless it has at least the following operable radio communication and navigational equipment appropriate to the facilities to be used and able to transmit to, and receive from, at any place on the route, at least one surface facility:

(1) Two transmitters.

(2) Two microphones.

(3) Two headsets or one headset and one speaker.

(4) Two independent receivers for navigation.

(5) Two independent receivers for communications.

FAR 121.339 Emergency equipment for extended overwater operations

(a) Except where the Administrator, by amending the operations specifications of the certificate holder, requires the carriage of all or any specific items of the equipment listed below for any over-water operation, or upon application of the certificate holder, the Administrator allows deviation for a particular extended over-water operation, no person may operate an airplane in extended over-water operations without having on the airplane the following equipment:

(1) A life preserver equipped with approved survivor locator light, for each occupant of the airplane.

(2) Enough liferafts (each equipped with an approved survivor locator light) of a rated capacity and buoyancy to accommodate the occupants of the airplane.

(3) At least one pyrotechnic signaling device for each liferaft.

(4) A survival type emergency locator transmitter that after October 21, 1972, meets the applicable requirements of 37.200 of this chapter, except that, until December 30, 1975, the transmitter is not required to meet those requirements if its installation was approved before October 21, 1971, it was manufactured under a TSO Authorization issued against TSO-C61a of Part 37 of this chapter, and it transmits simultaneously on 121.5 and 243.0 MHz. Batteries used in this transmitter must be replaced (or recharged, if the battery is rechargeable) when the transmitter has been in use for more than 1 cumulative hour, and also when 50 percent of their useful life (or for rechargeable batteries, 50 percent of their useful life of charge), as established by the transmitter manufacturer under 37.200(g)(2) of this chapter, has expired. The new expiration date for the replacement (or recharged) battery must be legibly marked on the outside of the transmitter. The battery useful life (or useful life of charge) requirements of this subparagraph do not apply to batteries (such as water-activated batteries) that are essentially unaffected during probable storage intervals.

(b) The required liferafts, life preservers, and survival type emergency locator transmitter must be easily accessible in the event of a ditching without appreciable time for preparatory procedures. This equipment must be installed in conspicuously marked, approved locations.

FAR 121.340 Emergency flotation means

(a) Except as provided in paragraph (b) of this section, after September 1, 1967, no person may operate a large airplane in any over-water operation unless it is equipped with life preservers in accordance with 121.339 (a)(1), or with an approved flotation means for each occupant. This means must be within easy reach of each seated occupant and must be readily removable from the airplane.

FAR 121.351 Radio equipment for extended over-water operations and for certain other operations

(a) No person may conduct an extended over-water operation unless the airplane is equipped with the radio equipment necessary to comply with 121.349 and an independent system that complies with 121.347(a)(1).

(b) No flag or supplemental air carrier or commercial operator may conduct an operation without the equipment specified in paragraph (a) of this section, if the Administrator finds that equipment to be necessary for search and rescue operations because of the nature of the terrain to be flown over.

FAR 127.121 Equipment for single engine helicopter over-water operations

No person may operate a single-engine helicopter over water beyond autorotative gliding distance from the land unless it is equipped with the following equipment:

(a) Helicopter flotation devices.

(b) A life preserver (or other adequate individual flotation device) for each occupant.

(c) Any other equipment that the Administrator determines is necessary for safety for a particular operation.

FAR 135.159 Radio and navigational equipment: Extended over-water or IFR operations

(a) No person may operate an aircraft under IFR or in extended over-water operations unless it has at least the following radio communication and navigational equipment appropriate to the facilities to be used and able to transmit to, and receive from, at any place on the route, at least one ground facility:

(1) A transmitter.

(2) Two microphones.

(3) Two headsets or one headset and one speaker.

(4) A marker beacon receiver.

(5) Two independent receivers for navigation.

(6) Two independent receivers for communications.

(7) For extended over-water operations only, an additional transmitter.

FAR 135.163 Emergency equipment: Extended over-water operations

(a) No person may operate an aircraft in extended over-water operations unless it carries enough liferafts (with proper buoyancy) to carry all occupants of the aircraft, and unless there is attached to each liferaft, and clearly marked for identification, at least--

(1) One canopy (for sail, sunshade, or rain catcher);

(2) One radar reflector (or similar device);

(3) One liferaft repair kit;

(4) One bailing bucket;

(5) One signaling mirror;

(6) One police whistle;

(7) One raft knife;

(8) One CO2 bottle for emergency inflation;

(9) One inflation pump;

(10) Two oars;

(11) One 75-foot retaining line;

(12) One magnetic compass;

(13) One dye marker;

(14) One flashlight;

(15) At least one pyrotechnic signaling device;

(16) A 2-day supply of emergency food rations supplying at least 1,000 calories a day for each person;

(17) One sea water desalting kit for each two persons the raft is rated to carry or 2 pints of water for each person;

(18) One fishing kit; and

(19) One book on survival appropriate for the area in which the aircraft is operated.

(b) After October 21, 1972, no person may operate an aircraft in extended over-water operations unless there is attached to one of the liferafts required by paragraph (a) of this section, a survival type emergency locator transmitter.

Justification: Extended over-water operations require proper equipment for emergencies. Life preservers, liferafts, signaling devices and survival kits must be available in the event of a forced landing in water.

M. Oxygen Equipment

FAR 121.327 Supplemental oxygen: Reciprocating engine powered airplanes

(b) Crewmembers

(1) At cabin pressure altitudes above 10,000 feet up to and including 12,000 feet, oxygen must be provided for, and used by, each member of the flight crew on flight deck duty, and must be provided for other crewmembers, for that part of the flight at those altitudes that is of more than 30 minutes direction.

(2) At cabin pressure altitudes above 12,000 feet, oxygen must be provided for and used by, each member of the flight crew on flight deck duty, and must be provided for other crewmembers, during the entire flight time at those altitudes.

(c) Passengers. Each certificate holder shall provide a supply of oxygen approved for passenger safety, in accordance with the following:

(1) For flights of more than 30 minutes duration at cabin pressure altitudes above 8,000 feet up to and including 14,000 feet, enough oxygen for 30 minutes for 10 percent of the passengers.

(2) For flights at cabin pressure altitudes above 14,000 feet up to and including 15,000 feet, enough oxygen for that part of the flight at those altitudes for 30 percent of the passengers.

(3) For flights at cabin pressure altitudes above 15,000 feet, enough oxygen for each passenger carried during the entire flight at those altitudes.

FAR 121.329 Supplemental oxygen for sustenance; turbine powered airplanes

(b) Crewmembers. Each certificate holder shall provide a supply of oxygen for crewmembers in accordance with the following:

(1) At cabin pressure altitudes above 10,000 feet, up to and including 12,000 feet, oxygen must be provided for and used by each member of the flight crew on flight deck duty and must be provided for other crewmembers for that part of the flight at those altitudes that is of more than 30 minutes duration.

(2) At cabin pressure altitudes above 12,000 feet, oxygen must be provided for and used by, each member of the flight crew on flight deck duty, and must be provided for other crewmembers during the entire flight at those altitudes.

(c) Passengers. Each certificate holder shall provide a supply of oxygen for passengers in accordance with the following:

(1) For flights at cabin pressure altitudes above 10,000 feet, up to and including 14,000 feet, enough oxygen for that part of the flight at those altitudes that is of more than 30 minutes duration, for 10 percent of the passengers.

