Report of the Fuel Requirements Working Group, Aviation Rulemaking Advisory Committee Air Carrier Operations Issues

Background

The Fuel Requirements Working Group was formed to review the fuel supply requirements for flight operations conducted under FAR Parts 121 and 135. The review was initiated because of numerous accidents and incidents involving low-fuel situations and fuel exhaustion including, a recent fatal accident. The former Air Carrier Operations Subcommittee chartered the working group to accomplish the following:

> Determine fuel supply requirements for international and overseas operations including criteria for minimum fuel, diversion fuel, contingency fuel, and alternate fuel. Determine fuel requirements related to redispatching. Develop regulatory language for revision of Parts 121 and 135 and advisory material for publication as one or more advisory circulars.

Members of the working group and the organizations they represent are listed in Appendix A.

Activities

- Meetings. The first working group meeting was held on July 10, 1991. Since then, a total of 12 meetings have been held approximately every other month. The most recent meeting was adjourned on April 16, 1993. In addition, smaller subgroups were formed to accomplish specific tasks to improve the effectiveness of the working group.

- Accident/Incident Review. The working group conducted a review of fuel-related accident and incident reports to determine if the historical data for Federal Aviation Regulations (FAR) Part 121 and Part 135 operations indicate the need for regulatory revision. The review covered 110 Aviation Safety Reporting System (ASRS) reports filed from 1986 to 1992 and 30 National Transportation Safety Board (NTSB) reports filed from 1965 to 1992.

- Survey. The working group developed and circulated an informal survey to obtain the input of industry representatives on issues related to

fuel supply operation and regulations. The informal survey was distributed to organizations represented by working group members, domestic and overseas operators, aircraft dispatcher groups, pilot groups, manufacturers, and other interested industry organizations.

- Fuel Management Principles. The group formulated fuel management principles for preflight fuel planning and en route fuel management and developed low-fuel procedures for pilots, aircraft dispatchers, and air traffic controllers.

- Advisory Circular. The working group drafted an AC that recommends fuel management principles and procedures to the aviation industry.

- Industry Briefings. Working group members briefed interested groups such as the Air Traffic Procedures Advisory Committee (ATPAC), to solicit and receive feedback on the groups' recommendations.

Scope

Although fuel considerations affect all aircraft, the group focused on FAR Part 121 and 135 operations, in keeping with its charter. However, the working group also reviewed FAR Parts 91, 125, and 129 to ensure that its recommendations were consistent with these parts of the FAR.

Conclusions

1. **Clarifying and documenting definitions, regulations, and responsibilities would provide helpful guidance for handling and resolving low-fuel situations.**

   This conclusion is supported by responses to the informal industry survey, the review of fuel-related accidents and incidents, and the opinions of organizations represented by working group members.

   The proposed draft AC describes fuel requirements, defines terms, presents guidance material for en route fuel management, and establishes procedures for pilots, aircraft dispatchers, and air traffic controllers to resolve low-fuel situations. The proposed AC would address the need, as indicated by survey respondents, for improved communication among pilots, controllers, and aircraft dispatchers during low-fuel situation.

2. **The majority opinion of the working group is that the current FAR Part 121 and Part 135 fuel supply regulations are adequate.**

Initially, all working group members agreed that the existing FAR Part 121 and Part 135 fuel supply regulations were adequate. This conclusion was derived from the review of the fuel-related accidents and incidents, which established that the majority of the problems resulted from improper inflight fuel management decisions, not from poor flight planning or from fuel supply regulations. The conclusion is also supported by the informal industry survey conducted in 1991. However, some working group members now feel that, if a similar survey were circulated after the publication of the AC, it would elicit a different response.

It is noted that the representatives of the major pilot groups recommend that the fuel requirements of FAR Part 121 be increased for specific operations. After initial acceptance of the position that the current rules were adequate, the Allied Pilots Association (APA) and the Air Line Pilots Association (ALPA) completed a more extensive evaluation of all the fuel supply regulations and now propose that the current reserve fuel required by FAR Part 121.645, for international operation of turbine powered airplanes (30 minutes reserve fuel plus 10 percent en route reserve fuel), be revised to be never less than that specified for FAR Part 121.639 (45 minute reserve fuel). Thus, domestic and international flights would both have a minimum reserve of 45 minutes. The pilot groups also note that substantial differences exist among parts of the FAR, and it may be necessary to rewrite the parts, in the future, to ensure consistency.

The other members of the working group respect the viewpoints and expertise of APA and ALPA and feel that their position should be allowed proper consideration and clarification during the industry's review of the proposed AC. Industry responses should be considered when determining whether the current fuel supply regulations should be revised.

Because of the extensive time required to revise regulations, the working group recommends that priority be given to implementing the fuel management policies in the AC. The working group believes that it would be inappropriate to delay the implementation of the AC because the procedures it recommends will increase safety throughout the aviation industry. The working group will make a recommendation to the Aviation Rulemaking Advisory Committee (ARAC) about revising fuel requirements after the AC has been reviewed and released.

3. **Adequate en route fuel management guidance for pilots is lacking.**

   This opinion was voiced by many respondents to the informal industry survey, and the position is consistent with NTSB and ASRS reports on the factors that contribute to accidents and incidents. The proposed AC contains guidance for en route fuel management.

Recommendations

The Fuel Requirements Working Group recommends that the FAA:

1. Issue the enclosed draft AC. The AC contains a description of preflight fuel planning requirements that applies to all FAR parts; fuel management principles for flight operation after departure; and low-fuel procedures for pilots, aircraft dispatchers, and air traffic controllers.

2. Incorporate the fuel planning and management procedures and the definitions of "minimum fuel," "emergency fuel," and "fuel remaining" into all appropriate FAA documents. (Appendix B contains the recommended definitions.) The appropriate documents include but are not limited to the Pilot/Controller Glossary, the Airman's Information Manual, The Controller's Handbook (FAA Order 7110.65), the General Aviation Operations Inspector's Handbook (FAA Order 8700.1), and the Air Transportation Operations Inspector's Handbook (FAA Order 8400.10). Updating these documents will ensure consistent application and presentation of the fuel requirements guidance introduced in the AC.

3. Review the responses received during public comment on the AC and the corresponding recommendations of the working group, when available, to determine whether the fuel supply regulations should be reexamined.

4. Establish a transponder code for the identification of aircraft in a minimum fuel condition.

5. Provide the final AC to the International Civil Aviation Organization (ICAO) and other aviation authorities with the recommendation that the procedures and definitions be incorporated into their governing documents.

6. Disseminate the AC to the widest possible audience of pilots, aircraft dispatchers, and air traffic controllers, including air carriers, Part 129 operators, aviation associations, and organizations.

7. Incorporate the concepts described in the AC into a training video for circulation to all of the parties mentioned in Recommendation 6.

Fuel Requirements Working Group Members

Industry Representatives

Patrick W. Clyne	Northwest Airlines
John H. Enders	Flight Safety Foundation (FSF)
Paul Engel	Allied Pilots Association (APA) (American Airlines)
Steven R. Farrow	Regional Airline Association (RAA) (Henson Aviation Inc.)
Robert W. Hall, Jr.	Air Line Pilots Association (ALPA)
Webster C. Heath	McDonnell Douglas
Norm Joseph	Professional Airline Flight Controllers Association (PAFCA)
Suzanne M. Lubin	International Airline Passengers Association (IAPA)
Al Meyer	Helicopter Association International (HAI) (Era Helicopters)
Donald H. Patterson	Boeing
Albert H. Prest	Air Transport Association of America (ATA)
Brad Rasmussen	Flight Dispatchers, Meteorologists and Operation Specialists Union (World Airways)
George W. Rigert	United Airlines
Richard Thiele	Department of Defense (USAF IFC)
Chris Witkowski	Aviation Consumer Action Project (ACAP)
Richard W. Xifo	National Air Transportation Association (NATA)

Federal Aviation Administration Representatives

David L. Catey	Air Transportation Division
Katherine Hakala	Air Transportation Division
Joseph C. Hart	Air Traffic Procedures Division
William H. Wallace	Air Transportation Division

Fuel Requirements Definitions

MINIMUM FUEL

Current Definition

Minimum Fuel — Indicates that an aircraft's fuel supply has reached a state where, upon reaching the destination, it can accept little or no delay. This is not an emergency situation but merely indicates an emergency situation is possible should any undue delay occur.

Recommended Definition

Minimum Fuel — A minimum fuel condition exists if: (1) The expected fuel on arrival, at the airport of intended landing, based on the flight's expected route to that point of landing, is less than 30 minutes* of flight calculated at 1500 feet above airport elevation, at holding airspeed until fuel exhaustion, with an allowance for established fuel quantity indicating system error; and (2) all available options to resolve a low fuel condition have been exhausted, and no further delay can be accepted.
*(Note: Military aircraft and VFR helicopters may use 20 minutes, as appropriate.)

EMERGENCY FUEL

Current Definition

There is no current definition.

Recommended Definition

Emergency Fuel — An emergency fuel condition exists when the expected fuel on arrival at the airport of intended landing, based on the normal route expected for the flight, is equal to or less than the amount of fuel required to execute a missed

approach, and another approach to landing based on the actual conditions at the airport. This should be no less than the fuel required to climb to 1500 feet, proceed downwind, and then to execute another approach and land from a point 10 miles from the end of the runway. All emergency fuel should include an allowance for established fuel quantity indicating system error.

FUEL REMAINING

Current Definition

Fuel Remaining — A phrase used by either pilots or controllers when relating to the fuel remaining on board until actual fuel exhaustion. When transmitting such information in response to either a controller question or pilot initiated cautionary advisory to air traffic control, pilots will state the approximate number of minutes the flight can continue with the fuel remaining. All reserve fuel should be included in the time stated, as should an allowance for established fuel gauge system error.

Recommended Definition

Fuel Remaining — A term that pilots or air traffic controllers use when referring to the usable fuel remaining on board until actual fuel exhaustion. When transmitting such information, in response to either a controller question or pilot initiated cautionary advisory to air traffic control, pilots should state the approximate number of minutes the flight can continue with the fuel remaining. All reserve fuel should be included in the time stated, as should an allowance for established fuel quantity indicating system error.

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

OCT 25 1993

DRAFT

Subject: FUEL PLANNING, AND MANAGEMENT
Date:
Initiated by:
AC No: 120-XX
Change:

1. PURPOSE. This advisory circular (AC) provides acceptable methods, but not the only methods, of effective fuel planning and management for air carrier flight operations conducted under Federal Aviation Regulations (FAR) Parts 121 and 135. This AC also provides fuel calculation methods and acceptable actions to be taken if a low fuel situation develops during flight operations. The AC emphasizes good planning and judgment as key to safe fuel management.

2. FOCUS. This AC applies primarily to domestic, flag, and supplemental air carrier operations and commercial operations conducted under FAR Part 121 and to on-demand air taxi and commuter operations conducted under FAR Part 135. The fuel management principles discussed in this AC can also be applied to operations conducted under FAR Parts 91, 125, and 129. Specific regulatory fuel requirements for FAR Parts 91, 121, 125, and 135 are included in Appendix 1.

3. RELATED FAR SECTIONS.

a. FAR Part 91.

(1) SFAR 29-4 Limited IFR Operations of Rotorcraft.

(2) FAR § 91.3 Responsibility and authority of the pilot in command.

(3) FAR § 91.103 Preflight action.

(4) FAR § 91.151 Fuel requirements for flight in VFR conditions.

(5) FAR § 91.153 VFR flight plan: Information required.

(6) FAR § 91.167 Fuel requirements for flight in IFR conditions.

FAA Form 1320-15 (4-82) Supersedes WA Form 1320-2

(7) FAR § 91.169 IFR flight plan: Information required.

b. <u>FAR Part 121</u>.

(1) FAR § 121.181 Transport category airplanes: Reciprocating engine powered: En route limitations: One engine inoperative.

(2) FAR § 121.183 Part 25 transport category airplanes with four or more engines: Reciprocating engine powered: En route limitations: Two engines inoperative.

(3) FAR § 121.193 Transport category airplanes: Turbine engine powered: En route limitations: Two engines inoperative.

(4) FAR § 121.329 Supplemental oxygen for sustenance: Turbine engine powered airplanes.

(5) FAR § 121.331 Supplemental oxygen requirements for pressurized cabin airplanes: Reciprocating engine powered airplanes.

(6) FAR § 121.333 Supplemental oxygen for emergency descent and for first aid; turbine engine powered airplanes with pressurized cabins.

(7) FAR § 121.533 Responsibility for operational control: Domestic air carriers.

(8) FAR § 121.535 Responsibility for operational control: Flag air carriers.

(9) FAR § 121.537 Responsibility for operational control: Supplemental air carriers and commercial operators.

(10) FAR § 121.557 Emergencies: Domestic and flag air carriers.

(11) FAR § 121.559 Emergencies: Supplemental air carriers and commercial operators.

(12) FAR § 121.601 Aircraft dispatcher information to pilot in command: Domestic and flag air carriers.

(13) FAR § 121.619 Alternate airport for destination: IFR or over-the-top: Domestic air carriers.

(14) FAR § 121.621 Alternate airport for destination: Flag air carriers.

(15) FAR § 121.623 Alternate airport for destination; IFR or over-the-top: Supplemental air carriers and commercial operators.

(16) FAR § 121.627 Continuing flight in unsafe conditions.

(17) FAR § 121.631 Original dispatch or flight release, redispatch or amendment of dispatch or flight release.

(18) FAR § 121.635 Dispatch to and from refueling or provisional airports: Domestic and flag air carriers.

(19) FAR § 121.639 Fuel supply: All operations: domestic air carriers.

(20) FAR § 121.641 Fuel supply: nonturbine and turbo-propeller-powered airplanes: Flag air carriers.

(21) FAR § 121.643 Fuel supply: Nonturbine and turbo-propeller-powered airplanes; supplemental air carriers and commercial operators.

(22) FAR § 121.645 Fuel supply: Turbine-engine powered airplanes, other than turbo-propeller; flag and supplemental air carriers and commercial operators.

(23) FAR § 121.647 Factors for computing fuel required.

c. FAR Part 125.

(1) FAR § 125.23 Rules applicable to operations subject to this part.

(2) FAR § 125.319 Emergencies.

(3) FAR § 125.367 Alternate airport for destination: IFR or over-the-top.

(4) FAR § 125.375 Fuel supply: Nonturbine and turbopropeller-powered airplanes.

(5) FAR § 125.377 Fuel supply: Turbine-engine-powered airplanes other than turbo-propeller.

d. FAR Part 135.

(1) FAR § 135.19 Emergency operations.

(2) FAR § 135.209 VFR: Fuel supply.

(3) FAR § 135.223. IFR: Alternate airport requirements.

4. RELATED READING MATERIAL.

a. AC 120-42, Extended Range Operation With Two-Engine Airplanes (ETOPS) (12-30-88) (AFS-210).

b. National Transportation Safety Board (NTSB) Aircraft Accident Report PB91-910404.

c. NTSB Accident Report NTISUB/E/104-007.

d. NTSB Accident Report PB-199806.

e. NTSB Accident Report PB85-910408.

f. NTSB Accident Report LAX88LA051.

g. FAA Order 8400.10, Vol. 3, Sections 2, 3, 4, and 5;

h. Air Carrier Operations Specifications

5. BACKGROUND.

a. Avianca Airlines flight 052 departed Bogota, Colombia on January 25, 1990, on an international flight to John F. Kennedy International Airport with an intermediate stop in Medellin, Colombia. At approximately 9:30 p.m. Eastern Standard Time, the Boeing 707-321B crashed in a residential area while attempting its second approach to land. Of the 158 passengers on board, 73 were fatally injured. Although Avianca Airlines flight 052 was conducted under FAR Part 129, an examination of the chain of events leading to the crash provides useful lessons for operations conducted under FAR Parts 91, 121, 125, and 135.

b. Poor weather in the northeast United States had caused air traffic control (ATC) to place Avianca flight 052 in holding patterns three times for a total of approximately 1 hour and 17 minutes. During the third period of holding, the crew reported that the airplane was running out of fuel, could not reach its alternate destination (Boston-Logan International Airport), and could only hold for 5 minutes. After missing the first approach, the aircraft received vectors for a second attempt. While turning inbound to the airport, the aircraft exhausted its fuel supply, lost power to all four engines, and crashed approximately 16 miles from the airport.

c. The National Transportation Safety Board (NTSB) determined that the probable cause of this accident was the flight crew's failure to adequately manage the airplane's fuel load and communicate the emergency fuel situation to air traffic

controllers prior to fuel exhaustion. The NTSB report also cited the following contributing factors:

(1) The flight crew's failure to use an airline operational control dispatch system while conducting an international flight into a congested airport during poor weather.

(2) Lack of standardized terms for use by flight crewmembers and controllers to communicate minimum and emergency fuel conditions.

d. NTSB records for FAR Part 121 and 135 operations indicate that between 1965 and 1989 there have been 30 air carrier accidents that were the result of fuel exhaustion. These accidents had the following contributing factors in common:

(1) Improper inflight fuel management decisions,

(2) Miscalculated fuel consumption,

(3) Mismanagement of fuel.

e. The Fuel Requirements Working Group under the Aviation Rulemaking Advisory Committee analyzed 110 fuel-related Aviation Safety Reporting System reports from the period 1986 to 1991, and NTSB data from the 30 fuel-related accidents. The group also solicited comments from domestic and foreign air carriers, aircraft dispatcher groups, and pilot groups. An analysis of these responses and the accident data indicates the need for:

(1) An explanation of FAR fuel requirements and terminology,

(2) Clarification of the responsibilities of pilots, aircraft dispatchers, and air traffic controllers,

(3) Additional guidance on fuel management principles,

(4) Acceptable procedures to be followed in low fuel situations.

6. INTRODUCTION TO FUEL MANAGEMENT.

a. Safe flight operations are dependent on thorough preflight planning. This planning should include compliance with regulatory requirements; a comprehensive evaluation of the weather and air traffic conditions; the airport conditions at the departure, destination, and alternate airports; and the mechanical condition of the aircraft. The information gained during planning is used to determine the quantity of fuel necessary for the flight.

b. Once preflight planning has been completed, the necessary fuel has been loaded, and the flight has departed, it is the responsibility of the pilot and the aircraft dispatcher to monitor the fuel on board as the aircraft proceeds toward its destination and to confirm that sufficient fuel remains to complete the flight safely.

NOTE: All references to aircraft dispatchers are applicable only to FAR Part 121 domestic and flag operations.

c. Even with proper preflight planning and en route fuel management, the flight crew may encounter circumstances (e.g., unanticipated air traffic, airport closings, aircraft routing, and wind and weather conditions) that cause the fuel used to exceed planned quantities. If this occurs, the pilot and/or the aircraft dispatcher should act to prevent the flight from operating in a low fuel condition.

7. FUEL MANAGEMENT - PREFLIGHT PLANNING

a. Preflight fuel planning includes compliance with the regulatory requirements. Federal Aviation Regulations specify the minimum fuel requirements for operations conducted under FAR Parts 91, 121, 125, and 135. FAR Part 121 specifies minimum fuel requirements for domestic, flag, and supplemental air carrier operators and commercial operators. FAR Part 121 further specifies the requirements for engine type and geographic area in which operations are conducted. FAR Part 135 fuel requirements are specified for type of aircraft, day versus night operation, and whether the operation is conducted under Visual Flight Rules (VFR) or Instrument Flight Rules (IFR) conditions. Air Carrier Operation Specifications may further define fuel requirements. A detailed description of regulatory fuel requirements, by operating part, is contained in Appendix 1 of this AC and in the set of charts entitled Summary of FAR Fuel Requirements.