(2) For flights at cabin pressure altitudes above 14,000 feet, up to and including 15,000 feet, enough oxygen for that part of the flight at those altitudes for 30 percent of the passengers.

(3) For flights at cabin pressure altitudes above 15,000 feet, enough oxygen for each passenger carried during the entire flight at those altitudes.

FAR 212.331 Supplemental oxygen requirements for pressurized cabin airplanes: Reciprocating engine powered airplanes

(b) For crewmembers. When operating at flight altitudes above 10,000 feet, the certificate holder shall provide enough oxygen for each crewmember for the entire flight at those altitudes and not less than a two-hour supply for each flight crewmember on flight deck duty.

(c) For passengers. When operating at flight altitudes above 8,000 feet, the certificate holder shall provide oxygen as follows:

(1) When an airplane is not flown at a flight altitude above flight level 250, enough oxygen for 30 minutes for 10 percent of the passengers, if at any point along the route to be flown the airplane can descend to a flight altitude of 14,000 feet or less within four minutes.

(2) If the airplane cannot descend to a flight altitude of 14,000 feet or less within four minutes, the following supply of oxygen must be provided:

(i) For that part of the flight that is more than four minutes duration at flight altitudes above 15,000 feet, the supply required by 121.327(c)(3).

(ii) For that part of the flight at flight altitudes above 14,000 feet, up to and including 15,000 feet, the supply required by 121.327(c)(2).

(iii) For flight at flight altitudes above 8,000 feet up to and including 14,000 feet, enough oxygen for 30 minutes for 10 percent of the passengers.

(3) When an airplane is flown at a flight altitude above flight level 250, enough oxygen for 30 minutes for 10 percent of the passengers for the entire flight (including emergency descent) above 8,000 feet, up to and including 14,000 feet, and to comply with 121.327(c)(2) and (3) for flight above 14,000 feet.

FAR 121.333 Supplemental oxygen for emergency descent and for first aid: Turbine engine powered airplanes with pressurized cabins

(b) Crewmembers. When operating at flight altitudes above 10,000 feet, the certificate holder shall supply enough oxygen to comply with 121.329, but not less than a two-hour supply for each flight crewmember on flight deck duty.

(d) Use of portable oxygen equipment by cabin attendants. Each attendant shall, during flight above flight level 250 flight altitude, carry portable oxygen equipment with at least a 15-minutes supply of oxygen unless it is shown that enough portable oxygen units with masks or spare outlets and masks are distributed throughout the cabin to insure immediate availability of oxygen to each cabin attendant, regardless of his location at the time of cabin depressurization.

(e) Passenger cabin occupants. When the airplane is operating at flight altitudes above

10,000 feet, the following supply of oxygen must be provided for the use of passenger cabin occupants:

(1) When an airplane certificated to operate at flight altitudes up to and including flight level 250, can at any point along the route to be flown, descend safely to a flight altitude of 14,000 feet or less within four minutes, oxygen must be available at the rate prescribed by this part for a 30-minute period for at least 10 percent of the passenger cabin occupants.

(2) When an airplane is operated at flight altitudes up to and including flight level 250 and cannot descend safely to a flight altitude of 14,000 feet within four minutes, or when an airplane is operated at flight altitudes above flight level 250, oxygen must be available at the rate prescribed by this part for not less than 10 percent of the passenger cabin occupants for the entire flight after cabin depressurization, at cabin pressure altitudes above 10,000 feet up to and including 14,000 feet and, as applicable, to allow compliance with 121.329(c)(2) and (3), except that there must be not less than a 10-minute supply for the passenger cabin occupants.

(3) For first-aid treatment of occupants who for physiological reasons might require undiluted oxygen following descent from cabin pressure altitudes above flight level 250, a supply of oxygen in accordance with the requirements of 25.1443(d) must be provided for two percent of the occupants for the entire flight after cabin depressurization at cabin pressure altitudes above 8,000 feet, but in no case to less than one person. An appropriate number

of acceptable dispensing units, but in no case less than two, must be provided, with a means for the cabin attendants to use this supply.

FAR 121.337 Protective breathing equipment for the flight crew

(a) Pressurized cabin airplanes. Each required flight crewmember on flight deck duty must have readily available at his station protective breathing equipment covering the eyes, nose, and mouth (or the nose and mouth if accessory equipment is provided to protect the eyes) to protect him from the effect of smoke or carbon dioxide or other harmful gases. There must be at least a 300-liter standard temperature and pressure dry supply of oxygen for each required flight crewmember on flight deck duty (Standard temperature and pressure dry oxygen at 0 degrees centigrade, 760 mm.Hg.)

FAR 135.165 Oxygen equipment requirements

(a) Unpressurized aircraft: No person may operate an aircraft at altitudes prescribed in this section unless it is equipped with enough oxygen dispensers and oxygen to supply the oxygen required for pilots by 135.83(a) and to supply, when flying--

(1) At altitudes above 10,000 feet up to and including 15,000 feet MSL, oxygen so at least one occupant of the aircraft other than the pilots, for that part of the flight at those altitudes that is of more than 30 minutes duration; and

(2) Above 15,000 feet MSL, oxygen to each occupant of the aircraft, except the pilots.

(b) Pressurized aircraft: No person may operate an aircraft having a pressurized cabin unless

it is equipped with enough oxygen to, in the event of cabin pressurization failure, comply with 135.83(a), or a two-hour supply for each pilot, whichever is greater, and to supply, when flying--

(1) At altitudes above 10,000, up to and including 15,000 feet MSL, oxygen to at least one occupant of the aircraft other than the pilots, for that part of the flight at those altitudes that is of more than 30 minutes duration; and

(2) Above 15,000 feet MSL, oxygen to each occupant of the aircraft, except the pilots, for one hour unless, at all times during flight above that altitude, the aircraft can safely descend to 15,000 feet MSL within four minutes, in which case only a 30-minute supply is required.

FAR 135.83 Requirements for use of oxygen

(a) Unpressurized aircraft. Each pilot of an aircraft that has an unpressurized cabin shall use oxygen continuously when flying--

(1) At altitudes above 10,000 up to and including 12,000 feet MSL for that part of the flight at those altitudes that is of more than 30 minutes duration; and

(2) Above 12,000 feet MSL.

Justification: As aircraft climb to higher altitudes, the crew and passengers become exposed to oxygen starvation. With cabin pressurization, such starvation is forestalled. However, should pressurization be lost, a secondary oxygen-source must be provided.

N. Emergency Equipment

FAR 91.52 Emergency locator transmitters

(a) Except as provided in paragraphs (e), (f), and (g) of this section:

(1) After December 30, 1971, no person may operate a U.S. registered civil airplane manufactured or imported after that date unless it meets the applicable requirements of paragraphs (b), (c), and (d) of this section.

(2) After June 30, 1974, no person may operate a U.S. registered civil airplane unless it meets the applicable requirements of paragraphs (b), (c), and (d) of this section.

(b) To comply with paragraph (a) of this section, each U.S. registered civil airplane must be equipped as follows:

(1) For operations governed by the supplemental air carrier and commercial operator rules of Part 121 of this chapter, or air travel club rules of Part 123 of this chapter, there must be attached to the airplane an automatic type emergency locator transmitter that is in operable condition and meets the applicable requirements of 37.200 of this chapter;

(2) For charter flights governed by the domestic and flag air carrier rules of Part 121 of this chapter, there must be attached to the airplane an automatic type emergency locator transmitter that is in operable condition and meets the applicable requirements of 37.200 of this chapter;

(3) For operations governed by Part 135 of this chapter, there must be attached to the airplane an automatic type emergency locator transmitter that is in operable condition and meets the applicable requirements of 37.200 of this chapter; and

(4) For operations other than those specified in subparagraphs (1), (2), and (3)

of this paragraph, there must be attached to the airplane a personal type or an automatic type emergency locator transmitter that is in operable condition and meets the applicable requirements of 37.200 of this chapter.