PREFLIGHT PLANNING

TAXI

EN ROUTE (takeoff to landing)

ADDITIONAL

- ALTERNATE
- RESERVE
- EN ROUTE RESERVE
- OTHER REQUIRED
- CONTINGENCY

NOTE: Because the FAR is subject to revision, operators using this AC should consult the most current edition of the FAR, to verify that the FAR references are not obsolete.

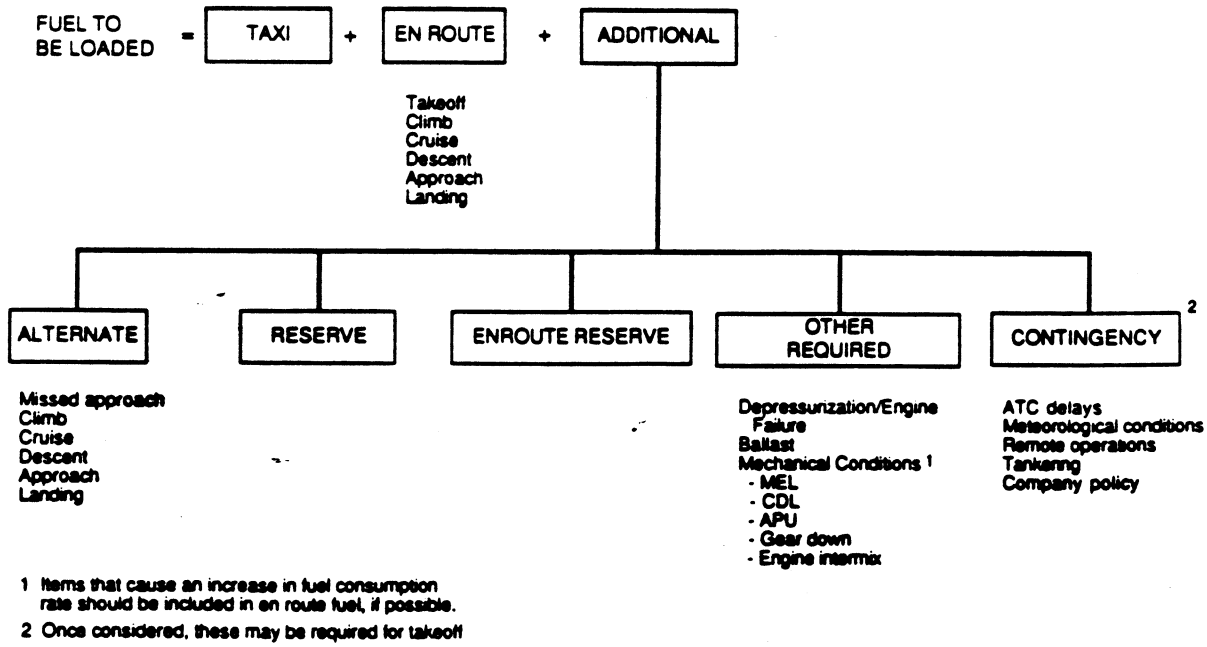
b. Preflight fuel planning should account for the fuel needed to position the aircraft for takeoff, to fly to the destination along the planned route, and additional fuel. This additional amount of fuel includes alternate fuel, reserve fuel, en route reserve, other required fuel, and contingency fuel. It allows continued operation of the aircraft in the event of either anticipated or unanticipated circumstances. The different fuel considerations are illustrated in Figure 1 and are listed below:

NOTE: All required fuel is in addition to unusable fuel.

(1) Taxi Fuel. The fuel necessary to position the aircraft for takeoff. When determining this quantity, consideration should be given to any known or anticipated delays that the aircraft may encounter while taxiing to the runway.

(2) En Route Fuel. The fuel necessary for takeoff, climb, cruise, descent, approach, and landing at the destination. Calculations should include allowances for the expected wind and weather conditions forecast for the flight and aircraft-specific fuel consumption rates. This quantity should allow for any known or expected air traffic routings, standard instrument departures, or arrival procedures. Fuel sufficient to conduct an instrument approach at the destination should be included, if appropriate.

FIGURE 1. FUEL PLANNING



1 Items that cause an increase in fuel consumption rate should be included in en route fuel, if possible.

2 Once considered, these may be required for takeoff

(3) Alternate Fuel. The fuel necessary to fly from the destination to an alternate airport(s). An alternate may be specified because of regulatory requirements or other operational considerations. The calculation of the alternate fuel amount begins at the missed approach point at the destination and includes climb, cruise, descent, approach, and landing at the alternate airport. The amount of alternate fuel should be based on normal air traffic routing and procedures, and forecast meteorological conditions. For flights for which an alternate is not specified, the operator should consider the need to provide fuel for a missed approach at the destination.

(4) Reserve Fuel. The fuel that allows continued operation after arriving over the alternate airport, or the destination if no alternate is specified. The FAR specifies, by type of operation, both the time that an aircraft should be able to remain in flight, and the fuel consumption rate at which the reserve fuel should be calculated. (See Appendix 1 for specific regulatory requirements.) The fuel consumption rate is calculated based on one of the following:

(i) The holding speed at 1500 feet above the alternate or destination airport at standard temperature conditions,

(ii) The normal cruising fuel consumption. Acceptable methods of calculating normal cruising fuel consumption include using the average fuel flow rate, representative of the operator's use of the aircraft type; or using the fuel consumption rate attained at the end of the alternate or en route flight segment, or

(iii) The normal cruising speed. Normal Cruising speed is a specific speed schedule selected by the operator.

(5) En Route Reserve. Additional fuel that is calculated as a percentage of the en route flight time to the airport of intended landing on certain international flights. The purpose of en route reserve is to allow for variations in operational conditions that may result in a higher fuel usage than planned. For example, FAR §§ 121.645(b)(2) and 125.377(b)(2) specify that an additional fuel amount be calculated using 10 percent of the en route flight time. The operator may use any reasonable method, appropriate to the operation, to determine this fuel quantity. An acceptable method of calculation is to use the fuel consumption rate at the end of the en route segment to determine this amount. (En route reserve requirements may be amended by Operations Specifications paragraphs B43 or B44. Redispatch/rerelease procedures that reduce the en route reserve amount are discussed in paragraph 7c. Special fuel reserves for international operations are discussed in paragraph 7d.)

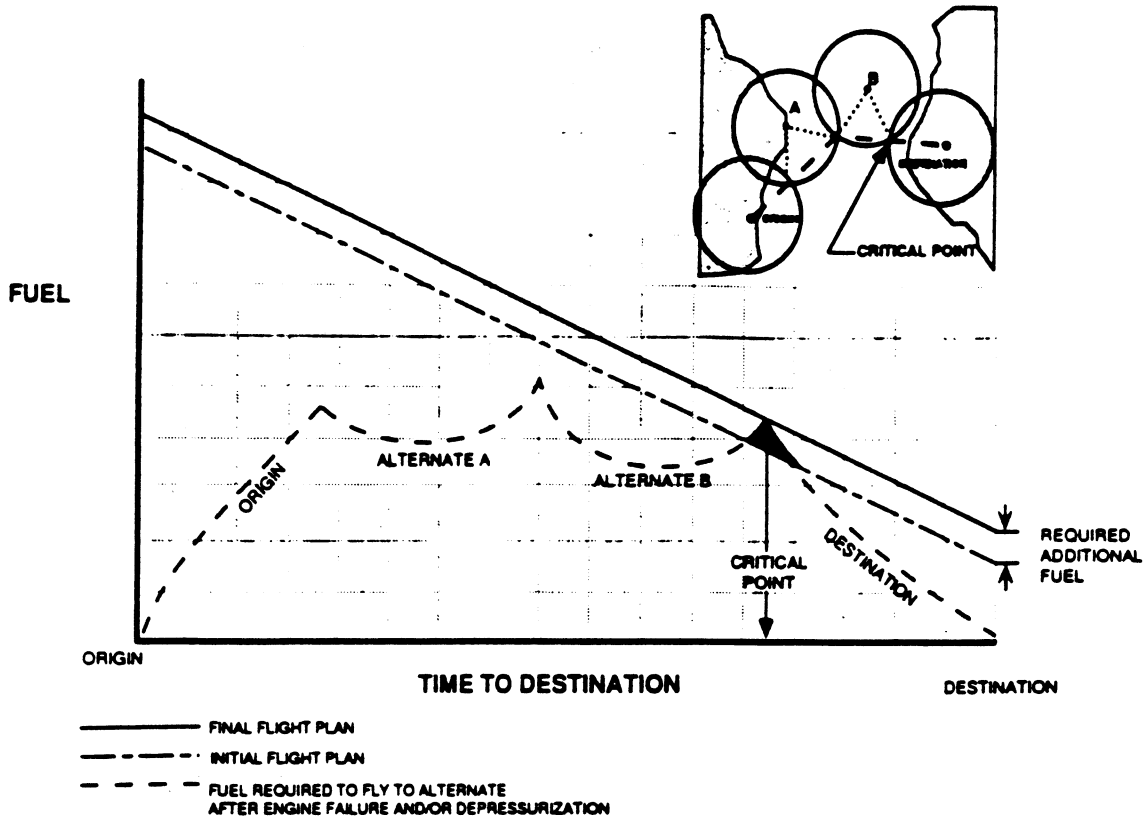
(6) Other Fuel Required for Takeoff. Other types of fuel required for takeoff include the following:

(i) Fuel for Aircraft Mechanical Conditions. Fuel planning should consider other conditions that increase fuel consumption or require that additional fuel be carried. Examples include Minimum Equipment List (MEL) and Configuration Deviation List limitations, fuel for auxiliary power unit operation, engine inter-mix configurations, flights conducted with the landing gear extended and other abnormal operations. Increased fuel consumption should either be included in the en route fuel calculation or specified as Other Fuel Required for Takeoff.

(ii) Fuel for Engine Failure or Depressurization. The FAR prescribes performance operating limitations that affect fuel requirements and should be considered during flight planning. Flight plans should include an allowance for the possibility of the failure of one or more engines and/or the loss of cabin pressurization. An aircraft should have sufficient fuel at the most critical en route point to divert to and land at an airport. During flight planning, it is necessary to compare the fuel necessary to fly to the designated en route alternate at every point along the flight path with the amount of fuel expected to be on board at each point along the route as illustrated in Figure 2. If the fuel expected to be on board at the critical point is not sufficient, additional fuel to complete the diversion should be carried.

(A) Figure 2 illustrates a flight planned from New York's John F. Kennedy Airport to London's Gatwick Airport. An initial flight plan is calculated that includes en route fuel, alternate fuel, and reserve fuel. Gander, Newfoundland (point A in Figure 2) and Keflavik, Iceland (point B in Figure 2) are selected as suitable en route alternate airports. Next, a calculation is performed to determine if at the flight's most critical point the aircraft would have sufficient fuel to reach either of the two planned en route alternates in the event of an engine failure or loss of cabin pressurization. In this example, the initial flight plan diagonal illustrates that at the most critical point between Keflavik and London the aircraft would not have enough fuel to reach either airport. Therefore, a new flight plan that includes the additional fuel necessary to divert and land safely from the most critical point would have to be computed. This added fuel would then be considered required fuel for takeoff and is illustrated by the final flight plan diagonal.

FIGURE 2. CRITICAL FUEL ANALYSIS



NOTE: A detailed description of the requirements for calculation of the fuel for two-engine aircraft that operate more than 60 minutes from a suitable airport is defined in AC 120-42.

(iii) Fuel for Ballast. Fuel carried to comply with aircraft specific weight and balance requirements. This fuel should be considered unusable fuel.

(7) Contingency Fuel. The FAR requires that consideration be given to any other condition that may delay the landing of the aircraft. These conditions include meteorological conditions, air traffic delays, and deviations from the planned flight route that could increase the amount of fuel consumed.

(i) Factors that may influence the decision to add fuel may include equipment limitations, pilot qualifications, carrier operating experience, company policy, and weather. Additional fuel may not be necessary for expected conditions if an alternative course of action that ensures the safe completion of the flight is available. Additional fuel may be considered for operations into airports with single runways, or into areas of the world in which weather information, airport information, communications, or air traffic services may be limited.

(ii) Operators may also plan to carry additional fuel because of the availability or price of fuel, or company operating policies.

c. Redispatch/Rerelease Procedures.

(1) FAR § 121.631(c) permits the planned redispatch (PRD) of flag air carrier flights and the planned rerelease (PRR) of supplemental air carrier flights. This procedure reduces the en route reserve fuel requirement. These operations are conducted in accordance with Paragraph B44 of the Air Carrier Operation Specifications. Using PRD/PRR, two destinations are identified: 1) the intended destination, and 2) an intermediate destination. The flight is planned and released to the intermediate destination, with the expectation that the flight will be rereleased or redispatched to the intended destination while en route. Prior to reaching the predetermined PRD/PRR point, the pilot and aircraft dispatcher review the en route and destination weather and recalculate the time and fuel required to reach the intended destination. The en route reserve fuel amount required at the PRD/PRR point is based on the en route time from the PRD/PRR point to the destination. When this procedure is used, the requirements applied to an original release, with the exception of the MEL, are met at the time of redispatch or rerelease.

(2) If the fuel on board permits, the flight may be redispatched or rereleased to the intended destination no more than 120 minutes prior to reaching the PRD/PRR point.

d. Special Fuel Reserves in International Operations. Fuel supplies required by B43 of the Air Carrier Operation Specifications are essentially the same as those required for domestic operations. Operations conducted in accordance with B43 require that additional international fuel supplies be loaded on board the airplane when a portion of the route requires use of a long-range navigation system or flight navigator, i.e. the aircraft position cannot be reliably fixed by ICAO standard NAVAIDs. The additional fuel must be equal to the amount of fuel required to fly for a period of 10 percent of the time it takes to fly that portion of the route where a long-range navigation system or flight navigator is required.

8. FUEL MANAGEMENT - EN ROUTE OPERATION.

a. En route fuel management begins when the pilot verifies that all necessary fuel is boarded. Fuel management continues when, prior to beginning the takeoff roll, the pilot verifies that the fuel on board meets or exceeds the amount required to fly to the destination, then to the alternate (if specified), plus applicable reserve amounts and any additional fuel agreed to by the pilot and aircraft dispatcher.

b. Proper fuel management depends on constant awareness of the expected fuel on arrival (EFOA) at the airport of intended landing. The EFOA is equal to the total fuel on board minus the planned fuel consumption from the aircraft's current position to the airport of intended landing. The pilot and aircraft dispatcher should monitor the EFOA during the flight. Whenever the actual conditions of the flight differ from those anticipated when the flight was planned, the pilot and the aircraft dispatcher should recalculate the EFOA and verify that the flight will arrive at the airport of intended landing with reserve and alternate fuel intact.

FUEL MANAGEMENT PRINCIPLE

Pilots and aircraft dispatchers must maintain awareness of expected fuel on arrival

Fuel on board
– Planned fuel consumption
= Expected fuel on arrival

c. All flights should be *planned* to land with reserve fuel intact. The purpose of reserve fuel is to allow continued operation if unanticipated delays or circumstances are encountered. This fuel provides an additional margin of safety that is designed to prevent fuel exhaustion. Pilots should be prepared to make fuel management decisions regarding when, and under what circumstances, reserve fuel can be used. Reserve fuel should only be used to complete the flight after all other alternative actions have been taken. Use of reserve fuel is at the pilot's discretion, provided that the flight can be completed safely. Use of reserve fuel does not, in itself, make completion of the flight unsafe.

FUEL MANAGEMENT PRINCIPLE

Reserve Fuel:

- Pilots should always plan to carry reserve fuel to the alternate airport.
- Reserve fuel may be used while en route if, in the opinion of the pilot, the flight can be completed safely.

d. If it becomes apparent that the flight cannot be completed as currently planned, the pilot and the aircraft dispatcher should initiate an alternative course of action. The decision to execute a new plan of action should be made no later than when the EFOA at the airport of intended landing is equal to reserve plus alternate fuel (if applicable). The following options are available:

(1) Change the planned route of flight, the flight level, or the cruise speed to reduce the fuel consumed en route to the airport of intended landing.

(2) Select a different alternate airport that requires less fuel to reach than the one originally specified.

(3) Delete the alternate if no longer required.

(4) Change the airport of intended landing if none of the above alternatives is feasible.

FUEL MANAGEMENT PRINCIPLE

Recalculate EFOA

- **Periodically during flight**
- **When plan is altered**
  - **Altitude**
  - **Routing**
  - **Weather**
  - **Delays**
  - **Mechanical condition**

e. In order to avoid operating in a low fuel condition, it is imperative that the pilot and aircraft dispatcher make decisions in a timely manner concerning alternative courses of action. It is important to maintain communication between the pilot and the aircraft dispatcher.

9. LOW FUEL CONSIDERATIONS. Proper flight planning and appropriate fuel management procedures should ensure that all flights arrive at the airport of intended landing with reserve fuel remaining. When no alternatives remain that can reduce the fuel required to reach the airport of intended landing, subsequent events may cause the EFOA to decrease to unacceptable levels. This section describes the fuel management procedures that pilots, aircraft dispatchers, and air traffic controllers should follow when a low fuel condition develops. Procedures for low fuel operation assume that the aircraft is flying to the closest suitable airport, and that no alternative airports or procedures are available to the pilot. These procedures also assume that the EFOA is based on the normal routing to be flown.

NOTE: See Appendix 2 - Fuel Management—Low Fuel diagram

a. Minimum Fuel Condition.

(1) A minimum fuel condition exists if:

(i) EFOA at the airport of intended landing, based on the flight's expected route to that point of landing, is less than 30 minutes* of flight, calculated at 1500 feet above airport elevation, at holding airspeed, until fuel exhaustion, with an allowance for established fuel quantity indicating system error; and

(ii) All available options to resolve a low fuel condition (see paragraph 8d, (1)-(4)) have been exhausted, and no further delay can be accepted.

* NOTE: Military aircraft and VFR helicopters may use 20 minutes, as appropriate.

(2) A minimum fuel condition requires that the aircraft proceed to the airport with no further delays or deviations from its planned route of flight. The planned route includes normal arrival procedures plus any delays in routing known at the time the minimum fuel condition is declared to ATC. At this point, priority handling is not required or requested, but air traffic controllers are expected to advise the pilot of any unusual circumstances or occurrences that may further extend the aircraft's flight time to the airport of intended landing, holding, additional delay vectors for weather, spacing for traffic, or speed restrictions. Air traffic controllers should be aware that a declaration of "emergency fuel" may be forthcoming if the pilot encounters any further delays.

LOW FUEL CONDITIONS

Minimum Fuel

A minimum fuel condition exists when the EFOA *IS LESS THAN* 30 minutes of flying time to fuel exhaustion:

- Calculated at 1500 feet AGL and holding air speed
- Plus an allowance for fuel quantity indicating system error

In all cases, the Minimum Fuel declaration should be made in sufficient time to prevent the development of an emergency fuel condition.

(3) When a minimum fuel condition develops, the pilot should:

(i) Declare "MINIMUM FUEL" to ATC,

(ii) State the usable fuel remaining in minutes,

(iii) Continue along ATC cleared routing. ATC may continue to assign normal arrival routings,

(iv) Notify the aircraft dispatcher that a minimum fuel declaration has been made,

(v) Report present position and time to destination (VFR or nonradar environment operations).