FAR 91.193 Emergency equipment

(a) No person may operate an airplane unless it is equipped with the emergency equipment listed in this section:

(c) Hand fire extinguishers must be provided for use in crew, passenger, and cargo compartments in accordance with the following:

(1) The type and quantity of extinguishing agent must be suitable for the kinds of fires likely to occur in the compartment where the extinguisher is intended to be used.

(2) At least one hand fire extinguisher must be provided and located on or near the flight deck in a place that is readily accessible to the flight crew.

(3) At least one hand fire extinguisher must be conveniently located in the passenger compartment of each airplane accommodating more than six but less than 31 passengers, and at least two hand fire extinguishers must be conveniently located in the passenger compartment of each airplane accommodating more than 30 passengers.

(d) First aid kits for treatment of injuries likely to occur in flight or in minor accidents must be provided.

(e) Each airplane accommodating more than 19 passengers must be equipped with a crash ax.

(f) Each passenger-carrying airplane must have a portable battery-powered megaphone or megaphones readily accessible to the crewmembers assigned to direct emergency evacuation, installed as follows:

(1) One megaphone on each airplane with a seating capacity of more than 60 but less than 100 passengers, at the most rearward location in the passenger cabin where it would be readily accessible to a normal flight attendant seat. However, the Administrator may grant a deviation from the requirements of this subparagraph if he finds that a different location would be more useful for evacuation of persons during an emergency.

(2) Two megaphones in the passenger cabin in each airplane with a seating capacity of more than 99 passengers, one installed at the forward end and the other at the most rearward location where it would be readily accessible to a normal flight attendant seat.

FAR 121.309 Emergency equipment

(a) General: No person may operate an airplane unless it is equipped with the emergency equipment listed in this section and in 121.310.

(c) Hand fire extinguishers for crew, passenger, and cargo compartments. Hand fire extinguishers of an approved type must be provided for use in crew, passenger, and cargo compartments in accordance with the following:

(1) The type and quantity of extinguishing agent must be suitable for the kinds of fires likely to occur in the compartment where the extinguisher is intended to be used.

(2) At least one hand fire extinguisher must be provided and conveniently located on the flight deck for use by the flight crew.

(3) At least one hand fire extinguisher must be conveniently located in the passenger compartment of each airplane accommodating more than 6 but less than 31 passengers, and at least two hand fire extinguishers must be conveniently located in each airplane accommodating more than 30 passengers.

(d) First-aid equipment. Approved first-aid kits for treatment of injuries likely to occur in flight or in minor accidents must be provided and must meet the specifications and requirements of Appendix A.

(e) Crash ax. Each airplane must be equipped with a crash ax.

(f) Megaphones. Each passenger-carrying airplane must have a portable battery-powered megaphone or megaphones readily accessible to the crewmembers assigned to direct emergency evacuation, installed as follows:

(1) One megaphone on each airplane with a seating capacity of more than 60 and less than 100 passengers, at the most rearward location in the passenger cabin where it would be readily accessible to a normal flight attendant seat. However, the Administrator may grant a deviation from the requirements of this subparagraph if he finds that a different location would be more useful for evacuation of persons during an emergency.

(2) Two megaphones in the passenger cabin on each airplane with a seating capacity of more than 99 passengers, one installed at the forward end and at

the most rearward location where it would be readily accessible to a normal flight attendant seat.

FAR 121.310 Additional emergency equipment

(a) Means for emergency evacuation. Each passenger-carrying landplane emergency exit (other than over-the-wing) that is more than 6 feet from the ground with the airplane on the ground and the landing gear extended, must have an approved means to assist the occupants in descending to the ground.

FAR 121.353 Emergency equipment for operations over uninhabited terrain areas: Flag and supplemental air carriers and commercial operators

Unless it has the following equipment, no flag or supplemental air carrier or commercial operator may conduct an operation over an uninhabited area or any other area that (in its operations specifications) the Administrator specifies requires equipment for search and rescue in case of emergency:

(a) Suitable pyrotechnic signaling devices.

(b) A survival type emergency locator transmitter that after October 21, 1972, meets the applicable requirements of 37.200 of this chapter, except that, until December 30, 1975, the transmitter is not required to meet those requirements if its installation was approved before October 21, 1971, it was manufactured under a TSO Authorization issued against TSO-C61a of Part 37 of this chapter and it transmits simultaneously on 121.5 and 243.0 MHz. Batteries used in this transmitter must be replaced (or recharged, if the battery is rechargeable) when the transmitter has been in use for more than 1 cumulative hour, and also when 50 percent of their useful life (or for rechargeable batteries, 50 percent of their useful life of charge), as established by the transmitter

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manufacturer under 37.200(g)(2) of this chapter, has expired. The new expiration date for the replacement (or recharged) battery must be legibly marked on the outside of the transmitter. The battery useful life (or useful life of charge) requirements of this paragraph do not apply to batteries (such as water-activated batteries) that are essentially unaffected during probable storage intervals.

(c) Enough survival kits, appropriately equipped for the route to be flown for the number of occupants of the airplane.

FAR 127.107 Emergency equipment

(a) General. No person may operate a helicopter unless it is equipped with the emergency equipment listed in this section.

(c) Hand fire extinguishers for crew, passenger, and cargo compartments. Hand fire extinguishers of a type approved by the Underwriters' Laboratories, Inc., Factory Mutual Laboratories, Underwriters Laboratories of Canada, or any other person whose approval is acceptable to the FAA, or an extinguisher approved under 21.305 (and that are accessible in flight) must be provided for use in crew, passenger, and cargo compartment, in accordance with the following:

(1) The type and quantity of extinguishing agent must be suitable for the kinds of fires likely to occur in the compartment where the extinguisher is intended to be used.

(2) At least one hand fire extinguisher must be conveniently located on the flight deck for use by the flight crew.

(3) At least one hand fire extinguisher must be conveniently located in the passenger compartment of each helicopter accommodating more than six passengers.

(d) First-aid equipment. First-aid kits for treatment of injuries likely to occur in flight or in minor accidents must be provided in a quantity appropriate to the number of passengers and crew accommodated by the helicopter.

(e) Interior emergency exit markings. Each helicopter must have conspicuously marked emergency exits. Each emergency exit must have conspicuously marked means of access and means of opening. The identity and location of each emergency exit must be recognizable from a distance equal to the width of the cabin. The location of the emergency exit operating handle and the instructions for opening must be marked on or adjacent to the emergency exit and must be readable from at least 30 inches by a person with normal eyesight.

(f) Lighting for interior emergency exit markings. Each passenger-carrying helicopter must have a source or sources of light (with an energy supply that is independent of the main lighting system) for each passenger emergency exit marking. Each light must be designed to--

(1) Function automatically in a crash landing, to continue functioning thereafter and to be manually operable; or

(2) Be manually operable only and to continue functioning after a crash landing.

If a light requires manual operation, it must be turned on before each takeoff and landing. If a light requires arming of the system to function automatically, the system must be armed before each takeoff and landing.