NOTE: "Fuel remaining" is a term that pilots or air traffic controllers use when referring to the usable fuel remaining on board until actual fuel exhaustion. When transmitting such information, in response to either a controller question or pilot initiated cautionary advisory to air traffic control, pilots should state the approximate number of minutes the flight can continue with the fuel remaining. All reserve

fuel should be included in the time stated, as should an allowance for established fuel quantity indicating system error (see the Pilot/Controller Glossary).

(4) When a minimum fuel condition exists, the aircraft dispatcher should contact the appropriate ATC facility to ensure that communication and coordination among the pilot, aircraft dispatcher, and ATC continues until the flight has landed safely.

(5) When a minimum fuel condition exists the air traffic controller should:

(i) Relay this information to the facility to whom control jurisdiction is transferred,

(ii) Be alert for any occurrence that might delay the aircraft,

(iii) Advise the pilot of any unusual circumstances or occurrences that may further extend the aircraft's flight time to the airport of intended landing,

(iv) Be aware that a declaration of "emergency fuel" may be forthcoming if the pilot encounters any further delays.

(6) The following example illustrates a situation in which a minimum fuel declaration is made. All other options (see paragraph 8d, (1)-(4)) have been exhausted prior to making the declaration:

(i) The pilot of Airworthy Flight 123, on an IFR flight plan, determines that the flight time to XYZ is 19 minutes and that the EFOA will be equivalent to 29 minutes. The radio transmission used is "Zulu Approach, Airworthy 123 declaring minimum fuel. I have four eight minutes fuel remaining."

(7) The minimum fuel value used in this AC is based on a review of regulatory fuel amounts, and recognizes that some reserve fuel can be used without compromising safety. In some operations it may be appropriate to take action at a higher minimum fuel value. Early communication of a low fuel state may help to prevent a minimum fuel declaration. The minimum fuel declaration should be made in sufficient time to prevent the development of an emergency condition.

b. Emergency Fuel Condition.

(1) If the EFOA continues to decrease, an emergency fuel condition may develop. An emergency fuel condition exists when the EFOA at the airport of intended landing, based on the normal route expected for the flight, is equal to or less than

the amount of fuel required to execute a missed approach, and another approach to landing based on the actual conditions at the airport. This should be no less than the fuel required to climb to 1500 feet, proceed downwind, and then execute another approach and land from a point 10 miles from the end of the runway. All emergency fuel should include an allowance for established fuel quantity indicating system error.

> LOW FUEL CONDITIONS
>
> **Emergency Fuel**
>
> An emergency fuel condition exists when the EFOA *IS LESS THAN* the amount of fuel required to:
>
> - Execute a missed approach
> - Climb to 1500 feet
> - Proceed downwind
> - Execute a 10-mile final approach to landing
> - Plus an allowance for fuel quantity indicating system error.

(2) When an emergency fuel condition exists, the pilot should:

(i) Declare an emergency to ATC,

(ii) State the usable fuel remaining in minutes,

(iii) Ask for and receive priority handling from ATC,

(iv) Proceed directly to the airport,

(v) Advise the aircraft dispatcher of the emergency condition, if time permits.

(3) When an emergency fuel condition exists, the aircraft dispatcher should:

(i) Provide any assistance requested by the pilot.

(ii) Ensure that ALL appropriate ATC facilities are advised of the emergency.

(iii) Ensure that the airport of intended landing is advised of the emergency.

(iv) Ensure that all appropriate emergency procedures and notifications are initiated.

(v) Record the emergency and related circumstances.

(4) When an emergency fuel condition exists the air traffic controller should:

(i) Provide priority handling directly to the airport of intended landing,

(ii) Advise the pilot of any circumstances or occurrences that may further extend the aircraft's flight time to the airport of intended landing,

(iii) Relay this information to the facility to which control jurisdiction is transferred.

(5) It is imperative that pilots and aircraft dispatchers be aware of the fuel quantities that constitute minimum fuel and emergency fuel, respectively. To improve awareness, some operators calculate these values for each flight, and provide this information with the flight dispatch documents.

10. FUEL MANAGEMENT EXAMPLE. The following example depicts a situation in which fuel calculations are necessary en route, and illustrates when an alternative plan becomes imperative.

An air carrier flight is operating under FAR Part 121 domestic regulations from Cleveland Hopkins Airport (CLE) to Washington National Airport (DCA). Pittsburgh International Airport (PIT) is specified as the alternate airport for the flight.

Before the flight, the pilot and aircraft dispatcher review all factors that may affect the flight to determine if the flight can be completed safely. During this preflight planning process they calculate the taxi, en route, alternate, and 45 minute reserve fuel amounts, and then add 30 minutes of contingency fuel that can be used to absorb any delays that might be encountered while en route. Before engine start, the pilot determines that all requested fuel has been loaded. After completing preflight duties and taxiing to the departure runway, the pilot confirms that there is sufficient fuel on board to fly to DCA, then to the alternate airport (PIT), and then to fly for an additional 45 minutes after reaching the alternate. The flight is still carrying an additional 30 minutes of contingency fuel.

The flight departs CLE. After climbing to the cruising altitude, the pilot calculates the EFOA and determines that it will be the same as when the flight was planned. While en route, the flight receives a clearance from ATC to hold at Morgantown VOR for 20 minutes. Using this information, the pilot and the aircraft dispatcher, recalculate the EFOA at DCA and determine that after the holding is complete, the flight can proceed to DCA and arrive with 10 minutes of contingency fuel, as well as sufficient fuel to fly to the alternate airport (PIT), and then fly for an additional 45 minutes.

NOTE: It is a good fuel management practice to calculate the EFOA after departure and again after receiving notice of a

delay. This ensures that there will be enough fuel remaining at the completion of the hold to fly to the airport of intended landing without using the alternate or reserve fuel. If there is insufficient fuel on board, the pilot and aircraft dispatcher should consider other available options for the flight.

After holding at Morgantown for 20 minutes, the flight receives clearance to proceed toward its destination. ATC advises the pilot that flights into DCA can expect further delays. The pilot and the aircraft dispatcher review the weather in the Washington area and determine that based on the weather forecast, Dulles International Airport (IAD), is available as an alternate airport. After changing the alternate to an airport that is closer to the intended destination, they recalculate the EFOA at DCA. The flight has sufficient fuel to fly to DCA, hold in the DCA area for 25 minutes, fly to the alternate airport (IAD), and then fly for an additional 45 minutes.

NOTE: It is a good fuel management practice to consider options that improve the EFOA at the destination. In this example, the alternate has been changed to an airport closer to the destination. This reduces the alternate fuel required, which increases the available contingency fuel.

As the flight proceeds to DCA, it experiences additional holding and receives a series of delaying vectors from ATC. The EFOA is again recalculated. In addition to alternate and reserve fuel, five minutes of contingency fuel remains. Approach control advises the flight that the approach to DCA will take the flight on an extended downwind leg and that additional holding is a possibility. The pilot confers with the aircraft dispatcher and they agree that the flight should divert to the alternate airport.

NOTE: It is a good fuel management practice to recalculate EFOA every time the flight encounters a delay or deviates from the flight plan. The pilot and the aircraft dispatcher should also consider changing the flight destination whenever circumstances develop that may cause the flight to consume reserve fuel. In this case the destination has been changed to the alternate airport so that the flight will arrive at IAD with 45 minutes of reserve fuel remaining.

As the flight proceeds toward IAD, ATC informs the pilot that it will be necessary to fly an extended arrival route because many other aircraft are also diverting to that airport. ATC advises the pilot to expect vectors around the airport before entering a 15-mile final approach. The pilot estimates that the time required to fly to IAD, based on the expected route, will be

NOTE: On this approach, an unexpected go-around will cause the flight to consume additional fuel. The pilot knows that the new EFOA will be unacceptably low, so the flight should return to the airport with no delay. The pilot declares an emergency and begins to fly the most direct route to the airport, and lands on the closest suitable runway.

In this example, the pilot has demonstrated proper fuel management on a flight that experienced numerous unexpected delays. After each delay the EFOA was recalculated and evaluated. The pilot and aircraft dispatcher made timely and appropriate decisions to change the alternate airport and destination, to ensure that the flight would arrive at the alternate (IAD) with 45 minutes of reserve fuel remaining. After experiencing additional delays while diverting to the alternate airport, the pilot declared that a minimum fuel condition existed. Finally, after executing the go-around, the pilot declared a fuel emergency and flew the most direct route to a safe landing.

Each of the decisions made by the pilot and the aircraft dispatcher was based on the EFOA that was recalculated every time the flight encountered a delay. The pilot and the aircraft dispatcher made each decision without delay, when the information indicated that the EFOA had decreased to inappropriately low levels. This enabled the pilot to manage the flight with the knowledge that the aircraft would always have sufficient fuel on board to complete the flight safely.

APPENDIX 1. QUICK REFERENCE GUIDE

1. FAR PART 121 DOMESTIC OPERATIONS.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight dispatch or in a section of the flight dispatch called taxi fuel.

b. En route fuel. FAR §§ 121.639(a) and 121.647(a) and (c). The fuel required for the flight to reach the airport to which it is dispatched and execute one instrument approach [and land].

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.619(a).) FAR §§ 121.639(b) and 121.647(a) and (c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight dispatch, execute an approach, and land.

(2) Reserve Fuel. FAR § 121.639(c). The fuel required for the aircraft to continue flight for 45 minutes at normal cruising fuel consumption.

(3) En Route Reserve. Not Applicable. (N/A).

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

2. FAR PART 121 FLAG OPERATIONS — NONTURBINE AND TURBO-PROP AIRPLANES.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight dispatch or in a section of the flight dispatch called taxi fuel.

b. En Route Fuel. FAR §§ 121.641(a)(1) and 121.647(c). The fuel required for the flight to reach the airport to which it is dispatched and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.621(a)(1).) FAR §§ 121.641(a)(2) and 121.647(c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight dispatch, execute an approach, and land.

(2) Reserve Fuel.