FAR 135.161 Fire extinguishers: Passenger-carrying aircraft

No person may operate an aircraft carrying passengers unless it is equipped with a hand fire

extinguisher that is accessible to the pilot and passengers or two hand type fire extinguishers, one of which is accessible to the pilot and the other to the passengers.

Justification: The emergency location transmitter assists rescue efforts by facilitating location of a downed aircraft. Fire is an ever-present potential aircraft problem because of the fuel carried on board. Fire extinguishers help contain fire in the cabin area. Other needed emergency equipment includes first-aid kits, crash ax, megaphone, emergency exit slides and survival kits.

O. Miscellaneous Equipment

FAR 121.321 Shoulder harness

No person may operate a transport category airplane that was type certificated after January 1, 1958, unless it is equipped with a shoulder harness at the pilot in command station, the second in command station, and the flight engineer station.

FAR 121.360 Ground proximity warning-glide slope deviation alerting system

(a) Except as provided in paragraphs (b) and (h) of this section, after December 1, 1975, no person may operate a large turbine-powered airplane unless it is equipped with a ground proximity warning system that meets the performance and environmental standards of TSO-D92 or incorporates TSO-approved ground proximity warning equipment.

(b) Ground proximity warning systems approved for use under this Part and installed before June 5, 1975, may be used in lieu of equipment that meets the performance and environmental standards of TSO-C92 or is TSO-approved until January 1, 1977, except that the requirements of paragraph (c) of this section must be met.

(c) For the ground proximity warning system required by this section, the Airplane Flight Manual shall contain--

(1) Appropriate procedures for--

(i) The use of the equipment;

(ii) Proper flight crew action with respect to the equipment;

(iii) Deactivation for planned abnormal and emergency conditions; and

(2) An outline of all input sources that must be operating.

(d) After September 1, 1976 (unless required earlier in the certificate holder's operations specifications), no person may deactivate a ground proximity warning system required by this section except in accordance with the procedures contained in the Airplane Flight Manual.

(e) Whenever a ground proximity warning system required by this section is deactivated, an entry shall be made in the airplane maintenance record that includes the date and time of deactivation.

(f) Except as provided in paragraph (g) of this section, after June 1, 1976, no person may operate a large turbine-powered airplane unless it is equipped with a ground proximity warning-glide slope deviation alerting system that meets the performance and environmental standards contained in TSO-C92a or incorporates TSO-approve ground proximity warning-glide slope deviation alerting equipment.

(g) Large turbine-powered airplanes being operated under the provisions of paragraph (b) of this section may be operated until January 1, 1977, without being equipped with the ground proximity warning-glide

slope deviation alerting system required by paragraph (f) of this section.

(h) A certificate holder may obtain an extension of the December 1, 1975, compliance date specified in paragraph (a) of this section, but not beyond June 1, 1976, from the Director, Flight Standards Service if, before December 1, 1975--

(1) It shows that due to circumstance beyond its control it cannot comply by that date; and

(2) It has submitted by that date a schedule for compliance, acceptable to the Director, indicating that the system will be installed at the earliest practicable date.

FAR 121.581 Forward observer's seat: en route inspections: air carriers

(a) Each air carrier shall make available a seat on the flight deck of each airplane, used by it in air transportation, for occupancy by the Administrator while conducting en route inspections. The location and equipment of the seat, with respect to its suitability for use in conducting en route inspections, is determined by the Administrator.

(b) In each airplane that has more than one observer's seat, in addition to the seats required for the crew complement for which the airplane was certificated, the forward observer's seat must be made available to the Administrator.

FAR 127.109 Seat and safety belt

(a) No person may operate a helicopter unless there are available during the takeoff, en route flight, and landing--

(1) An approved seat for each person on board the helicopter who has reached his second birthday; and

(2) An approved safety belt for separate use by each person on board the helicopter who has reached his second birthday.

(b) During the takeoff and landing of a helicopter, each person on board shall occupy an approved seat with a safety belt properly secured about him. A person who has not reached his second birthday may be held by an adult who is occupying a seat.

However, not withstanding the provisions of this section, in the case of children who have reached their second birthday, but not their 12th birthday, a safety belt may be used for two in a single seat if the strength requirements of the seat and the safety belt are not exceeded.

FAR 127.111 Miscellaneous equipment.

No person may conduct any operation unless the following equipment is installed in the helicopter:

(a) A windshield wiper or equivalent for each pilot station.

(b) An alternate source of energy able to carry the necessary load for all instruments required by 127.119 that require a power source.

(c) A means to indicate the adequacy of the power being supplied to required flight instruments.

Justification: The shoulder harness and seat belts keep the crew and passengers secure during turbulent air and emergency landings. The ground proximity warning system alerts the crew when the aircraft is too close to the surface. The forward observer's seat provides a seating location for the purpose of conducting line evaluations of crew performance by FAA personnel.

P. Summary

The proper flight and navigation of an aircraft can only be accomplished with proper equipment. Equipment is needed for engine monitoring, navigation, communication, emergencies, oxygen availability and a number of additional reasons. To reduce on-board equipment would be to lower safety of flight. As new methods of air traffic control are implemented, the equipment requirements are expected to increase rather than diminish. Technological developments are needed which lower the weight of equipment while maintaining or improving performance capabilities. Subminiaturization and digital avionics are present technologies which will, over time, alleviate the equipment weight problem and the associated fuel burn. Nevertheless, these regulations are minimum equipment requirements. Users add substantial loads of equipment that increase reliability and reduce maintenance down-time. The extra equipment may reduce diversions thereby conserving fuel.

# VIII. REGULATIONS PERTAINING TO CREWMEMBER QUALIFICATIONS

## VIII. REGULATIONS PERTAINING TO CREWMEMBER QUALIFICATIONS

In order to insure that crewmembers in charge of a flight are properly qualified for their position, a series of regulations have been promulgated which detail minimum requirements for serving as pilot-in-command, second-in-command, flight engineer and flight instructor. Where passengers are carried commercially, the crew qualifications are more rigid and continued training with associated proficiency checks is mandated.

From a fuel conservation standpoint, the less required training, the lower the fuel burn. The use of simulators has produced substantial savings already to air carriers who thus become able to transfer some airborne training to the ground. The regulations have been structured so as to facilitate the acquisition of experience by crewmembers through the use of simulators.

### A. Aeronautical Experience

FAR 61.65 Instrument rating requirements

(e) Flight experience. An applicant for an instrument rating must have at least the following flight time as a pilot:

(1) A total of 200 hours of pilot flight time, including 100 hours as pilot in command, of which 50 hours are cross-country in the category of aircraft for which an instrument rating is sought.

(2) 40 hours of simulated or actual instrument time, of which not more than 20 hours may be instrument instruction by an authorized instructor in an instrument ground trainer acceptable to the Administrator.

FAR 61.67 Category II pilot authorization requirements

(b) Experience requirements. Except for the holder of an airplane transport pilot certificate, an applicant for a Category II authorization must have at least--

(1) 50 hours of night flight time under VFR conditions as pilot in command;

(2) 75 hours of instrument time under actual or simulated conditions that may include 25 hours in a synthetic trainer; and

(3) 250 hours of cross-country flight time as pilot in command.

FAR 61.69 Glider towing: Experience and instruction requirements

(c) He has made and entered in his pilot logbook--

(1) At least three flights as sole manipulator of the controls of an aircraft towing a glider (while accompanied by a pilot who has met the requirements of this section), and at least three flights as pilot or observer in a glider being towed by an aircraft--

(d) If he holds only a private pilot certificate he must have had and entered in his pilot logbook at least--

(1) 100 hours of pilot flight time in powered aircraft; or

(2) 200 total hours of pilot flight time in powered or other aircraft.

(e) Within the preceding 12 months he has--

(1) Made at least three actual or simulated glider tows while accompanied by a qualified pilot who meets the requirements of this section; or

(2) Made at least three flights as pilot in command of a glider towed by an aircraft.

FAR 61.109 Airplane rating: Aeronautical experience

An applicant for a private pilot certificate with an airplane rating must have had at least a total of 40 hours of flight instruction and solo flight time which must include the following:

(a) 20 hours of flight instruction from an authorized flight instructor, including at least--

(1) Three hours of cross country;

(2) Three hours at night, including 10 takeoffs and landings for applicants seeking night flying privileges; and

(3) Three hours in airplanes in preparation for the private pilot flight test within 60 days prior to that test.

(b) 20 hours of solo flight time including at least--

(1) 10 hours in airplanes;

(2) 10 hours of cross-country flights, each flight with a landing more than 50 nautical miles from the point of departure, and one with landings at three points, each of which is more than 100 nautical miles from each of the other two points; and

(3) Three solo takeoffs and landings to a full stop at an airport with an operating control tower.

FAR 61.113 Rotorcraft rating: Aeronautical experience

An applicant for a private pilot certificate with a rotorcraft category rating must have at least the following aeronautical experience:

(a) For a helicopter rating an applicant must have at least a total of 40 hours of flight

instruction and solo flight time in aircraft with at least 15 hours of solo time in helicopters, which must include--

(1) A takeoff and landing at an airport which serves both airplanes and helicopters;

(2) A flight with a landing at a point other than an airport; and

(3) Three hours of cross-country flying, including one flight with landings at three or more points, each of which must be more than 25 nautical miles from each of the other two points.

(b) For a gyroplane rating an applicant must have at least a total of 40 hours of flight instruction and solo flight time in aircraft with at least 10 hours of solo flight time in a gyroplane, which must include--

(1) Flights with takeoffs and landings at paved and unpaved airports; and

(2) Three hours of cross-country flying, including a flight with landings at three or more points, each of which must be more than 25 nautical miles from each of the other two points.

FAR 61.117 Lighter-than-air rating: Aeronautical experience

An applicant for a private pilot certificate with a lighter-than-air category rating must have at least the aeronautical experience prescribed in paragraph (a) or (b) of this section, appropriate to the rating sought.

(a) Airships. A total of 50 hours of flight time as pilot with at least 25 hours in airships, which must include 5 hours of solo flight time in airships, or time performing the functions of pilot in command in an airship for which more than one pilot is required.

(b) Free balloons.

(1) If a gas balloon or a hot air balloon with an airborne heater is used, a total of 10 hours in free balloons with at least six flights under the supervision of a person holding a commercial pilot certificate with a free balloon rating; and

(2) If a hot air balloon without an airborne heater is used, six flights in a free balloon under the supervision of a commercial balloon pilot, including at least one solo flight.

FAR 61.129 Airplane rating: Aeronautical experience

(b) Flight time as pilot. An applicant for a commercial pilot certificate with an airplane rating must have a total of at least 250 hours of flight time as pilot, which may include not more than 50 hours of instruction from an authorized instructor in a ground trainer acceptable to the Administrator. The total flight time as pilot must include--

(1) 100 hours in powered aircraft, including at least--

(i) 50 hours in airplanes, and

(ii) 10 hours of flight instruction and practice given by an authorized flight instructor in an airplane having a retractable landing gear, flaps, and a controllable pitch propeller; and

(2) 50 hours of flight instruction given by an authorized flight instructor, including--

(i) 10 hours of instrument instruction, of which at least 5 hours must be in flight in airplanes, and

(ii) 10 hours of instruction in preparation for the commercial pilot flight test; and

(3) 100 hours of pilot in command time including at least--

(i) 50 hours in airplanes;

(ii) 50 hours of cross-country flights,

(iii) 5 hours of night flying including at least 10 takeoffs and landings as sole manipulator of the controls.

FAR 61.131 Rotorcraft ratings: Aeronautical experience

(a) Helicopter. An applicant for a commercial pilot certificate with a helicopter rating must have a total of at least 150 hours of flight time as pilot, including--

(1) 100 hours in powered aircraft and at least 50 hours in helicopters;

(2) 100 hours of pilot in command time, including a cross-country flight with landings at three points, each of which is more than 50 nautical miles from each of the other points;

(3) 40 hours of flight instruction from an authorized flight instructor, including 15 hours in helicopters; and

(4) 10 hours as pilot in command in helicopters, including--

(i) Five takeoffs and landings at night; and

(ii) Takeoffs and landings at three different airports which serve both airplanes and helicopters; and

(iii) Takeoffs and landings at three points other than airports.

(b) Gyroplanes. An applicant for a commercial pilot certificate with a gyroplane rating must have a total of at least 200 hours of flight time as pilot, including--

(1) 100 hours in powered aircraft;

(2) 100 hours as pilot in command, including a cross-country flight with landings at three points, each of which is more than 50 nautical miles from each of the other two points;

(3) 75 hours as pilot in command in gyroplanes, including--

(i) Flight with takeoffs and landings at three different paved airports and three unpaved airports; and

(ii) Three flights with takeoffs and landings at an airport with an operating control tower; and

(4) 20 hours of flight instruction in gyroplanes, including 5 hours in preparation for the commercial pilot flight test.

FAR 61.135 Airship rating: Aeronautical experience

An applicant for a commercial pilot certificate with an airship rating must have a total of at least 200 hours of flight time as pilot, including--

(a) 50 hours of flight time as pilot in airships;

(b) 30 hours of flight time performing the duties of pilot in command in airships, including--

(1) 10 hours of cross-country flight; and

(2) 10 hours of night flight; and

(c) 40 hours of instrument time, of which at least 20 hours must be in flight with 10 hours of that flight time in airships.

FAR 61.155 Airplane rating: Aeronautical experience

(a) An applicant for an airline transport pilot certificate with an airplane rating must hold a commercial pilot license without limitations, issued by a member state of ICAO, or he must be a pilot in an Armed Force of the United States whose military experience qualifies him for a commercial pilot certificate under 61.31.

(b) An applicant must have had--

(1) At least 250 hours of flight time as pilot in command of an airplane, or as copilot of an airplane performing the duties and functions of a pilot in command under the supervision of a pilot in command or any combination thereof, at least 100 hours of which were cross-country time and 25 hours of which were night flight time; and

(2) At least 1,500 hours of flight time as a pilot, including at least--

(i) 500 hours of cross-country flight time;

(ii) 100 hours of night flight time; and

(iii) 75 hours of actual or simulated instrument time, at least 50 hours of which were in actual flight.

FAR 61.161 Rotorcraft rating: Aeronautical experience

(a) An applicant for an airline transport pilot certificate with a rotorcraft rating must hold a commercial pilot certificate, or its equivalent as determined by the Administrator;

(b) In addition, such an applicant must have had at least 1,200 hours of flight time as a pilot within the 8 years before the date he applies, including at least--

(1) 5 hours in rotorcraft within the 60 days before that date;

(2) 500 hours of cross-country flight time;

(3) 100 hours at night, including at least 15 hours in rotorcraft; and

(4) 200 hours in rotorcraft, including at least 75 hours as pilot in command performing the duties and functions of a pilot in command under the supervision of a pilot in command, or any combination thereof.