(i) With Available Alternate. FAR § 121.641(a)(3). The fuel required to fly for 30 minutes plus 15 percent of the total time required to fly at normal cruising fuel consumption to the airport of intended landing and the most distant alternate specified on the dispatch release, or to fly for 90 minutes at normal cruising fuel consumption, whichever is less.

(ii) Without Available Alternate. FAR §§ 121.621(a)(2) and 121.641(b). If no alternate is available there must be enough fuel to fly to the airport of intended landing, considering wind and weather, to execute an approach, and then fly for 3 hours at normal cruising fuel consumption.

(3) En Route Reserve. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

3. FAR PART 121 FLAG OPERATIONS — TURBINE-POWERED AIRPLANES (OTHER THAN TURBO-PROPELLER) WITHIN THE CONTIGUOUS UNITED STATES AND DISTRICT OF COLUMBIA. In accordance with FAR § 121.645(a), flag operations using turbine-engine-powered (other than turbo-propeller) airplanes operated within the 48 contiguous States and District of Columbia may use the fuel requirements for domestic air carriers found in FAR § 121.639. These are:

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight dispatch or in a section of the flight dispatch called taxi fuel.

b. En Route Fuel. FAR §§ 121.639(a) and 121.647(a) and (c). The fuel required for the flight to reach the airport to which it is dispatched and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.621(a)(1).) FAR §§ 121.639(b) and 121.647(a) and (c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight dispatch, execute an approach, and land.

(2) Reserve Fuel. FAR § 121.639(c). The fuel required for the aircraft to continue flight for 45 minutes at normal cruising fuel consumption.

(3) En Route Reserve Fuel. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

4. FAR PART 121 FLAG OPERATIONS — TURBINE-POWERED AIRPLANES (OTHER THAN TURBO-PROPELLER) OUTSIDE THE CONTIGUOUS UNITED STATES AND DISTRICT OF COLUMBIA.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight dispatch or in a section of the flight dispatch called taxi fuel.

b. En Route Fuel. FAR §§ 121.645(b)(1) and 121.647(c). The fuel required for the flight to reach the airport to which it is dispatched and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.621(a)(1).) FAR §§ 121.645(b)(3) and 121.647(c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight dispatch, execute an approach, and land.

(2) Reserve Fuel.

(i) FAR § 121.645(b)(4). The fuel necessary to fly for 30 minutes at holding speed at 1,500 feet above the alternate airport (or the airport of intended landing if no alternate is required by § 121.621(a)(1)) under standard temperature conditions.

(ii) (Without Available Alternate.) FAR §§ 121.621(a)(2) and 121.645(c). If no alternate airport is available, the aircraft must carry enough fuel to fly to its destination and thereafter to fly for at least 2 hours at normal cruising fuel consumption.

(3) En Route Reserve. FAR § 121.645(b)(2). The fuel needed to fly for a period of 10 percent of the total time required to fly from the airport of departure to the airport to which it is dispatched, and land.

(i) Planned redispatch for flag operations.

(A) FAR § 121.631(c) permits the planned redispatch (PRD) of flag air carrier flights. These operations are conducted in accordance with paragraph B44 of the Air Carrier Operation Specifications. Using this procedure, two destinations are identified, the intended destination and a declared intermediate destination. PRD is conducted by dividing the flight into two segments, the segment from the point of origin to the declared intermediate destination via a redispatch point, and the segment from the redispatch point to the airport of intended landing.

(B) The flight crew and aircraft dispatcher review weather, fuel status, and other conditions no more than 120 minutes before reaching the PRD point. If the flight has progressed as planned and no unexpected events have occurred that unfavorably affect fuel usage, then the original fuel load should be sufficient to provide flight fuel plus the required 10 percent en route reserve from the PRD point to the airport of intended landing. After making this determination the flight may be redispatched.

(ii) Special fuel reserves in international operations. Fuel supplies required by B43 of the operations specifications are essentially the same as those required for domestic operations. However, when a portion of the route requires use of a long-range navigation system or flight navigator (aircraft position cannot be reliably fixed by ICAO standard NAVAIDs), additional international fuel supplies must be loaded on board the airplane. The additional fuel must be equal to the amount of fuel required to fly for a period of 10 percent of the time it takes to fly that portion of the route where a long-range navigation system or flight navigator is required.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

5. FAR PART 121 SUPPLEMENTAL AND COMMERCIAL OPERATORS. OPERATIONS WITHIN THE 48 CONTIGUOUS STATES AND DISTRICT OF COLUMBIA: NON-TURBINE AND TURBOPROPELLER POWERED AIRCRAFT.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR §§ 121.643(a)(1) and 121.647(c). The fuel required for the flight to reach the airport to which it is released and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.623.) FAR §§ 121.643(a)(2), and 121.647(c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release, execute an approach, and land.

(2) Reserve Fuel. FAR § 121.643(a)(3). The amount of fuel required to fly for 45 minutes at normal cruising fuel consumption.

(3) En Route Reserve. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

6. FAR PART 121 SUPPLEMENTAL AND COMMERCIAL OPERATIONS OUTSIDE OF THE 48 CONTIGUOUS UNITED STATES AND THE DISTRICT OF COLUMBIA: NON-TURBINE AND TURBO-PROP AIRCRAFT.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR § 121.643(a)(1) and (b) and FAR § 121.647(c). The fuel required for the flight to reach the airport to which it is released and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.623.) FAR § 121.643(a)(2), and FAR § 121.647(c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release, execute an approach, and land.

(2) Reserve Fuel:

(i) FAR § 121.643(b). The fuel required to fly for 30 minutes plus 15 percent of the total time required to fly at normal cruising fuel consumption to the airport of intended landing and the most distant alternate airport, or to fly for 90 minutes at normal cruising fuel consumption, whichever is less.

(ii) (Without Available Alternate.) FAR §§ 121.623(b) and 121.643(c). If there is no available alternate airport, the aircraft must have enough fuel, considering wind and other weather conditions, to fly to the airport of intended landing and then to fly for 3 hours at normal fuel consumption.

(3) En Route Reserve Fuel. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

7. FAR PART 121 SUPPLEMENTAL AND COMMERCIAL OPERATORS. OPERATIONS WITHIN THE 48 CONTIGUOUS STATES AND DISTRICT OF COLUMBIA: TURBINE-POWERED AIRCRAFT (OTHER THAN TURBOPROPELLER).

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR §§ 121.643(a)(1) and 121.647(c). The fuel required for the flight to reach the airport to which it is released and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.623.) FAR §§ 121.643(a)(2) and 121.647(c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release, execute an approach, and land.

(2) Reserve Fuel. FAR § 121.643(a)(3). The amount of fuel required to fly for 45 minutes at normal cruising fuel consumption.

(3) En Route Reserve. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

8. FAR PART 121 SUPPLEMENTAL AND COMMERCIAL OPERATIONS OUTSIDE OF THE 48 CONTIGUOUS UNITED STATES AND THE DISTRICT OF COLUMBIA: TURBINE-POWERED AIRCRAFT (OTHER THAN TURBO-PROP).

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR §§ 121.645(b)(1) and 121.647(c). The fuel required for the flight to reach the airport to which it is released and execute one instrument approach and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 121.623.) FAR §§ 121.645(b)(3) and 121.647(c). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release, execute an approach, and land.

(2) Reserve Fuel.

(i) FAR § 121.645(b)(4) The fuel necessary to fly for 30 minutes at holding speed at 1,500 feet above the alternate airport (or the airport of intended landing if no alternate is required by § 121.623(b)) under standard temperature conditions.

(ii) (Without Available Alternate) FAR § 121.623(b) and FAR § 121.645(c). If no alternate airport is available, the aircraft must also carry enough fuel to fly to its destination and thereafter to fly for at least 2 hours at normal cruising fuel consumption.

(3) En Route Reserve Fuel. FAR § 121.645(b)(2). The fuel required to fly for a period of 10 percent of the total time required to fly from the airport of departure to the airport to which it is released, and land.

(i) Planned rerelease for supplemental operations.

(A) FAR § 121.631(c) permits the planned rerelease (PRR) of supplemental air carrier flights. These operations are conducted in accordance with paragraph B44 of the Air Carrier Operation Specifications. Using this procedure, two destinations are identified, the intended destination and a declared intermediate destination. PRR is conducted by dividing the flight into two segments, the segment from the point of origin to the declared intermediate destination via a rerelease point, and the segment from the rerelease point to the airport of intended landing.

(B) The flight crew and flight follower review weather, fuel status, and other conditions no more than 120 minutes before reaching the PRR point. If the flight has progressed as planned and no unexpected events have occurred that unfavorably affect fuel usage, then the original fuel load should be sufficient to provide flight fuel plus the required 10 percent en route reserve from the PRR point to the airport of intended landing. After making this determination the flight may be rereleased.

(ii) Special fuel reserves in international operations. Fuel supplies required by B43 of the operations specifications are essentially the same as those required for domestic operations. However, when a portion of the route requires use of a long-range navigation system or flight navigator (aircraft position cannot be reliably fixed by ICAO standard NAVAIDs), additional international fuel supplies must be loaded on board the airplane. The additional fuel must be equal to the amount of fuel required to fly for a period of 10 percent of the time it takes to fly that portion of the route where a long-range navigation system or flight navigator is required.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR § 121.647(d). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

9. FAR PART 125 OPERATIONS WITHIN THE 48 CONTIGUOUS STATES AND DISTRICT OF COLUMBIA: NON-TURBINE AND TURBOPROPELLER POWERED AIRCRAFT.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR § 125.375(a)(1). The fuel required for the flight to reach the airport to which it is released and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 125.367.) FAR § 125.375(a)(2). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release and land.

(2) Reserve Fuel. FAR § 125.375(a)(3). The amount of fuel required to fly for 45 minutes at normal cruising fuel consumption.