(c) In addition to the requirements of paragraphs (a) and (b) of this section, an applicant for an airline transport pilot certificate with a rotorcraft category and a helicopter class rating not limited to VFR, must have at least 75 hours of instrument time under actual or simulated instrument conditions of which at least 25 hours is in helicopters as pilot in command, or as second in command, or as second in command performing the duties and functions of a pilot in command under the supervision of a pilot in command, or any combination thereof.

FAR 61.165 Additional category ratings

(a) Rotorcraft category and gyroplane class rating or helicopter class rating limited to VFR only. The holder of an airline transport pilot certificate (airplane rating) who applies for a rotorcraft category and

gyroplane class rating, or a rotorcraft category and helicopter class rating limited to VFR only must meet the applicable requirements of 61.151 and 61.155.

(1) Have at least 100 hours, including at least 15 hours at night, of rotorcraft flight time as pilot in command or as second in command performing the duties and functions of a pilot in command under the supervision of a pilot in command who holds an airline transport pilot certificate with an appropriate rotorcraft rating, or any combination thereof; or

(2) Complete a training program conducted by a certified air carrier or other approved agency requiring at least 75 hours of rotor-craft flight time as pilot in command, second in command, or as flight instruction from an appropriately rated FAA certificated flight instructor or an airline transport pilot, or any combination thereof, including at least 15 hours of night flight time.

(c) Airplane rating. The holder of an airline transport pilot certificate (rotorcraft rating) who applies for an airplane rating, must comply with 61.143 through 61.147.

FAR 61.191 Additional flight instructor ratings

The holder of a flight instructor certificate who applies for an additional rating on that certificate must--

(b) Have had at least 15 hours as pilot in command in the category and class of aircraft appropriate to the rating sought.

FAR 135.121 Pilot-in-command qualifications: Night flight

No person may act as pilot in command of an aircraft at night unless--

(a) He has had at least 500 hours of flight time as pilot, including at least 100 hours of cross-country flight time, at least 25 hours of which were at night.

FAR 135.123 Pilot-in-command qualifications: Carrying passengers under VFR over the top

(a) No person may act as pilot in command of an aircraft under VFR over-the-top unless he has--

(1) Had at least 500 hours of flight time as a pilot including at least 100 hours of cross-country time.

FAR 135.125 Pilot-in-command qualifications: IFR flight

No person may act as pilot in command of an aircraft under IFR unless he has had at least 1,200 hours of flight time as a pilot, including 500 hours of cross-country flight time, 100 hours of night flight time, including at least 10 night takeoffs and landings, and 75 hours of actual or simulated instrument flight time, at least 50 hours of which were in actual flight.

FAR 141.35 Chief instructor qualifications

(b) For a course of training leading to the issuance of a private pilot certificate or rating, a chief flight instructor or an assistant chief flight instructor must have--

(2) At least 1,000 hours as pilot in command;

(3) Primary flight instruction experience, acquired as either a certificated flight instructor or an instructor in a military pilot primary flight training program, or a combination thereof consisting of at least--

(i) Two years and a total of 500 flight hours; or

(ii) 1,000 flight hours; and

(4) Within the year preceding designation, at least 100 hours of flight instruction as a certificated flight instructor in the category of aircraft used in the course.

(c) For a course of training leading to the issuance of an instrument rating or a rating with instrument privileges, a chief flight instructor or an assistant chief flight instructor must have--

(2) At least 100 hours of flight time under actual or simulated instrument conditions;

(3) At least 1,000 hours as pilot in command;

(4) Instrument flight instructor experience, acquired as either a certificated instrument flight instructor or an instructor in a military pilot basic or instrument flight training program, or a combination thereof, consisting of at least--

(i) Two years and a total of 250 flight hours; or

(ii) 400 flight hours; and

(5) Within the year preceding designation, at least--

(i) 100 hours of instrument flight instruction as a certificated instrument flight instructor; or

(ii) One year of active service as an FAA designated instrument rating examiner.

(d) For a course of training other than those that lead to the issuance of a private pilot certificate or rating, or an instrument rating or a rating with instrument privileges, a chief flight instructor or an assistant chief flight instructor must have--

(1) At least a commercial pilot certificate and a flight instructor certificate, each with a rating for the category and class of aircraft used in the course of training and, for a course of training using airplanes or airships an instrument rating on his commercial pilot certificate;

(2) At least 2,000 hours as pilot in command;

(3) Flight instruction experience, acquired as either a certificated flight instructor or an instructor in a military pilot primary or basic flight training program or a combination thereof, consisting of at least--

(i) Three years and a total of 1,000 flight hours; or

(ii) 1,500 flight hours; and

(4) Within the year preceding designation, at least--

(i) 100 hours of pilot instruction as a certificated flight instructor in the category of aircraft use in the course;

(ii) One year of active service as chief flight instructor of an approved course of training; or

(iii) One year of active service as an FAA designated pilot examiner.

Justification: The primary technique by which pilot proficiency is increased is through experience. Whether it be an applicant for a private pilot certificate or one for an airline transport pilot certificate, actual in-flight experience is essential. The greater the responsibility for other human lives, the greater the experience requirements.

B. Flight Test.

FAR 61.63 Additional aircraft ratings (other than airline transport pilot)

(a) General. To be eligible for an aircraft rating after his certificate is issued to him an applicant must meet the requirements of paragraphs (b) through (d) of this section, as appropriate to the rating sought.

(c) Class rating. An applicant for an aircraft class rating to be added on his pilot certificate must--

(2) Pass a flight test appropriate to his pilot certificate and applicable to the aircraft category and class rating sought.

(d) Type rating. An applicant for a type rating to be added on his pilot certificate must meet the following requirements--

(2) He must pass a flight test showing competence in pilot operations appropriate to the pilot certificate he holds and to the type rating sought.

(3) He must pass a flight test showing competence in pilot operations under instrument flight rules in an aircraft of the type for which the type rating is sought, or in the case of a single pilot station airplane, meet the requirements of paragraph (d)(3) or (ii) of this section, whichever is applicable.

FAR 61.65 Instrument rating requirements

(g) Practical test. An applicant for an instrument rating must pass a flight test in an airplane or a helicopter, as appropriate. The test must include instrument flight procedures selected by the inspector or examiner conducting the test to determine

the applicant's ability to perform competently the IFR operations on which instruction is required by paragraph (c) or (d) of this section.

FAR 61.67 Category II pilot authorization requirements

(c) (2) To be eligible for the practical test an applicant must meet the requirements of paragraph (a) of this section and, if he has not passed a practical test since the beginning of the twelfth month before the test, he must meet the following recent experience requirements--

(i) The requirements of 61.57 (e);

(ii) At least six ILS approaches since the beginning of the sixth month before the test. These approaches must be under actual or simulated instrument flight conditions down to the minimum landing altitude for the ILS approach in the type airplane in which the flight test is to be conducted down to the decision heights authorized for Category II operations. At least three of these approaches must have been conducted manually, without the use of an approach coupler.

(d) (2) Phase II--flight test. The flight test must be taken in an airplane that meets the requirements of Part 91 of this chapter for Category II operations. The test consists of at least two ILS approaches to 100 feet including at least one landing and one missed approach.

FAR 61.103 Eligibility requirements: General

To be eligible for a private pilot certificate, a person must--

(e) Pass an oral and flight test on procedures and maneuvers selected by an FAA inspector or examiner to determine the applicant's competency in the flight operations on which instruction is required by the flight proficiency provisions of 61.107.