(3) En Route Reserve. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR §§ 125.23(a) and 91.103(a). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

10. FAR PART 125 OPERATIONS OUTSIDE OF THE 48 CONTIGUOUS STATES AND THE DISTRICT OF COLUMBIA: NON-TURBINE AND TURBO-PROP AIRCRAFT.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR § 125.375(a)(1) and (b). The fuel required for the flight to reach the airport to which it is released and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 125.367.) FAR § 125.375(a)(2). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release and land.

(2) Reserve Fuel:

(i) With Alternate. FAR § 125.375(b). The fuel required to fly for 30 minutes plus 15 percent of the total time required to fly at normal cruising fuel consumption to the airport of intended landing and alternate airport(s), or to fly for 90 minutes at normal cruising fuel consumption, whichever is less.

(ii) Without Available Alternate. FAR §§ 125.367(b) and 125.375(c). If there is no available alternate airport, the aircraft must have enough fuel, considering wind and other weather conditions, to fly to the airport of intended landing and then to fly for 3 hours at normal fuel consumption.

(3) En Route Reserve Fuel. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR §§ 125.23(b) and 91.103(a). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

11. FAR PART 125 OPERATIONS WITHIN THE 48 CONTIGUOUS STATES AND THE DISTRICT OF COLUMBIA: TURBINE-POWERED AIRCRAFT OTHER THAN TURBO-PROP AIRCRAFT.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR § 125.377(a)(1). The fuel required for the flight to reach the airport to which it is released and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 125.367.) FAR § 125.377(a)(2). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release and land.

(2) Reserve Fuel. FAR § 125.377(a)(3). The amount of fuel required to fly for 45 minutes at normal cruising fuel consumption.

(3) En Route Reserve. N/A.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR §§ 125.23(a) and 91.103(a). The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

12. FAR PART 125 OPERATIONS OUTSIDE OF THE 48 CONTIGUOUS STATES AND THE DISTRICT OF COLUMBIA: TURBINE-POWERED AIRCRAFT OTHER THAN TURBO-PROP AIRCRAFT.

a. Taxi Fuel. Start-up, taxi, and predeparture delay fuel should be included in the en route fuel section of a flight release or in a section of the flight release called taxi fuel.

b. En Route Fuel. FAR § 125.377(b)(1). The fuel required for the flight to reach the airport to which it is released and land.

c. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 125.367.) FAR § 125.377(b)(3). The fuel required to execute a missed approach at the airport of intended landing, fly to the most distant alternate airport specified in the flight release and land.

(2) Reserve Fuel.

(i) FAR § 125.377(b)(4). The fuel necessary to fly for 30 minutes at holding speed at 1,500 feet above the alternate airport (or the airport of intended landing if no alternate is required) under standard temperature conditions.

(ii) (Without Available Alternate.) FAR §§ 125.637(b) and 125.377(c). If no alternate airport is available, the aircraft must also carry enough fuel to fly to its destination and thereafter to fly for at least 2 hours at normal cruising fuel consumption.

(3) En Route Reserve Fuel. FAR § 125.377(b)(2). The fuel required to fly for a period of 10 percent of the total time required to fly from the airport of departure to the airport to which it is released, and land.

(4) Other Required Fuel. As necessary.

(5) Contingency Fuel. FAR §§ 125.23(b) and 91.103(a) The fuel that may be necessary to compensate for any other conditions that may delay the landing of the flight.

13. FAR PART 135 AIRPLANE VFR OPERATIONS.

a. Taxi and En Route Fuel. FAR § 135.209(a). No person may begin a flight in an airplane under Visual Flight Rules (VFR) unless, considering wind and forecast weather conditions, it has enough fuel to fly to the first point of intended landing.

b. Additional Fuel:

(1) Alternate Fuel. N/A.

(2) Reserve Fuel:

(i) FAR § 135.209(a)(1). During the day the required reserve fuel is the amount that allows continued operation for 30 minutes.

(ii) FAR § 135.209(a)(2). At night the required reserve fuel is the amount that allows continued operation for 45 minutes.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced in FAR Part 135, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

14. FAR PART 135 AIRPLANE IFR CONDITIONS.

a. Taxi and En Route Fuel. FAR § 135.223(a)(1). No person may operate an aircraft in Instrument Flight Rules (IFR) conditions unless it carries enough fuel, considering weather reports or forecasts, to complete the flight to the first airport of intended landing.

b. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 135.223(b).) FAR § 135.223(a)(2). The fuel required to fly from the airport of intended landing to the alternate airport.

(2) Reserve Fuel. FAR § 135.223(a)(3). The fuel required to fly for 45 minutes at normal cruising speed.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced in FAR Part 135, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

15. FAR PART 135 HELICOPTER VFR OPERATIONS.

a. Taxi and En Route Fuel. FAR § 135.209(b). No person may begin a flight 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.

b. Additional Fuel:

(1) Alternate Fuel. N/A.

(2) Reserve Fuel. FAR § 135.209(b). During day or night the required reserve fuel is the amount that allows continued operation for 20 minutes.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced in FAR Part 135, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

16. FAR PART 135 HELICOPTER IFR CONDITIONS.

a. Taxi and En Route Fuel. FAR § 135.223(a)(1). No person may operate an aircraft in IFR conditions unless it carries enough fuel, considering weather reports or forecasts, to complete the flight to the first airport of intended landing.

b. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 135.223(b).) FAR § 135.223(a)(2). The fuel required to fly from the airport of intended landing to the alternate airport.

(2) Reserve Fuel. FAR § 135.223(a)(3). The fuel required to fly for 30 minutes at normal cruising speed.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced in FAR Part 135, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

17. FAR PART 91 AIRPLANE VFR CONDITIONS.

a. Taxi and En Route Fuel. FAR § 91.151(a). No person may begin a flight in an airplane under VFR conditions unless, considering wind and forecast weather conditions, it has enough fuel to fly to the first point of intended landing.

b. Additional Fuel:

(1) Alternate Fuel. N/A.

(2) Reserve Fuel:

(i) FAR § 91.151(a)(1). During the day the required reserve fuel is the amount that allows continued operation for 30 minutes.

(ii) FAR § 91.151(a)(2). At night the required reserve fuel is the amount that allows continued operation for 45 minutes.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

18. FAR PART 91 AIRPLANE IFR CONDITIONS.

a. Taxi and En Route Fuel. FAR § 91.167(a)(1). No person may operate an aircraft in IFR conditions unless it carries enough fuel, considering weather reports or forecasts, to complete the flight to the first airport of intended landing.

b. Additional Fuel:

(1) Alternate Fuel. (If required by FAR § 91.167(b).) FAR § 91.167(a)(2). The fuel required to fly from the airport of intended landing to the alternate airport.

(2) Reserve Fuel. FAR § 91.167(a)(3). The fuel required to fly for 45 minutes at normal cruising speed.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

19. FAR PART 91 HELICOPTER VFR CONDITIONS.

a. Taxi and En Route Fuel. FAR § 91.151(a). No person may begin a flight 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.

b. Additional Fuel:

(1) Alternate Fuel. N/A.

(2) Reserve Fuel. FAR § 91.151(b). During day or night the required reserve fuel is the amount that allows continued operation for 20 minutes.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced in FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

20. FAR PART 91 HELICOPTER IFR CONDITIONS.

a. Taxi and En Route Fuel. FAR § 91.167(a)(1). No person may operate an aircraft in IFR conditions unless it carries enough fuel, considering weather reports or forecasts, to complete the flight to the first airport of intended landing.

b. Additional Fuel:

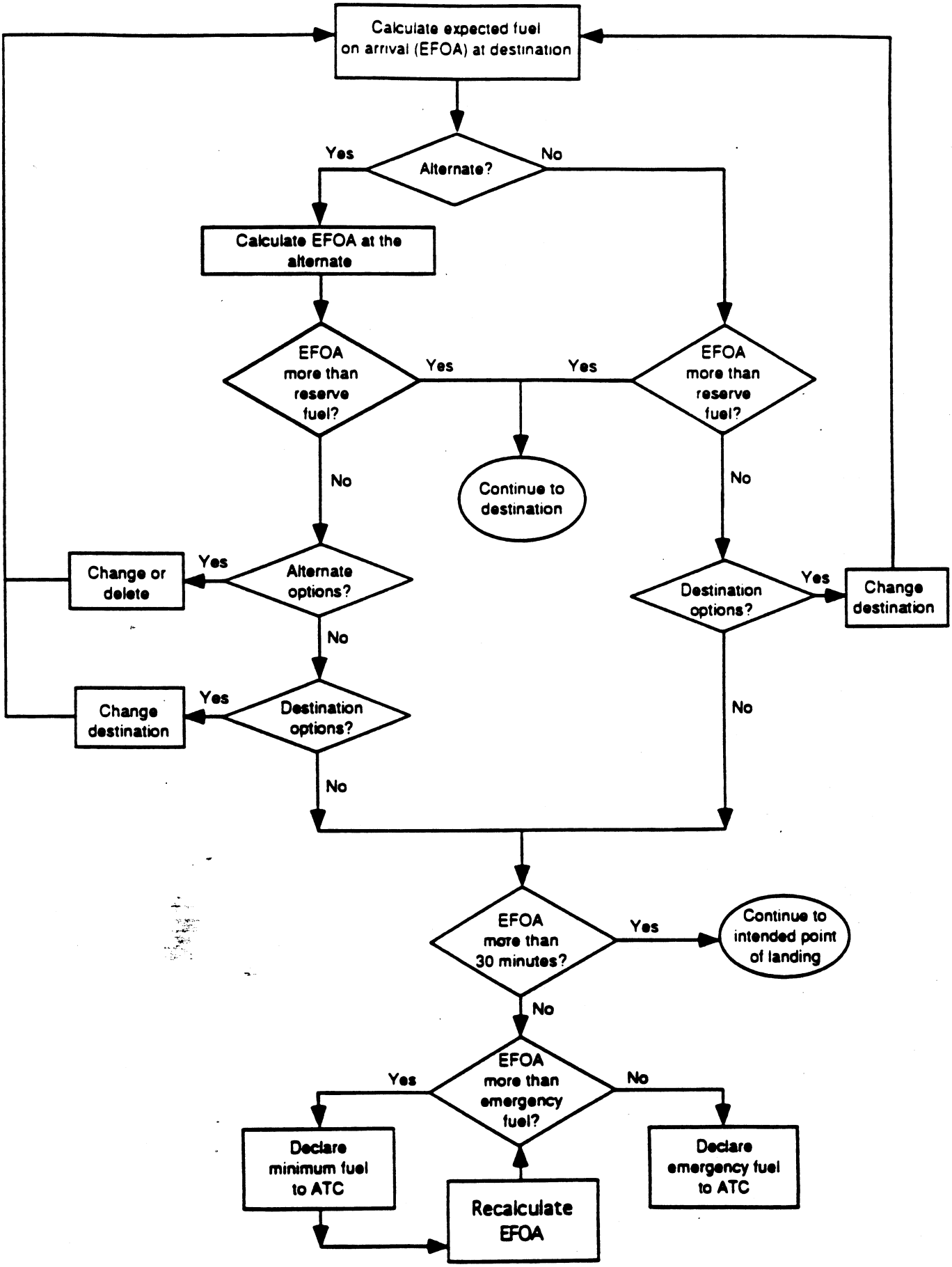
(1) Alternate Fuel. (If required by FAR § 91.167(b).) FAR § 91.167(a)(2). The fuel required to fly from the airport of intended landing to the alternate airport.

(2) Reserve Fuel. FAR § 91.167(a)(3). The fuel required to fly for 30 minutes at normal cruising speed.

(3) Other Required Fuel. As necessary.

(4) Contingency Fuel. Although this fuel increment is not specifically referenced, FAR §§ 91.103(a) and 91.167(a) require that any known traffic delays or other information that would affect the flight be considered.

Appendix 2. Fuel Management & Low Fuel Diagram



Summary of FAR Fuel Requirements

Type of Operation	Fuel Supply Requirement [Reference and Amount]						Comments
	Taxi	En route	Alternate	Reserve	En route Reserve	Other Required and/or Contingency	
• Part 121 • Domestic Operations	Implied in 121.639(a)	121.639(a) 121.647(a) & (c)	121.639(b) 121.647(a) & (c) [See 121.619(a)]	121.639(c) Normal Cruise Consumption for 45 min	None	121.647(d)	
• Part 121 Flag Operations • Non-turbine and Turbo-prop Airplanes	Implied in 121.641(a)(1)	121.641(a)(1) 121.647(c)	121.641(a)(2) 121.647(c) [See 121.621(a)(1)]	121.641(a)(3) Normal Cruise Consumption for the lesser of 30 min + 15% of flight time to destination & alt. or 90 min	None	121.647(d)	
			No available alternate [See 121.621(a)(2)]	121.641(b) Normal Cruise Consumption for 3 hours			
• Part 121 Flag Operations [Use 121.639] • Turbine powered airplanes (other than turbo-propeller) • Within the United States	Implied in 121.639(a)	121.639(a) 121.647(a) & (c)	121.639(b) 121.647(a) & (c) [See 121.621(a)(1)]	121.639(c) Normal Cruise Consumption for 45 min	None	121.647(d)	
• Part 121 Flag Operations • Turbine powered airplanes (other than turbo-propeller) • Outside of the United States	Implied in 121.645(b)(1)	121.645(b)(1) 121.647(c)	121.645(b)(3) 121.647(c) [See 121.621(a)(1)]	121.645(b)(4) 30 min at 1500 feet at holding speed	121.645(b)(2) Normal Cruise Consumption for 10% of flight time to destination	121.647(d)	May be amended by OpSpecs
			No available alternate - see 121.621(a)(2)	121.645(c) Normal Cruise Consumption for 2 hours			

Type of Operation	Fuel Supply Requirement [Reference and Amount]						Comments
	Taxi	En route	Alternate	Reserve	En route Reserve	Other Required and/or Contingency	
• Part 121 Supplemental and Commercial Operations • Non-turbine and Turbo-propeller powered Aircraft • Within the United States	Implied in 121.643(a)(1)	121.643(a)(1) 121.647(c)	121.643(a)(2) 121.647(c) [See 121.623]	121.643(a)(3) Normal Cruise Consumption for 45 min	None	121.647(d)	
• Part 121 Supplemental and Commercial Operations • Non-turbine and Turbo-prop Aircraft • Outside of the United States	Implied in 121.643(a)(1)	121.643(a)(1) & (b) 121.647(c)	121.643(a)(2) 121.647(c) [See 121.623]	121.643(b) Normal Cruise Consumption for the lesser of 30 min + 15% of flight time to destination & alt. or 90 min	None	121.647(d)	
			No available alternate [See 121.623(b)]	121.643(c) Normal Cruise Consumption for 3 hours			
• Part 121 Supplemental and Commercial Operations [Use 121.643] • Turbine powered Aircraft (other than turbo-propeller) • Within the United States	Implied in 121.643(a)(1)	121.643(a)(1) 121.647(c)	121.643(a)(2) 121.647(c) [See 121.623]	121.643(a)(3) Normal Cruise Consumption for 45 min	None	121.647(d)	
• Part 121 Supplemental and Commercial Operations • Turbine powered Aircraft (other than turbo propeller) • Outside of the United States	Implied in 121.645(b)(1)	121.645(b)(1) 121.647(c)	121.645(b)(3) 121.647(c) [See 121.623]	121.645(b)(4) 30 min at 1500 feet at holding speed	121.645(b)(2) Normal Cruise for 10% of flight time to destination	121.647(d)	May be amended by OpSpecs
			No available alternate [See 121.623(b)]	121.645(c) Normal Cruise Consumption for 2 hours	None		

Type of Operation	Fuel Supply Requirement [Reference and Amount]						Comments
	Taxi	En route	Alternate	Reserve	En route Reserve	Other Required and/or Contingency	
• Part 125 Operations • Nonturbine and turbo-propeller powered Aircraft • Within the United States	Implied in 125.375(a)(1)	125.375(a)(1)	125.375(a)(2) [See 125.367]	125.375(a)(3) Normal Cruise Consumption for 45 min	None	125.23(a) 91.103(a)	
• Part 125 Operations • Nonturbine and turbo-prop Aircraft • Outside of the United States	Implied in 125.375(a)(1)	125.375(a)(1) & (b)	125.375(a)(2) [See 125.367]	125.375(b) Normal Cruise Consumption for the lesser of 30 min + 15% of flight time to destination & alt. or 90 min	None	125.23(b) 91.103(a)	
			No available alternate [See 125.367(b)]	125.375(c) Normal Cruise Consumption for 3 hours			
• Part 125 Operations • Turbine powered Aircraft (other than turboprop) • Within the United States	Implied in 125.377(a)(1)	125.377(a)(1)	125.377(a)(2)] [See 125.367]	125.377(a)(3) Normal Cruise Consumption for 45 min	None	125.23(a) 91.103(a)	
• Part 125 Operations • Turbine powered Aircraft (other than turboprop) • Outside of the United States	Implied in 125.377(b)(1)	125.377(b)(1)	125.377(b)(3) [See 125.367]	125.377(b)(4) 30 min at 1500 feet at holding speed	125.377(b)(2) Normal Cruise Consumption for 10% of flight time to destination	125.23(b) 91.103(a)	
			No available alternate [See 125.367(b)]	125.377(c) Normal Cruise Consumption for 2 hours	None		

Type of Operation		Fuel Supply Requirement [Reference and Amount]						Comments
		Taxi	En route	Alternate	Reserve	En route Reserve	Other Required and/or Contingency	
• Part 91 Operations • Airplanes • Visual Flight Rules	VFR DAY	91.151(a)		N/A	91.151(a)(1) Normal Cruising speed for 30 min	None	91.103(a)	
	VFR NIGHT	91.151(a)		N/A	91.151(a)(2) Normal Cruising speed for 45 min	None	91.103(a)	
• Part 91 Operations • Airplanes • Instrument Flight Rules Conditions		91.167(a)(1)		91.167(a)(2) [See 91.167(b)]	91.167(a)(3) Normal Cruising speed for 45 min	None	91.103(a) 91.167(a)	
• Part 91 Operations • Helicopters • Visual Flight Rules Conditions		91.151(a)		N/A	91.151(b) Normal Cruising speed for 20 min	None	91.103(a)	
• Part 91 Operations • Helicopters • Instrument Flight Rules Conditions		91.167(a)(1)		91.167(a)(2) [See 91.167(b)]	91.167(a)(3) Normal Cruising speed for 30 min	None	91.103(a) 91.167(a)	

Type of Operation		Fuel Supply Requirement [Reference and Amount]						Comments
		Taxi	En route	Alternate	Reserve	En route Reserve	Other Required and/or Contingency	
• Part 135 Operations • Airplanes • Visual Flight Rules	VFR DAY	135.209(a)		N/A	135.209(a)(1) Normal Cruise Consumption for 30 min	None	91.103(a)	
	VFR NIGHT	135.209(a)		N/A	135.209(a)(2) Normal Cruise Consumption for 45 min	None	91.103(a)	
• Part 135 Operations • Airplanes • Instrument Flight Rules Conditions		135.223(a)(1)		135.223(a)(2) [See 135.223(b)]	135.223(a)(3) Normal Cruising speed for 45 min	None	91.103(a)	
• Part 135 Operations • Helicopters • Visual Flight Rules	VFR DAY & NIGHT	135.209(b)		N/A	135.209(b) Normal Cruise Consumption for 20 min	None	91.103(a)	
• Part 135 Operations • Helicopters • Instrument Flight Rules Conditions		135.223(a)(1)		135.223(a)(2) [See 135.223(b)]	135.223(a)(3) Normal Cruising speed for 30 min	None	91.103(a)	