FAR 61.123 Eligibility requirements: General

To be eligible for a commercial pilot certificate, a person must--

(e) Pass an oral and flight test appropriate to the rating he seeks, covering items selected by the inspector or examiner from those on which training is required by 61.127.

FAR 61.157 Airplane rating: Aeronautical skill

(a) An applicant for an airline transport pilot certificate with a single-engine or multiengine class rating or an additional type rating must pass a practical test that includes the items set forth in Appendix A of this part. The FAA inspector or designated examiner may modify any required maneuver where necessary for the reasonable and safe operation of the airplane being used and, unless specifically prohibited in Appendix A, may combine any required maneuvers and may permit their performance in any convenient sequence.

FAR 61.183 Eligibility requirements: General

To be eligible for a flight instructor certificate a person must--

(e) Pass an oral and flight test on those items in which instruction is required by FAR 61.187.

Justification: After a certificate candidate has received sufficient aeronautical experience, then he must further demonstrate his abilities in a flight test under observation. This serves as a check on the abilities of the pilot which might not have been otherwise obtained.

C. Initial, Transition and Upgrade Training

FAR 121.424 Pilots: Initial, transition and and upgrade flight training

(c) Except as permitted in paragraph (d) of this section, the initial flight training required by paragraph (a) of this section must include at least the following programmed hours of inflight training and practice unless reduced under 121.405;

(1) Group I airplanes--

(i) Reciprocating powered. Pilot in command, 10 hours; second in command, 6 hours; and

(ii) Turbopropeller powered. Pilot in command, 15 hours; second in command, 7 hours.

(2) Group II airplanes, Pilot in command, 20 hours; second in command, 10 hours.

FAR 121.434 Operating experience

(a) No certificate holder may use a person nor may any person serve as a required crewmember on an airplane unless he has completed, in that type airplane and in that crewmember position, the operating experience required by this section, except as follows:

(3) The hours of operating experience for all pilots are as follows--

(i) For initial training, 15 hours in Group I reciprocating powered airplanes, 20 hours in Group I turbopropeller powered airplanes, and 25 hours in Group II airplanes;

(ii) For transition training, except as provided in subparagraph (3) (iii) of this paragraph, 10 hours in Group I reciprocating powered

airplanes, 12 hours in Group I turbopropeller powered airplanes, and 15 hours in Group II airplanes; and

(d) A flight engineer must perform the duties of a flight engineer under the supervision of a check airman or a qualified flight engineer for at least the following number of hours--

(1) Group I reciprocating powered airplanes, 8 hours.

(2) Group I turbopropeller powered airplanes, 10 hours.

(3) Group II airplanes, 12 hours.

Justification: Air carrier pilots have great responsibilities due to their passenger carrying role. Therefore, additional training is required of them prior to pilot in command status and in transition from one type airplane to another.

D. Recent Flight Experience

FAR 61.57 Recent flight experience: Pilot in command

(c) General experience. No person may act as pilot in command of an aircraft carrying passengers, nor of an aircraft certificated for more than one required pilot flight crewmember, unless within the preceding 90 days, he has made three takeoffs and three landings as the sole manipulator of the same category and class and if a type rating is required of the same type. If the aircraft is a tailwheel airplane, the landings must have been made to a full stop in a tailwheel airplane.

(d) Night experience. No person may act as pilot in command of an aircraft carrying passengers during the period beginning 1 hour after sunset and ending 1 hour before sunrise

(as published in the American Air Almanac) unless, within the preceding 90 days, he has made at least three takeoffs and three landings to a full stop during that period in the category and class of aircraft to be used.

(e) Instrument.

(1) Recent IFR experience. No pilot may act as pilot in command under IFR, nor in weather conditions less than the minimums prescribed for VFR, unless he has, within the past 6 months--

(i) In the case of an aircraft other than a glider, logged at least 6 hours of instrument time under actual or simulated IFR conditions, at least 3 of which were in flight in the category of aircraft involved, including at least 6 instrument approaches, or passed an instrument competency check in the category of aircraft involved.

(ii) In the case of the glider, logged at least 3 hours of instrument time, at least half of which were in a glider or an airplane. If a passenger is carried in the glider, at least 3 hours of instrument flight time must have been in gliders.

Justification: The skills of a pilot may be somewhat diminished if continuous flying is not maintained. Therefore, prior to carrying passengers, a pilot who has not flown recently must gain fresh experience in the aircraft to be used.

E. Proficiency checks

FAR 61.57 Recent flight experience: Pilot in command

(a) Flight review. After November 1, 1974, no person may act as pilot in command of an aircraft unless, within the preceding 24 months, he has--

(1) Accomplished a flight review given to him, in an aircraft for which he is rated, by an appropriately certificated instructor or other person designated by the Administrator.

FAR 61.58 Pilot-in-command proficiency check: Operation of aircraft requiring more than one required pilot

(a) Except as provided in paragraph (e) of this section, after November 1, 1974, no person may act as pilot in command of an aircraft that is type certificated for more than one required pilot crewmember unless he has satisfactorily completed the proficiency checks or flight checks prescribed in paragraphs (b) and (c) of this section.

(b) Since the beginning of the 12th calendar month before the month in which a person acts as pilot in command of an aircraft that is type certificated for more than one required pilot crewmember he must have completed one of the following--

(1) For an airplane--a proficiency or flight check in either an airplane that is type certificated for more than one required pilot crewmember, or in an approved simulator or other training device, given to him by an FAA inspector or designated pilot examiner and consisting of those maneuvers and procedures set forth in Appendix F of Part 121 of this chapter which may be performed in a simulator or training device.

(2) For other aircraft--a proficiency or flight check in an aircraft that is type certificated for more than one

required pilot crewmember given to him by an FAA inspector or designated pilot examiner which includes these maneuvers and procedures required for the original issuance of a type rating for the aircraft used in the check.

(3) A pilot in command proficiency check given to him in accordance with the provisions for that check under Parts 121,123, or 135 of this chapter. However, in the case of a person acting as pilot in command of a helicopter he may complete a proficiency check given to him in accordance with Part 127 of this chapter.

(4) A flight test required for an aircraft type rating.

(5) An initial or periodic flight check for the purpose of the issuance of a pilot examiner or check airman designation.

(6) A military proficiency check required for pilot in command and instrument privileges in an aircraft which the military requires to be operated by more than one pilot.

(c) Except as provided in paragraph (d) of this section, since the beginning of the 24th calendar month before the month in which a person acts as pilot in command of an aircraft that is type certificated for more than one required pilot crewmember he must have completed one of the following proficiency or flight checks in the particular type aircraft in which he is to serve as pilot in command--

(1) A proficiency check or flight check given to him by an FAA inspector or a designated pilot examiner which includes the maneuvers, procedures, and standards required for the original

issuance of a type rating for the aircraft used in the check.

(2) A pilot in command proficiency check given to him in accordance with the provisions for that check under Parts 121, 123, or 135 of this chapter. However, in the case of a person acting as pilot in command of a helicopter he may complete a proficiency check given to him in accordance with Part 127 of this chapter.

(3) A flight test required for an aircraft type rating.

(4) An initial or periodic flight check airman designation.

(5) A military proficiency check required for pilot in command and instrument privileges in an aircraft which the military requires to be operated by more than one pilot.

FAR 121.440 Line checks

(a) No certificate holder may use any person nor may any person serve as pilot in command of an airplane unless, within the preceding 12 calendar months, that person has passed a line check in which he satisfactorily performs the duties and responsibilities of a pilot in command in one of the types of airplanes he is to fly.

(b) A pilot in command line check for domestic and flag air carrier pilots must--

(2) Consist of at least a scheduled flight over a typical part of the air carriers route to which the pilot is normally assigned.

(c) A pilot in command line check for supplemental air carriers and commercial operators must--

(2) Consist of at least one flight over a part of a Federal airway, foreign airway, or advisory route over which the pilot may be assigned.

FAR 121.441 Proficiency checks

(a) No certificate holder may use any person nor may any person serve as a required pilot flight crewmember unless that person has satisfactorily completed either a proficiency check, or an approved simulator course of training under 121.409, as follows--

(1) For a pilot in command, a proficiency check within the preceding 12 calendar months and, in addition, within the preceding 6 calendar months, either a proficiency check or the simulator training.

(2) For all other pilots, a proficiency check within the preceding 24 calendar months and, in addition, within the preceding 12 calendar months, either a proficiency check or the simulator training.

FAR 121.443 Pilot in command qualifications: Routes and airports: Domestic and flag air carriers

(a) No domestic or flag air carrier may use a pilot as pilot in command until he has qualified, for the route on which he is to serve, in accordance with this section, and the appropriate instructor or an appropriate instructor or check pilot has so certified.

(c) The qualifying pilot shall make an entry as a member of a flight crew at each regular, provisional, and refueling airport into which he is scheduled to fly. The entry must include a landing and a takeoff. The qualifying pilot must occupy a seat in the pilot compartment and must be accompanied by a pilot who is qualified for the airport.

(e) No pilot in command may serve on a route or route segment on which he must navigate by pilotage and fly at or below the level of terrain that is within 25 miles horizontally of the centerline of that route or route segment unless he has made at least two one-way trips over the route or route segment on the flight deck under VFR weather conditions.

FAR 135.122 Pilot-in-command qualifications: Routes and airports

(a) The certificate holder may not utilize a pilot, nor may any person serve, as pilot in command of a flight under IFR unless, since the beginning of the 12th calendar month before that service he has passed a flight check in one of the types of airplanes he is to fly, given by an approved check pilot who is qualified in the aircraft, or by the Administrator, consisting of at least one flight over a representative airway or approved off-airway route, or portion thereof, over which he may be assigned to fly.

FAR 135.131 Pilot in command: Instrument check requirements

(a) No certificate holder may use a pilot, nor may any person serve as a pilot in command of an aircraft under IFR unless, since the beginning of the sixth calendar month before that use, he has passed an instrument check and the Administrator or an authorized check pilot has so certified in a letter of competency.

FAR 135.138 Initial and recurrent pilot testing requirements

(b) No certificate holder may use the services of a pilot, nor may any person serve as a pilot, of any aircraft unless, since the beginning of the 12th calendar month before that service, he has passed a flight check given to him by the Administrator or an

authorized check pilot in that class of aircraft, if single-engine airplane other than turbojet, to determine the pilot's competence in practical skills and techniques in that aircraft or class of aircraft.

Justification: Pilot skill levels fluctuate over time, generally as a function of continuing flight experience. However, examination of a pilot's log book is not a sufficient indication of abilities. Therefore, periodic flight tests which measure pilot skills are needed so that when skill levels do deteriorate to an unsafe level this fact will be detected.

F. Summary

Just as an aircraft should be proved for service, so should the crew. Appropriate experience must be obtained. Flight tests should be given for certificate candidates. Training should be an ongoing activity. Periodic reviews of crew skills should be conducted. Each of these activities help assure the crewmembers' skills are sufficient for the function they perform. Actual inflight experience has been the traditional method of skill development. The development of large scale simulators has transferred a large portion of training to the ground. Present regulations permit simulator usage to the maximum extent safely possible and therefore no changes to existing regulations appear needed at this time.

# IX. SUMMARY AND CONCLUSION

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This report was prepared in accordance with the requirements of the Energy Policy and Conservation Act, Section 382(a)(3), which requires the Federal Aviation Administration to search its regulations for any possible requirements which would produce inefficient fuel consumption on the part of those subject to FAA actions. In conducting the study, seven general areas were identified where regulations existed which directly or indirectly required fuel consumption:

- Flight Test Programs: The safety of flight is related to the quality of the aircraft which must be ascertained through flight testing. Present required testing is not excessive. Fuel consumed in testing is a small fraction of total aviation fuel. No regulatory changes are recommended.

- Environmental Control: Although aircraft noise is predominantly an annoyance problem, sonic boom and excessively high noise levels in populated areas can damage health and property. Similarly, emission control protects the public from fuel or fuel usage byproducts which might be harmful to public health and safety. Present standards do not produce sizeable fuel inefficiencies relative to the protection given the public. No regulatory changes are recommended.

- Aircraft Fuel Supply: Fuel reserves are necessary for crew and passenger safety in the event of delay or diversion to alternate airports. Increasing volumes of air traffic have produced more frequent and more extensive delays. Weather continues to be both a factor in delays and diversions. Presently, the air carrier practice is to place on board fuel in excess of any required minimums. The regulations do not appear to be causing fuel inefficiencies and no change is recommended.

- Aircraft Speed and Flight Altitude: In order to reduce the likelihood of airborne collision, regulations have been adopted relative to aircraft speed

and flight altitude. Aircraft speed is regulated downward in congested airspace. For certain aircraft this produces inefficiencies. As ground and airborne equipment improve, including air traffic control equipment, the requirement can be changed. Assigned flight altitudes restrict the slightly more fuel efficient technique of cruise climb. Once again, as the appropriate technologies are available, these regulations can be changed.

- Airspace and Air Traffic Control: The existence of airways from one navigational aid to another produces a degree of circuitous routing and corresponding inefficiency. The technique of area navigation (RNAV) permits the optimal flight path to be flown. Efforts are now underway within FAA to improve the efficiency and utilization of RNAV routes and technology.

- Aircraft Equipment: Proper navigation and communication require equipment. Flight under instrument flight rules (IFR), night flight, emergencies and flight over water impose additional equipment needs. Equipment weight increases fuel usage. An aid will be lowered equipment weight through new technology, i.e., subminiaturization and digital avionics. No regulatory changes are recommended.

- Crewmember Qualifications: In order to insure that crewmembers are properly qualified, regulations detail minimum experience and proficiency levels. Where passengers are carried commercially, qualifications are more rigid and continued training with associated frequent proficiency checks is mandated. The prime source of fuel conservation in training is use of simulators. Air carriers are currently using simulators extensively, and increased utilization is desired in the future. Current regulations permit simulator usage and no regulatory changes are recommended.

The economics of aviation is such that excessive fuel consumption produces increased costs for aviation users and historically fuel economy has been a consideration in regulation creation. Any regulation requiring excessive fuel usage without a logical basis would be strongly brought to the attention of the FAA by aviation users. Fuel inefficiency has not been and is not now a luxury which the aviation industry can afford and this has been reflected in the regulatory process.

The findings of this analysis, as detailed in the preceding chapters, is that: Regulations and laws administered by the FAA are fuel efficient subject to the constraints of safety, environmental control and existing technology. This finding is based upon a comprehensive evaluation of all such statutes as to their effect on fuel usage and their justification on safety or environmental grounds. Consequently, no changes to existing FAA regulations or delegations are recommended at this time with respect to energy efficiency.